ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

R18

M.Tech (STRUCTURAL ENGINEERING)

FOR

MASTER OF TECHNOLOGY TWO YEAR POST GRADUATE COURSE

(Applicable for the batches admitted from 2018-2019)

ANURAG

Engineering Engineers

ANURAG GROUP OF INSTITUTIONS

(AUTONOMOUS)

Venkatapur, Ghatkesar, Hyderabad – 500 088

R 18 - ACADEMICREGULATIONS (CBCS) FOR M. Tech. (REGULAR) DEGREE PROGRAMMES

Applicable for the students of M. Tech. (Regular) programme from the Academic Year *2018-19* 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.

1.0   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.

2.0   AWARD OF M.Tech. DEGREE

2.1   A student shall be declared eligible for the award of the M.Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years, 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. CAD/CAM
2. Computer Networks and Information Security
3. Computer Science
4. Computer Science and Engineering
5. Construction Management
6. Electrical Power Systems
7. Electronics and Communication Engineering
8. Embedded Systems
9. Machine Design
10. Power Electronics and Electrical Drives
11. Software Engineering
12. Structural Engineering
13. VLSI System Design
14. Wireless and Mobile communication

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   <u>ATTENDANCE</u>

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 below 65% 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 practical, on the basis of Internal Evaluation and End Semester Examination.

6.1 For the theory subjects 75 marks shall be awarded for the performance in the Semester End Examination and 25 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 5 marks.

There shall be an optional third midterm examination during the preparation cum external practical examinations period subject to the following.

i. Interested students have to register for the third mid examination by paying prescribed registration fee.

ii. Third midterm examination covers entire semester syllabus carrying 25 marks. The average of best two midterm examinations shall be taken as the final marks secured by each candidate. If he/she is absent for any test, he/she shall be awarded zero marks for that test.

The details of the Question Paper pattern for End Examination (Theory) are given below:

- The Semester End Examination will be conducted for 75 marks. It consists of two parts. i) Part-A for 25 marks, ii) Part-B for 50 marks.

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

- Part-B to be answered 5 questions carrying 10 marks each. There will be two questions from each unit and only one should be answered.

6.2   For practical subjects, 75 marks shall be awarded for performance in the Semester End Examinations and 25 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 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.

6.5   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   Technical Paper Writing shall cover concepts of abstract, introduction, material and methods, conclusion, references, acknowledgement etc of advanced topics in a branch of Engineering through the medium of attending seminars/ referring to peer reviewed journals, which will enhance the skill of writing technical reports. The students shall not be required to give oral presentation of technical paper. The report shall be presented as a printed document for evaluation. Evaluation shall be made solely by the teacher, but

may be moderated by committees appointed by the Head of the Department.

6.7   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.

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

6.9   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.

6.10   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
90% and above ($\geq 90\%, \leq 100\%$)	O (Outstanding)	10
Below 90% but not less than 80% ($\geq 80\%, < 90\%$)	A^+ (Excellent)	9
Below 80% but not less than 70% ($\geq 70\%, < 80\%$)	A (Very Good)	8
Below 70% but not less than 60% ($\geq 60\%, < 70\%$)	B^+ (Good)	7

Below 60% but not less than 50% ($\geq 50\%$, $< 60\%$)	**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 Credit Points (ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

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

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

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

(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 100, the evaluation should be done by the PRC for 50 marks and Supervisor will evaluate for 50 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 the PRC.

8.9 For Project work **Review II** in II Year II Sem. there is an internal marks of 100, the evaluation should be done by the PRC for 50 marks and Supervisor will evaluate for 50 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 the PRC.

8.10 After approval from the PRC, a soft copy of the thesis should be submitted for ANTI-PLAGIARISM check and the plagiarism report should be submitted to the examination branch and be included in the final thesis. The thesis will be accepted for submission, if the similarity index is less than **30%.** If the similarity index has more than the required percentage, the student is advised to modify accordingly and re-submit the soft copy of the thesis after one month. The maximum number of re-submissions of thesis after plagiarism check is limited to TWO. The candidate has to register for the project work and work for two semesters. After attempts, the admission is liable to be cancelled. The college authorities are advised to make plagiarism check of every soft copy of thesis before submissions.

8.11 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College, after submission of a research paper related to the project work in a UGC approved journal. A copy of the submitted research paper shall be attached to thesis.

8.12 For Project Evaluation (Viva Voce) in II Year II Sem. there is an external mark of 100 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.

8.13 If he fails to fulfill as specified in 8.12, 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.

8.14 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.

8.15 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.

8.16 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.

8.17 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 Credits 88 (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	≥ 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 or equivalent subjects 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 R18 Academic Regulations.

12   GENERAL

12.1 **Credit**: A unit by which the course work is measured. It determines the number of hours of 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, AGI.
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	Expulsion from the examination hall and cancellation of the performance in that subject and

	to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	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 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.	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 (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, AGI for further action to award suitable punishment.	

ANURAG GROUP OF INSTITUTIONS

M. Tech (STRUCTURAL ENGINEERING)
Effective from Academic Year 2018- 19 admitted batch

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
A31012	Theory of Elasticity	25	75	4	0	0	4
A31013	Structural Dynamics	25	75	4	0	0	4
A31014	Advanced Structural Analysis	25	75	4	0	0	4
A31015 A31016 A31017	Advanced Concrete Technology Tall Buildings Advanced Foundation Engineering	25	75	**3**	0	0	3
A31018 A31019 A31020	Advanced R.C. Design Soil Dynamic & Foundation Engineering Plastic Analysis & Design	25	75	**3**	0	0	3
	*Open Elective -I	25	75	3	0	0	3
A31203	Advanced Structural Engineering Laboratory	25	75	0	0	3	2
A31204	Seminar-I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
A32012	Advanced Steel Design	25	75	4	0	0	4
A32013	Theory of Plates	25	75	4	0	0	4
A32014	Pre-stressed Concrete	25	75	4	0	0	4
A32015 A32016 A32017	Finite Element Method Bridge Engineering Design of Sub Structures	25	75	**3**	0	0	3
A32018 A32019 A32020	Earthquake Resistant Design of Buildings Repair & Rehabilitation of Buildings Stability of Structures	25	75	**3**	0	0	3
	*Open Elective – II	25	75	3	0	0	3
A32203	CAD Lab	25	75	0	0	3	2
A32204	Seminar-II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

	Course Title	Int. marks	Ext. marks	L	T	P	C
A33204	Technical Paper Writing	100	0	0	3	0	2
A33205	Comprehensive Viva-Voce	0	100	0	0	0	4
A33206	Project work Review II	100	0	0	0	22	8
	Total	**200**	**100**	**0**	**3**	**22**	**14**

IV Semester

	Course Title	Int. marks	Ext. marks	L	T	P	C
A34203	Project work Review III	100	0	0	0	24	8
A34204	Project Evaluation (Viva-Voce)	0	100	0	0	0	16
	Total	**100**	**100**	**0**	**0**	**24**	**24**

*Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.

 # For Project review I, please refer 7.10 in R17 Academic Regulations.

ANURAG GROUP OF INSTITUTIONS

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

THEORY OF ELASTICITY
(PC-1)

Course Objectives: To impart knowledge on the basic concepts of theory of elasticity, and solve the Structural Engineering problems.

Course outcomes: The learner will be able to solve problems of elasticity and be able to apply numerical methods to solve continuum problems.

UNIT-I
Introduction: Elasticity - notation for forces and stress - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - differential equations of equilibrium - boundary conditions – Strain Displacement Relations - compatibility equations - stress function

UNIT - II
Two dimensional problems in rectangular coordinates - solution by polynomials - Saint-Venants principle - determination of displacements - bending of simple beams – Simple Supported and Cantilever Beam.

UNIT - III
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 Edge Dislocation - general solution of two-dimensional problem in polar coordinates - application to Plates with Circular Holes – Rotating Disk. Bending of Prismatic Bars: Stress function - bending of cantilever - circular cross section - elliptical cross section - rectangular cross section.

UNIT - IV
Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses Stress Invariants - max shear stresses Stress Tensor – Strain Tensor- 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 Strain Energy.

UNIT - V
Torsion of Circular Shafts - Torsion of Straight Prismatic Bars– Saint Venant's Method - torsion of prismatic bars - bars with elliptical cross sections - membrane analogy - torsion of a bar of narrow rectangular bars - solution of torsional problems by energy method - torsion of shafts, tubes , bars etc. - Torsion of Rolled Profile Sections.

TEXT BOOKS
1. Theory of Elasticity by Timoshenko, Mc-Graw hill Publications
2. Advanced Mechanics of Materials by Arthur P. Boresi, John Willey publishers

REFERENCES:
1. Theory of Elasticity by Y.C. Fung, Dover publications, New york
2. Theory of Elasticity by Sadhu singh, Khanna Publishers
3. Advanced Mechanics of solids by L.S.Srinath, Tata Mc-Graw Hill
4. Continuum Mechanics by P.N. ChandraMouli, Yes Dee Publishers

ANURAG GROUP OF INSTITUTIONS

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

STRUCTURAL DYNAMICS
(PC-2)

Course Objectives: To impart knowledge on the fundamental of structural dynamics and their applications.

Course Outcomes: The learner will be able to understand the equation of motion, dynamics response of single, and multi degree-of freedom systems.

UNIT - I:
Theory of vibrations: Introduction - Elements of vibratory system - Degrees of Freedom - Continuous System - 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 of prescribed 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 - Free vibration 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 structural property 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 - Analysis of second and higher modes - Holzer method - Basic procedure.

Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation of governing 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
Deterministic Earthquake Response of Systems – Rigid Foundation, Types of Earthquake Excitation – Response to Rigid – Soil Excitation, Lumped SDOF elastic systems – Lumped SDOF elastic system – Distributed Parameter Elastic Systems – SRSS, CQC combination of modal responses.

TEXT BOOKS:
1. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi
2. Dynamics of Structures by Clough & Penzien, McGraw Hill, New York

REFERENCES:

1. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
2. Vibrations, Dynamics and Structural systems by Madhujit Mukhopadhyay, CRC press

ANURAG GROUP OF INSTITUTIONS

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

ADVANCED STRUCTURAL ANALYSIS
(PC-3)

Course Objectives: To impart knowledge on the analysis of indeterminate structures like continuous beams, trusses and portal frames.

Course Outcomes: The learner will be able to analyse different indeterminate structures using Matrix methods.

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

TEXT BOOKS:
1. Matrix Analysis of Frames structures by William Weaver J.R and James M. Gere, CBS publications.
2. Advanced Structural Analysis by Ashok. K. Jain, Nem Chand Brothers.

REFERENCES:
1. Basic Structural Analysis by C.S. Reddy, Tata Mc-Graw hill
2. Matrix Structural Analysis by Madhu B. Kanchi, John Willey publishers
3. Indeterminate Structural Analysis by K.U. Muthu*et al*., I.K. International Publishing House Pvt. Ltd.
4. Matrix Methods of Structural Analysis by J.L. Meek, Mc-Graw hill

ANURAG GROUP OF INSTITUTIONS

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

ADVANCED CONCRETE TECHNOLOGY
(PE-1)

Course Objectives: To impart knowledge on ingredients of concrete, concrete mix design for proportioning and their testing.

Course Outcomes: The learner will be able to design concrete mixes of different grades and also use the special concretes.

UNIT – I
Ingredients of concrete: Cement-Bogue's compounds – Hydration Process– Types   of cement – Setting times of cement - Aggregates – Shapes Testes on 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 of HSC Using Erintroy Shaklok 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.

TEXT BOOKS:
1. Properties of Concrete by A.M. Neville, ELBS publications.
2. Concrete: Micro Structure, Properties and Materials by P.K. Mehta, Tata Mc-Graw Hill Publishing House Pvt. Ltd

REFERENCES:
1. Concrete Technology by M.S. Shetty, S. Chand & Co.
2. Concrete Technology by A. K. Santhakumar, Oxford University Press
3. Special Structural concretes by Rafat Siddique, Galgotia Publications.
4. IS: 10262: 2009 Code of practice for design of Concrete mix

TALL BUILDINGS
(PE-1)

Course Objective: To impart knowledge on analysis of tall buildings.

Course Outcomes : The learner will be able to analyse and chose a appropriate systems for tall buildings.

Unit-I
Introduction : Evolution of tall buildings - Classification of Buildings – Low-rise, medium-rise, high-rise –– Ordinary framed buildings & Shear-wall buildings –Behaviour of buildings under lateral loads like Wind loads, Earthquake loads & Blast loads – Basic structural & functional design requirements – Strength, Stiffness & Stability.

Unit-II
Lateral load resisting elements : Frames, Shear walls & Tubes – Shear, Bending & combined modes of deformation – Structural behavior of Rigid frames – Simplified methods of analysis – Substitute frame method, Portal method, Cantilever method, Equivalent frame method –Structural behaviour of Shear walls – Approaches of analysis – Elastic continuum approach & Discrete approach -- Structural behavior of Tubes –Actions.

Unit-III
Choice of System for a Building: Frame building, Shear wall building, Shear walls acting with frames, Single framed tubes – Other structural forms – Staggered Wall-beam system, Tube-in-tube system, Base isolation technique for earthquake resistance. Load distribution in a tall building – Load resisted by different shear walls & frames – Determinate & Indeterminate problems – Equivalent Stiffness method.

Unit-IV
Methods of Analysis: Shear walls without Openings – Estimation of Stiffness by simple Cantilever theory & Deep beam theory – Shear walls with Openings – Equivalent frame for large openings – Muto's method for small openings –Elastic Continuum approach – Coull & Chowdhry's method – Design Charts – Limitations of Continuum approach. Shear wall- Frame Interaction: Sharing of loads between wall & frame - Different methods – comparison -- Khan & Sbrounis' method – Design charts - - Mac Leod's method - Advantages & limitations -- Cooperation of Floor slabs – Equivalent width.

Unit-V
Modern Methods: Analysis of Tall buildings by Stiffness method – Available Softwares for analysis of tall buildings.

TEXT BOOKS:
1. Design of Tall Buildings by Taranath B., McGraw Hill.

REFERENCES
1. Reinforced Concrete Design of Tall Buildings by Bungales. Taranath, CRC Press.
2. Analysis of Shear Walled Buildings by S. M. A. Kazimi& R. Chandra, Tor-steel Research Foundation, Calcutta, India.
3. Analysis of Framed Structures by Gere & Weaver
4. Design of Building Structures by Wolfgang Schuller, Prentice Hall

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

ADVANCED FOUNDATION ENGINEERING
(PE-1)

Course Objective: To determine the bearing capacity of shallow and deep foundations and to estimate settlements of structures subjected to external loads, leading to design of foundations resting on soils.

Course Outcome: Students should be in a position to design foundations for varieties of structures resting on soil deposits, and appreciate the importance of reliability based design in geotechnical engineering.

Unit-I
Soil Exploration: Exploration Methods; Planning the Exploration Program; Boring and Sampling; In Situ Tests: Standard & Cone Penetration Tests, Field Vane, Dilatometer, Pressure meter; Rock Sampling, Core Recovery, RQD; Geophysical Exploration; Preparation of Soil Report, Case Studies.

Unit-II
Shallow Foundations: **Bearing Capacity:**- Shear Failure; Effect of Water Table; Footings with Eccentric or Inclined Loads, Footings on Layered Soils, Slopes on finite layer with a Rigid Base at Shallow Depth, effect of compressibility of soil, on soils with strength increasing with depth, Plate Load tests, Presumptive bearing capacity.

Unit-III
Settlement: Components – Immediate, Primary and Secondary Settlements, Consolidation, Stresses and Displacements in Homogeneous, Layered and Anisotropic Soils; Bearing Pressure using SPT, CPT, Dilatometer and Pressure meter; Settlement of foundations on Sands-Schmertmann and Burland & Burbridge methods; Structure Tolerance to Settlement and Differential Settlements, Rotation, Codal Provisions.

Unit-IV
Deep Foundations: **Single Pile:** Vertically loaded piles, Static capacity- α, β and λ Methods, Dynamic formulae; Wave Equation Analyses; Point Bearing Resistance with SPT and CPT Results; Bearing Resistance of Piles on Rock; Settlement; Pile Load Test; Uplift Resistance; Laterally Loaded Piles -Ultimate Lateral Resistance; Negative Skin Friction; Batter Piles; Under Reamed Piles; Ultimate Capacity of Pile Groups in Compression, Pullout & Lateral Load; Efficiency; Settlements of Pile Groups; Interaction of Axially & Laterally Loaded Pile Groups, Codal Provisions.

Unit-V
Special Topics of Foundation Engineering
Foundations on Collapsible Soils: Origin and occurrence, Identification, Sampling and Testing, Preventive and Remedial measures.

   Foundations on Expansive Soils: The nature, origin and occurrence, Identifying, testing and evaluating expansive soils, typical structural distress patterns and Preventive design & construction measures.

*Introduction to Reliability-Based Design: Brief introduction of probability and statistics, LRFD for structural strength requirements, LRFD for geotechnical strength requirements, Serviceability requirements

TEXT BOOKS

1. Das, B. M. - Principles of Foundation Engineering 5th Edition Nelson Engineering (2004)
2. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012. Phi Learning (2008)

REFERENCE BOOKS

1. Bowles, J. E. - Foundation Analysis & Design 5th Edition McGraw-Hill Companies, Inc. (1996)
2. Poulos, H. G. & Davis, E. H. - Pile Foundation Analysis and Design john Wiley & sons inc(1980-08)
3. Tomlinson, M. J. - Foundation Design and Construction - Prentice Hall (2003).
4. Baecher, G.B. & Christian, J.T. – Reliability and Statistics in Geotechnical Engineering, Wiley Publications (2003)

ADVANCED REINFORCED CONCRETE DESIGN
(PE-2)

Course Objectives: To impart knowledge on the behavior and design on various reinforced concrete structural elements.

Course Outcomes: The learner will be able to design the reinforced concrete elements like beams, slabs and compression members.

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, moment rotation characteristics of RC member, I.S. code provisions, and 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 Moment of Resistance, Design for shear, Deflection, Arrangement of Reinforcements.
Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-moment and 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, Design by 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 Elevated intz type of Water Tank **Design of Combined Footings**- Distribution of soil Pressure – Geometry of Two Column Combined Footing – Design Considerations in Combined Footing for Two – Columns.

TEXT BOOKS:
1. Reinforced concrete design by S. Unnikrishna Pillai & Menon, Tata Mc. Graw Hill, 2nd Edition, 2004
2. Advanced Reinforced Concrete Design – P.C. Varghese, Prentice Hall of India, 2008

REFERENCE BOOKS:
1. Reinforced concrete design by Kennath Leet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
2. Design of Reinforced concrete structures by N.Subramanian, Oxford University Press
3. Reinforced Concrete Structures by Park and Paulay, John Willey Publishers.
4. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Tata Mc. Graw-Hill, 3rd Edition, 2005.
5. Limit state theory and design of reinforced concrete by Dr. S.R. Karve and Dr. V.L. Shah, Standard Publishers, Pune, 3rd Edition, 1994.
6. IS : 456 : 2000, Code of Practice for Plane and Reinforced Cement Concrete,
7. SP 16, SP 34.
8. IS 3370 Part I to Part IV.

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

SOIL DYNAMICS AND FOUNDATIONS ENGINEERING
(PE-2)

Course Objective: To understand the wave propagation in soils, determine dynamic properties of soil for analyzing and designing foundations subjected to vibratory loading.

Course Outcome: Able to understand the fundamentals of wave propagation in soil media, evaluate the dynamic properties of soil, and design foundations for centrifugal and reciprocating machines.

Unit-I
Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.

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

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

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

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

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

REFERENCES:
1. Prakash, S. and Puri, V. K. - Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.

2. Kameswara Rao, N. S. V. - Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.

3. Das, B. M. & Ramana, G.V. - Principles of Soil Dynamics, 2nd Edition, CL Engineering Publishers, 2010.

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

PLASTIC ANALYSIS AND DESIGN
(PE-2)

Course Objectives: To impart knowledge on the analysis of steel structures like continuous beams, steel frames and connection, using Plastic Analysis.

Course Outcomes: The learner will be able to design continuous beams and steel frames

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 – Single bay, single storey frames – simplified procedures for Single span frames – Design of Gable frames with Haunched Connection. Ultimate Deflections: Introduction – Deflection at ultimate load – Deflection at working load – Deflections of Beams and Single span frames.

REFERENCES:
1. Plastic Design of Steel Frames, L.S. Beedle. John Willey & Sons.
2. Plastic Analysis, B.G.Neal. SponPres
3. Design of Steel Structures by N. Subramanian, Oxford University Press

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M. TECH. I YEAR I SEMESTER

List of Open Electives Offered by Various Departments, Effective from AY 2018- 19

S. No	Name of the Department	Open Elective (S) Offered for Other Departments	Subject Code
1	Civil Engineering (Open Elective – I)	Computational Methods in Engineering	A31010
2	Electronics and Communication Engineering (Open Elective – I)	Principles of Electronic Communications	A31050
3	Electrical and Electronics Engineering (Open Elective – I)	1. Renewable Energy Systems, 2. Electrical Installation & Safety	A31051 A31052
4	Mechanical Engineering (Open Elective – I)	Computer Oriented Numerical Methods	A31053
5	Computer Science and Engineering (Open Elective – I)	1. Fundamentals of Cyber Security 2. Database Management System	A31054 A31011

<u>**OPEN ELECTIVE – I**</u>

COMPUTATIONAL METHODS IN ENGINEERING

UNIT-I:
INTRODUCTION TO NUMERICAL METHODS APPLIED TO ENGINEERING PROBLEMS: Examples, solving sets of equation – Matrix notation – Determination and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs. **Numerical integration:** Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration.

UNIT-II:
OPTIMIZATION: One dimensional unconstrained optimization, multidimensional unconstrained optimization – direct methods and gradient search methods, constrained optimization.
Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayieigh - Ritz method – Characteristic value problems,

UNIT-III:
NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS: Laplace's equations – Representation as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non-rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.
Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

UNIT-IV:
HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS: Solving wave equation by finite differences-stability of numerical method – method of characteristics wave equation in two space dimension-computer programs.

UNIT- V:
Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares – regression analysis – multiple linear regression, non linear regression – computer programs.

REFERENCES:
1. Numerical Methods for Engineers/ Steven C.Chapra, Raymond P.Canale/ Tata Ma-Graw Hill
2. Applied numerical analysis / Curtis F.Gerald, partick.O.Wheatly /Addison-wesley,1989
3. Numerical methods / Douglas J.Faires, Riched Burden / Brooks-cole publishing company, 1998 Second edition.
4. Numerical mathematics and computing/ Ward cheney & David Kincaid / Brooks-cole publishing company 1999 fourth edition
5. Mathematical methods for physics and engineering / Riley K.F.M.P.Hobson & Bence S.J./ Cambridge university press,1999.

ELECTRONICS AND COMMUNICATION ENGINEERING
PRINCIPLES OF ELECTRONIC COMMUNICATIONS
(Open Elective -1)

UNIT - I

Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

UNIT - II

Simple description on Modulation: Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

UNIT - III

Telecommunication Systems: Telephones Telephone system, Paging systems, Internet Telephony. **Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

UNIT - IV

Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.
Optical Communication: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT - V

Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, WCDMA. **Wireless Technologies:** Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

TEXT BOOKS

1. Louis E. Frenzel, "Principles of Electronic Communication Systems", 3rd Ed., McGraw Hill publications, 2008.
2. Kennady, Davis, "Electronic Communications systems", 4Ed., TMH, 1999

REFERENCE BOOKS

1. Tarmo Anttalainen, "Introduction to Telecommunications Network Engineering", Artech House Telecommunications Library.
2. Theodore Rappaport, "Wireless Communications-Principles and practice", Prentice Hall, 2002.
3. Roger L. Freeman, "Fundamentals of Telecommunications", 2 Ed. Wiley publications.
4. Wayne Tomasi, "Introduction to data communications and networking", Pearson Education, 2005.

ELECTRICAL AND ELECTRONICS ENGINEERING
RENEWABLE ENERGY SYSTEMS
(Open Elective - I)

Course Objectives:
- ➢ To recognize the awareness of energy conservation in students
- ➢ To identify the use of renewable energy sources for electrical power generation
- ➢ To collect different energy storage methods
- ➢ To detect about environmental effects of energy conversion

Course Outcomes:
- ➢ Upon the completion of this course, the student will be able to
- ➢ find different renewable energy sources to produce electrical power
- ➢ estimate the use of conventional energy sources to produce electrical energy role-play the fact that the conventional energy resources are depleted
- ➢ arrange Store energy and to avoid the environmental pollution

Unit-I:
Photo voltaic power generation ,spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for PV systems, applications of super conducting materials in electrical equipment systems.

Unit-II:
Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology.
Wind Energy conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

Unit-III:
Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation.
Wave energy conversion: properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems Application of OTEC systems examples,

Unit-IV:
Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, description of fuel cells, Co-generation and energy storage, combined cycle co-generation, energy storage.
Global energy position and environmental effects: energy units, global energy position.

Unit-V:
Types of fuel cells, H_2-O_2 Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power. Environmental effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, pollution free energy systems.

TEXT BOOKS:

1 "Energy conversion systems" by Rakosh das Begamudre, New age International publishers, New Delhi - 2000.

2 "Renewable Energy Resources" by John Twidell and Tony Weir, 2nd Edition, Fspon & Co.

REFERENCES:

1. "Understanding Renewable Energy Systems" by Volker Quaschning, 2005, UK.

2. "Renewable Energy Systems-Advanced Conversion, Technologies & Applications" by Faner Lin Luo Honer Ye, CRC press, Taylor & Francis group.

ELECTRICAL INSTALLATION & SAFETY
(Open Elective - I)

Course Objectives:
- The course should enable the students to:
- Understand Electrical Wiring with IE rules. Residential Building Electrification, Electrification of commercial Installation, Electrification of factory unit Installation
- Protection against electric shocks, Safety Measures & Prevention of Accidents

Course Outcomes:
- The students will be able to:
- Acquire the knowledge of different types wires and wiring systems, I.E. rules and Electric supply act.
- Explain the importance of earthling, rating of wires & cables, procedures for residential, commercial electrification.
- Able to estimate the length of wire, cable, conduit, earth wire, and earthing and also cost of residential, commercial electrification.

Unit-I: Electrical Wiring with IE rules.
Introduction, Define types of wires; Different types of wiring system; Comparison of different types of wiring; Different types and specifications of wiring materials; Accessories and wiring tools; Prepare I.E. rules for wiring, including Electricity supply act 2003& 2005;

Unit-II : Residential Building Electrification
General rules guidelines for wiring of Residential Installation and positioning of equipment's; Principles of circuit design in lighting and power circuits.; Procedures for designing the circuits and deciding the number of circuits.; Method of drawing single line diagram.; Selection of type of wiring and rating of wires &cables.; Load calculations and selection of size of conductor.; Selection of rating of main switch, distributions board, protective switchgear ELCB and MCB and wiring accessories.; Earthing of Residential Installation.

Unit-III: Electrification of commercial Installation
Concept of commercial Installation.; Differentiate between electrification of Residential and commercial Installation.; Fundamental considerations for planning of an electrical Installation system for commercial building.; Design considerations of electrical Installation system for commercial building.; Load calculations & selection of size of service connection and nature of supply.; Deciding the size of cables, bus bar and bus bar chambers.; Mounting arrangements and positioning of switch boards, distribution boards main switch etc.; Earthing of the electrical Installation; Selection of type wire, wiring system & layout.

Unit-IV: Electrification of factory unit Installation
Concept of Industrial load; Concept of Motor wiring circuit and single line diagram. Important guidelines about power wiring and Motor wiring.; Design consideration of Electrical Installation in small Industry/Factory/workshop.; Motor current calculations.; Selection and rating of wire, cable size
1. conduct.; Deciding fuse rating, starter, distribution boards main switch etc.; Deciding the cable route, determination of length of wire, cable, conduit, earth wire, and earthing.

Unit-V: Protection against electric shocks

Electric shock- General , Protection against direct contact, Protection against indirect contact, Protection of goods in case of insulation fault, Implementation of the TT system, Implementation of the TN system, Implementation of the IT system. Protection provided for enclosed equipment: codes IP and IK, IP code definition, Elements of the IP Code and their meanings, IK Code definition, IP and IK code specifications for distribution switchboards

Safety Measures & Prevention of Accidents- Concept of electrical safety, electrical accidents, its causes & preventions.; Safety signs and symbols used in industry.; Electrical shocks and factors affecting the severity of it, method of rescuing electrocuted person & different methods of artificial respiration.; Electrical safety as per I.E. Rules 1956.; Do's & don'ts regarding safety while working on electrical installations.; Concept of Permit system, its preparation & regulation for attending to electrical work.; Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers, types of fire extinguishers.

TEXT BOOKS:

1. Dr. S.L. Uppal of Electrical Wiring, Estimating and Costing, New Age International (p) Limited, New Delhi.
2. Electrical Design Estimating and Costing, K.B. Raina & S.K. Battacharya, new age international (p) limited. Publishers
3. Electrical estimating & costing 2nd addition By Surjit singh
4. Electrical Installation Estimating & Costing, Gupta, J.B., S. K. Kataria & Sons, New Delhi

MECHANICAL ENGINEERING

COMPUTER ORIENTED NUMERICAL METHODS
(Open Elective – 1)

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 – Applications to Simply Supported Beams, Columns and Rectangular Plates.

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 – New Marks Method and Application to Beams – Calculation of Slopes and Deflections.

UNIT - V

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

TEXT BOOKS:

1   Numerical methods for scientific and engineering computations. M.K. Jain-S.R.K. Iyengar – R.K. Jain Willey Eastern Limited
2   Numerical Methods for Engineering Problems, N. Krishna Raju, KU Muthu, Mac-Millan publishers

REFERENCES:

1   Introductory Numerical Methods by S.S. Shastry, PHI Learning Pvt. Ltd.
2   Applied numerical analysis by – Curtis I. Gerala- Addission Wasley – published campus.
3   Numerical methods for Engineers Stevan C. Chopra, Raymond P. Canal Mc. Graw Hill Book Company.
4   C Language and Numerical methods by C. Xavier – New age international publisher.
5   Computer based numerical analysis by Dr. M. Shanta Kumar, Khanna Book publishers, New Delhi.

FUNDAMENTALS OF CYBER SECURITY
(Open Elective - I)

Course Objective:
This course is aimed to generate interest and awareness in cyber security field, which is important in the world of information security due to the wide variety of computer crimes that take place in cyber space. The course deals with various types of attacks framed by an attacker, and the security which need to be implemented at various levels along with latest trends in cyber security.

UNIT-I:
Cyber Security Basics – Sphere, Terminology, Vulnerability in the Cyber Structure and Infrastructure, Cyber threats and Weaponry, Cyber Defense, Cyber Attack Detection and Prevention, Information Security Testing, Cyber Security Investigation/assessment, Cyber-Deterrence.

UNIT-II:
Cyber Crimes and Cyber Laws – Introduction, IT laws & Cyber Crimes – Internet, Hacking, Password Cracking, Viruses, Virus Attacks, Pornography, Software Privacy, Intellectual Property, Legal System of Information Technology, Social Engineering, Phishing, Denial of Service attack, Malicious Code, Mail Bombs, Worms, Logic Bombs, Botnet, Trojan, Bug Exploits.

UNIT-III:
End point Security: Desktop and Laptop Security, Cell Phone and PDA Security, Bluetooth Security, Patch and Vulnerability Management, Password Management, Security for Full Virtualization Technologies, Media Sanitization, Security Radio Frequency Identification (RFID) Systems. **Network Security:** Intrusion Detection & Prevention Systems, Firewalls and Firewall Policy, Computer Security Log Management, Enterprise Tele work and Remote Access Security, Securing WiMAX Wireless Communication. **Web Security:** Server Security, Web authentication, SSL and SET, Securing Public Web Servers, Secure Deployment of IPv6, Secure Domain name System (DNS) Deployment, SSL VPNs, Unified Threat Management (UTM).**;**

UNIT-IV:
Application Security: Active Content and Mobile Code, E-commerce Security, Email Security (PGP, S/MIME), Web Security, Web Application Security, OWASP; **Data Security:** Data Management, Database Security, Data Encryption, Data Leakage Prevention (DLP), Data Destruction; **Software Security:** Software Flaws, Malware, Software based Attacks; Insecurity in Software: SRE, Software Tamper Resistance, DRM, Software Development.
Operating System Security: Security Functions, Software Updates and Patches, OS Integrity Checks, Account management, Antivirus Software, Security in Ordinary Operating Systems, Design of Secure OS, OS hardening, Configuring the OS for security, Security kernels, Secure Virtual machine Systems, Trusted Operating System, NGSCB.

UNIT-V:
Recent Trends in Cyber Security – Zero – day Malware, Trojan Wars, New Ways to Monetize Non-Financial Data, Fraud-as-a-service, Out-of-band Methods forcing Cybercriminals to

Innovate, The Rise of Hactivism, Attacks in mobile devices, social media and cloud computing; Insider threats, Increased regulatory security, Cyber-Terrorism, Cyber –War and Cyber-Peace. Topological Vulnerability Analysis, Cyber Situational Awareness, Secure Composition of Systems, Autonomic Recovery, Secure Data Centers, Cloud Computing Security, Privacy in location-Based Applications.

TEXT BOOKS:
1. Cyber Security, Edward Amoroso, kindle Edition, 2007
2. Cyber Security ,Understanding Cyber crimes, Computer Forensics and Legal Perspectives, Sunita Belapure and Nina Godbole, Wiley India Pvt Ltd. 2011

REFERENCES:
1. Computer Security, Dirter Gollmann, John Wiley & Sons Publication, 2011
2. Cyber Security Essentials, James Graham, Richard Howrad, Ryan Olson, CRC Press, 2011

OPEN ELECTIVE – I
DATA BASE MANAGEMENT SYSTEM

UNIT-I

Database System Applications, database system VS file system- view of data- data abstraction – instances and schemas – data models – the ER Model – Relational model – other models – Database languages – DDL – DML – database Access for applications programs – database users and administrator – transaction management – database system structure – storage manager – the query processor – history of database systems – database design and ER diagrams – Beyond ER design entities of ER model – concept design with the ER model – conceptual design for large enterprises.

UNIT-II

RELATIONAL MODEL: introduction to the relational model – integrity constraint over relations – enforcing integrity constraints – querying relational data – logical database design
– introduction to views – destroying / altering tables and views.

Relational Algebra and Calculus : relational algebra – selection and projection set operations – renaming – joins – division – examples of algebra overviews – relational calculus – tuple relational calculus – domain relational calculus – expressive power of algebra and calculus.

UNIT – III

Form of basic SQL Query – examples of basic SQL Queries – introduction to nested queries – correlated nested queries set – comparison operators – Aggressive operators -Null values – comparison using null values – logical connectivity's – AND, OR and NOTR – impact on SQL constructs – Outer joins – disallowing NULL values – complex integrity constraints in SQL Triggers and Active Database. Schema refinement – problems caused by redundancy – decompositions – problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join decomposition – Dependency preserving Decomposition – Schema refinement in database design – Multi valued dependencies – forth Normal Form.

UNIT-IV

OVERVIEW OF TRANSACTION MANAGEMENT: ACID properties – Transactions and schedules – concurrent execution of transaction – lock based concurrency control – performance locking – transaction support in SQL – Introduction to crash recovery. **Concurrency Control:** serializability and recoverability – introduction to lock management
– lock conversions dealing with dead locks – specialized locking techniques concurrency without locking.

Crash recovery : introduction to ARIES – the log – other recovery related structures – the write- Ahead Log Protocol – check pointing – recovering form a system crash – media recovery – other approaches and interaction with concurrency control.

UNIT-V

OVERVIEW OF STORAGE AND INDEXING : data on external storage – File organization and indexing – cluster indexing, primary and secondary indexes – index data structures – hash based indexing tree base indexing –comparison of file organizations – indexes and performance Tuning.
Storage data: Disks and Files: the Memory Hierarchy – redundant Arrays of independent – Disks – disk space management – buffer manager – files of records – page formats – record formats.
Tree structure Indexing : introduction for tree indexes – indexed sequential access methods
(ISAM)-B+ Tress: A dynamic Index structure.
Hash based Indexing: Static Hashing – extendable hashing – Linear Hashing – Extandable vs Linear hashing.

REFERENCES:

1. Database Management Systems/ Raghurama Krishnan, Johannes Gehrke/ TATA McGraw hills 3rd Edition.
2. Database systems Concepts/ Silberschatz, Korth/ McGraw hill, IV Edition
3. Database Management Systems/ P.Radha Krishna/ Hi-TECH Publications 2005
4. Introduction to Database Management Systems / C.J.Date/ Pearson Education
5. Database Systems design, Implemantation and Management/ Rob & Coronel/ 5th Edition, Thomson.
6. Database Management Systems/ Elmasri Navrate/ Pearson Education.
7. Database Management Systems /Mathew Leon, Leon Vikas/
8. Database Systems / Connoley/ Pearson Education

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

ADVANCED STRUCTURAL ENGINEERING LAB

Course Objective: to understand the test procedure and behavior of the concrete and RC beams

Course Outcome: the student will be able to design concrete mix which will satisfy the fresh and hardened concrete properties, and study the behavior of structural elements.

1. Workability of fresh concrete
   (a) slump core
   (b) Compaction Factor
   (c) Vee Bee Test
2. Air Entrainment test on fresh concrete
3. Mash cone test and modulus of elasticity of concrete
4. Permeability of concrete
5. NDT tests on hardened concrete
   a) Rebound hammer
   b) UPV hammer
6. Accelerated curing of concrete
7. Design and Testing of self compacting concrete of standard grade (M30 or M40)
   a) V- Funnel
   b) L -Box
   c) U -Box
   d) J -Ring

ANURAG GROUP OF INSTITUTIONS
M. Tech – I Year – II Sem. (Structural Engg.)

ADVANCED STEEL DESIGN (PC - IV)

Course Objectives: To impart knowledge on behavior and design of various connections, industrial and steel girders.

Course Outcomes: The learner will be able to design different steel structures

UNIT - I:
Simple connections – Bolted, Pinned and Welded 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 Bracket Connections. Bolted Moment Connections – Welded Framed Connections – Welded Bracket 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 Silos: Introduction – Janseen's Theory – Airy's Theory – Design of Parameters – Design Criteria – Analysis of Bins – Hopper Bottom –Design of Bins.

TEXT BOOKS:
3. Limit State Design of Steel Structures S. K. Duggal, McGraw Hill Education Private Ltd. New Delhi.
4. Design of Steel Structures, K. S. Sairam, Pearson Education.

REFERENCES:
5. Design of Steel Structures, N. Subramanian, Oxford University Press.
6. Design Steel Structures Volume – II, Dr. Ramachandra & Vivendra Gehlot, Scientific Publishers Journals Department.
7. Design of Steel Structures Gaylord & Gaylord, Publisher; Tata McGraw Hill, Education. Edition 2012.
8. Indian Standard Code – IS – 800-2007 General Construction in Steel- Code of Practice,
9. Steel Tables.

ANURAG GROUP OF INSTITUTIONS
M. Tech – I Year – II Sem. (Structural Engg.)

THEORY OF PLATES (PC - V)

Course Objectives: To impart knowledge on the behavior of plates and to analyse the problems pertaining to beams on elastic foundation.

Course Outcomes: The learner will be able to understand the behavior of plates for loadings and boundary conditions.

UNIT - I
Cylindrical Bending: Different kind of plates – Assumptions – Derivation of differential equation for cylindrical 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 between moments 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 governing differential equation for thin plates – Boundary conditions – simply supported plate under sinusoidal load – Navier's solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic 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 uniformlydistributed.
Orthotropic Plates: Introduction – Bending of anisotropic plates - Derivation of governing differential equation – 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 loaded simply 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-plane loading 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 simple loading.

TEXT BOOK
1. Theory of Plates and Shells by Timoshenko, McGraw Hill Book Co., New York.

REFERENCES:
3. Theory and Analysis of Plates by P. Szilard, Prentice Hall.
4. Theory of Plates by K. Chandrasekhara, University Press.
5. Plate Analysis by N. K. Bairagi, Khanna Publishers. New Delhi.
6. Numerical Methods for Engineering Problems, N. Krishna Raju & K. U Muthu, Mac-Millan publishers

ANURAG GROUP OF INSTITUTIONS
M. Tech – I Year – II Sem. (Structural Engg.)
PRE-STRESSED CONCRETE (PC - VI)

Course Objectives: To impart knowledge on basics of prestressing and designing of different structural elements using Prestressing techniques.

Course Outcomes: The learner will be able to understand the prestressing techniques, design the various structural elements using Prestressing techniques.

UNIT - I
General Principles of Prestressed Concrete : Pre–tensioning and post – tensioning – Prestressing by straight, concentric, eccentric, bent and parabolic tendons – Different methods and systems of prestressing like Hoyer system, Freyssinet system, Magnel Blaton system – Lee-Mc call system. **Losses of Prestress:** Loss of prestress in pre-tensioned and post-tensioned members due to various 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 having rectangular and I-section for flexure – kern lines – cable profile and cable layout.
Design of Sections for Shear: Shear and Principal Stresses – Improving shear resistance by different prestressing techniques – horizontal, sloping and vertical prestressing – Analysis of rectangular and I–beam – Design of shear reinforcement – IS: 1343: 2012 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 Pretensioned Members : Transmission of prestressing force by bond – Transmission length – Flexural bond stresses – IS: 1343 : 2012 provisions – Anchorage zone stresses in post tensioned members – stress distribution in End block – Analysis by approximate, Guyon and Magnel methods – Anchorage zone reinforcement.

UNIT - V
Statically Indeterminate Structures : Advantages & disadvantages of continuous PSC 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)

TEXT BOOKS:
3. Prestressed concrete by Krishna Raju, Tata McGraw Hill Book – Co., New Delhi.
4. Prestressed Concrete by K.U. Muthu, et.al, PHI Learning Pvt. Ltd.,

REFERENCES:
5. Design of Prestressed Concrete Structures by T.Y. Lin and Burn, John Wiley, New York.
6. Prestressed Concrete by N. Rajagopalan, Alpha Science International.
7. Prestressed Concrete by S. RamamruthamDhanpatRai& Sons, Delhi.
8. IS 1343 -2012 Prestressed Concrete – Code of Practice, Bureau of Indian Standards.

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

FINITE ELEMENT METHOD (PE – III)

Course Objectives: To impart knowledge about various finite element techniques and development of finite element code.

Course Outcome: The learner will be able to solve continuum problems using finite element analysis.

UNIT - I
Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles
– Discretization - 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 for 1-D 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 finite analysis – basic methods – application to Special structures.

Text Books:
   3. A First Course in a Finite Element by Daryl L .Logan, CL Engineers.
   4. Concepts and Applications of Finite Element Analysis by Robert D. Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons.

References:
   5. Introduction to Finite element Method by Tirupathi Chandra Patla and Belugunudu
   6. Finite element Methods by OC Zienkiewicz
   7. Finite element analysis, theory and programming by GS Krishna Murthy.
   8. Introduction to Finite element Method by JN Reddy.

BRIDGE ENGINEERING (PE - III)

Course Objectives: To impart knowledge on the behavior and design aspects of various types of bridges.

Course Outcomes: The learner will be able to analyze and design of different types of bridges

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-structure of bridges: Substructure- Beds block-Piers- Pier Dimensions-Design loads for piers- Abutments- Design loads for Abutments.

TEXT BOOKS:
5. Essentials of Bridge Engineering by Johnson Victor, Oxford & IBH
6. Design of Bridges by N. Krishna Raju, Oxford & IBH

REFERENCES
3. Design of Concrete Bridges by M. G. Aswani, V. N. Vazirani and M. M. Ratwani.
4. Bridge Deck Behaviour by E. C. Hambly.
5. Design of Bridges by V. V. Sastry, Dhanpat Rai & Co
6. Concrete Bridge Design and Practice by V. K. Raina.
7. Design of Bridge Structures by Jagadeesh & Jayaram, PHI learning Pvt. ltd.
8. IRC: 112, 2011, Code of Practice for Concrete Road Bridges.
9. IRC: 6 and 21 2000,Code of Practice for Concrete Road Bridges

ANURAG GROUP OF INSTITUTIONS
M. Tech. I Year II - Sem (Structural Engg.)

DESIGN OF SUBSTRUCTURES (PE - III)

Course Objectives: To impart knowledge on geotechnical and structural design of different types of foundation appropriate to the type of soil for different structures.

Course Outcome: The learner will be able to design shallow and deep foundations from both geotechnical and structural considerations.

UNIT – I
Shallow Foundations: Basic requirements of foundation –Types and selection of foundations. Bearing capacity of foundations, structural design of isolated, combined, eccentric, strip, and strap footings, Detailing of reinforcement.

UNIT – II
Raft Foundations: Types of rafts, SBC of raft foundation and structural design of different raft foundations, Detailing of reinforcement.

UNIT – III
Pile Foundations: Types of piles, Load carrying capacity of single and pile groups, structural design of piles, pile caps and pile-raft foundation, Detailing of reinforcement.

UNIT – IV
Design of Retaining walls: Stability Checks and structural design of gravity, Cantilever retaining walls, Detailing of reinforcement.

UNIT – V
Machine Foundations: Vibration analysis of machine foundation - Design of foundation for Reciprocating machines and Impact machines - as per I S Codes, Detailing of reinforcement.

TEXT BOOKS:
5. Varghese P.C. Design of RC foundations, PHI Learning Pvt. Ltd.
6. Unnikrishnana Pillai & Devadas Menon, Reinforces Concrete Design, McGraw Hill Publishing Pvt. Ltd.

REFERENCE:
3. Bowles .J.E., "Foundation Analysis and Design", McGraw Hill Publishing co., New York, 1986
4. Tomlinson. M.J, "Foundation Design and Construction", Longman, Sixth Edition, New Delhi, 1995.
3. Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999.
9. Narayan V. Nayak, Foundation design manual, Dhanpat Rai & Sons, 2006.
10. Prakash Shamsher and Puri Vijay K, Foundations for Machines, Analysis and Design" John Wiley and Sons, USA, 1988.
11. IS 2911: Part 1: Sec 1: 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 1 Driven cast in-situ concrete piles.

ANURAG GROUP OF INSTITUTIONS
M. Tech – I Year – II Sem. (Structural Engg.)

EARTHQUAKE RESISTANT DESIGN OF BUILDINGS (PE - IV)

Course Objectives: To impart knowledge on the seismology and behavior of buildings during earthquakes.

Course Outcomes: The learner will be able to analyse and design buildings to resist seismic forces

UNIT - I
Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics-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.

TEXT BOOKS:
3. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
4. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.

REFERENCE BOOKS:
2. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
3. Masory and Timber structures including earthquake Resistant Design – Anand S.Arya, Nemchand & Bros
4. Earthquake –Resistant Design of Masonry Building –Miha Tomazevic, Imperial College Press.
5. Earthquake Tips – Learning Earthquake Design and Construction C. V. R. Murty

REFERENCE CODES:
4. IS: 1893 (Part-1) -2016. "Criteria for Earthquake Resistant – Design of structures." B.I.S., New Delhi.
5. IS: 4326-1993, "Earthquake Resistant Design and Construction of Building", Code of Practice B.I.S., New Delhi.
6. IS: 13920- 2016, "Ductile detailing of concrete structures subjected to seismic force" – Guidelines, B.I.S., New Delhi.

ANURAG GROUP OF INSTITUTIONS
M. Tech – I Year – II Sem. (Structural Engg.)

REPAIR & REHABILITATION OF BUILDINGS (PE - IV)

Course Objectives: To impart knowledge on the distress in structures.

Course Outcomes: The learner will be able to understand the reasons for distress in structures and will be able to suggest suitable solutions

UNIT – I
Introduction – Deterioration of Structures – Distress in Structures – Causes and Prevention. Mechanism of Damage – Types of Damage.

UNIT – II
Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation.

UNIT – III
Inspection and Testing – Symptoms and Diagnosis of Distress - Damage assessment – NDT.

UNIT – IV
Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shotcreting – Underpinning -Strengtheningof Structures – Strengthening Methods – Retrofitting – Jacketing.

UNIT – V
Health Monitoring of Structures – Use of Sensors – Building Instrumentation

REFERENCES
4. Concrete Technology by A. R. Santhakumar, Oxford University press
5. Defects and Deterioration in Buildings, E F & N Spon, London
6. Non-Destructive Evaluation of Concrete Structures by Bungey - Surrey University Press
7. Maintenance, Repair & Rehabilitation and Minor Works of Buildings by P. C. Varghese, PHI.
8. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
9. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, (1981)
10. Building Failures: Diagnosis and Avoidance, EF & N Spon, London, B. A. Richardson, (1991**).**

ANURAG GROUP OF INSTITUTIONS
M. Tech – I Year – II Sem. (Structural Engg.)

STABILITY OF STRUCTURES (PE - IV)

Course Objectives: To impart knowledge on the elastic, inelastic buckling and torsional buckling of structures.

Course Outcomes: The learner will be able to understand buckling of bars and frames.

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.

TEXT BOOKS
1. Theory of elastic Stability by Timshenko & Gere -McGraw Hill

REFERENCES
2. Stability of metallic structures by Blunch- McGraw Hill
3. Theory of Beam- Columns Vol. I by Chem. & Atste McGraw Hill
4. Stability Theory of Structures by Ashwini Kumar, Allied Publishers.

ANURAG GROUP OF INSTITUTIONS
M. Tech – I Year – II Sem. (Structural Engg.)

CAD LABORATORY

Course Objective: To impart knowledge on the use of various softwares

Course Outcome: the student will be able to analyze and design structural elements of a building

8. Design of beam using Excel for flexural shear and with deflection check
    e) Singly and doubly reinforced RC Beam
9. Design of Steel Beam using Excel for flexural shear and with deflection check
10. Design of RC slab one-way and two-way using Excel
11. Design of RC short & long columns subjected to biaxial bending.
12. Design of isolated footings using Excel
13. Analysis & design of 2-D steel truss
14. Analysis & Design of 2-D building frame
15. Analysis & Design of Multi-storey space frame (for mid rise) subjected to lateral loads
16. Plate bending using FEM
17. Modal analysis of a high rise building

Note: Exercises from 6-10 may be carried out using any relevant commercial software package.

S. No	Name of the Department	Open Elective (S) Offered for Other Departments	Subject Code
1.	Civil Engineering (Open Elective – II)	1. Finite Element Method 2. Advanced Optimization Techniques and Applications	A32050 A32010
2.	Electronics and Communication Engineering (Open Elective-II)	1. Industrial Instrumentation 2. Principles of Computer Communications and Networks 3. Signal Analysis and Condition Monitoring	A32051 A32052 A32011
4.	Electrical and Electronics Engineering (Open Elective – II)	1. Energy From Waste 2. Distributed Generation and Microgrid 3. Reliability Engineering	A32053 A32054 A32055
4.	Mechanical Engineering (Open Elective – II)	Engineering Research Methodology	A32056
5.	Computer Science and Engineering (Open Elective – II)	Machine Learning	A32057

CIVIL ENGINEERING
FINITE ELEMENT METHOD

(Open Elective – II)

Course Objectives: To impart knowledge about various finite element techniques and development
of finite element code.
Course Outcome: The learner will be able to solve continuum problems using finite element analysis.

UNIT - I
Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles – Discretization - Raleigh - Ritz method of functional approximation. Principles of Elasticity: Stress equations - strain displacement elationships 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 for 1-D 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 finite analysis – basic methods – application to Special structures.

TEXT BOOKS:

1. A First Course in a Finite Element by Daryl L .Logan, CL Engineers.

2. Concepts and Applications of Finite Element Analysis by Robert D.Cook, DavidS. Malkus and Michael E. Plesha, John Wiley & Sons.

REFERENCES:

1. Introduction to Finite element Method by Tirupathi Chandra Patla and Belugunudu
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 JN Reddy

ANURAG GROUP OF INSTITUTIONS
M. Tech I Year – II Sem.

ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATIONS
(Open Elective – II)

UNIT- I
SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMITION: One dimensional Optimization methods:- Uni-modal function, elimination method, Fibonacci method, golden section method,i nterpolation methods- quadratic & cubic interpolation methods.

UNIT – II
MULTI VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION: Direct search method – Univariant Method – pattern search methods – Powell's – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method. Variable metric method.

UNIT – III
GEOMETRIC PROGRAMMING: Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P
DYNAMIC PROGRAMMING: Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

UNIT IV
LINEAR PROGRAMMING: formulation – Sensivity analysis. Change in the constraints, cost coefficients , coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types – Steps – application – inventory – queuing – thermal system.

UNIT V
INTEGER PROGRAMMING: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.
STOCHASTIC PROGRAMMING: Basic concepts of probability theory, random variables – distributions – mean, variance, Correlation, co variance, joint probability distribution – stochastic linear, dynamic programming.

REFERENCES:
1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan & Kumar/Springar
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.L Rardin
6. Optimization Techniques/Benugundu & Chandraputla/Person Asia

ELECTRONICS AND COMMUNICATION ENGINEERING
INDUSTRIAL INSTRUMENTATION
(Open Elective – II)

UNIT – I

METROLOGY, VELOCITY AND ACCELERATION MEASUREMENT: Measurement of length - Gauge blocks – Plainness – Area using Simpson's rule, Plain meter – Diameter – Roughness – Angle using Bevel protractor, sine bars and Clinometer – Mechanical, Electrical, Optical and Pneumatic Comparators. Optical Methods for length and distance measurements using Optical flats and Michelson Interferometer. Relative velocity – Translational and Rotational velocity measurements – Revolution counters and Timers - Magnetic and Photoelectric pulse counting stroboscopic methods. Accelerometers-different types, Gyroscopes-applications.

UNIT – II

FORCE AND PRESSURE MEASUREMENT: Force measurement – Different methods – Gyroscopic
Force Measurement – Vibrating wire Force transducer. Basics of Pressure measurement – Manometer types – Force-Balance and Vibrating Cylinder Transducers – High and Low Pressure measurement – McLeod Gauge, Knudsen Gauge, Momentum Transfer Gauge, Thermal Conductivity Gauge, Ionization Gauge, Dual Gauge Techniques, Deadweight Gauges, Hydrostatic Pressure Measurement

UNIT – III

FLOW MEASUREMENT AND LEVEL MEASUREMENT: Flow Meters- Head type, Area type (Rota
meter), electromagnetic type, Positive displacement type, mass flow meter, ultrasonic type, vertex shedding type, Hotwire anemometer type, Laser Doppler Velocity-meter. Basic Level measurements – Direct, Indirect, Pressure, Buoyancy, Weight, Capacitive Probe methods

UNIT – IV

DENSITY, VISCOSITY AND OTHER MEASUREMENTS: Density measurements – Strain Gauge load cell method – Buoyancy method - Air pressure balance method – Gamma ray method – Vibrating probe method. Units of Viscosity, specific gravity scales used in Petroleum Industries, Different Methods of measuring consistency and Viscosity –Two float viscorator –Industrial consistency meter. Sound-Level Meters, Microphones, Humidity Measurement

UNIT – V

CALIBRATION AND INTERFACING: Calibration using Master Sensors, Interfacing of Force, Pressure, Velocity, Acceleration, Flow, Density and Viscosity Sensors, Variable Frequency Drive

TEXT BOOKS:

1. Doeblin E.O., "Measurement Systems – Applications and Design", 4th Edition, McGraw Hill International, 1990.
2. Patranabis D, "Principles of Industrial Instrumentation", TMH. End edition 1997

REFERENCES:

1. Considine D. M., "Process Instruments and Control Handbook", 4th Edition, McGraw Hill International, 1993
2. Jain R.K., "Mechanical and Industrial Measurements", Khanna Publications.

ELECTRONICS AND COMMUNICATION ENGINEERING
PRINCIPLES OF COMPUTER COMMUNICATIONS AND NETWORKS
(Open Elective – II)

Prerequisite: Nil

Course Objectives:
- To understand the concept of computer communication.
- To learn about the networking concept, layered protocols.
- To understand various communications concepts.
- To get the knowledge of various networking equipment.

Course Outcomes: The student:
- Can get the knowledge of networking of computers, data transmission between computers.
- Will have the exposure about the various communication concepts.
- Will get awareness about the structure and equipment of computer network structures.

UNIT – I

Overview of Computer Communications and Networking: Introduction to Computer Communications and Networking, Introduction to Computer Network, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, The Telephone System and Data Communications.

UNIT – II

Essential Terms and Concepts: Computer Applications and application protocols, Computer Communications and Networking models, Communication Service Methods and data transmission modes, analog and Digital Communications , Speed and capacity of a Communication Channel, Multiplexing and switching, Network architecture and the OSI reference model.

UNIT – III

Analog and Digital Communication Concepts: Representing data as analog signals, representing data as digital signals, data rate and bandwidth reduction , Digital Carrier Systems.

UNIT – IV

Physical and data link layer Concepts: The Physical and Electrical Characteristics of wire, Copper media, fiber optic media, wireless Communications. Introduction to data link Layer , the logical link control and medium access control sub-layers.

UNIT – V

Network Hardware Components: Introduction to Connectors, Transreceivers and media convertors, repeaters, network interference cards and PC cards, bridges, switches, switches Vs Routers.

TEXT BOOKS:
1. Computer Communications and Networking Technologies, Michel A. Gallo and William H. Hancock, Thomson Brooks / Cole.

REFERENCE BOOKS:
1. Principles of Computer Networks and Communications, M. Barry Dumas, Morris Schwartz, Pearson.

ANURAG GROUP OF INSTITUTIONS
M. Tech I Year – II Sem.

SIGNAL ANALYSIS AND CONDITION MONITORING
(OPEN ELECTIVE – II)

UNIT-I
Introduction, Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution. Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types.

UNIT-II
PRACTICAL ANALYSIS OF STATIONARY SIGNALS: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.

UNIT-III
PRACTICAL ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.

UNIT-IV
PRACTICAL ANALYSIS OF TRANSIENTS: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).

UNIT-V
CONDITION MONITORING IN REAL SYSTEMS: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations.

REFERENCES:
1. Condition Monitoring of Mechanical Systems / Kolacat.
2. Frequency Analysis /R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa Publishing House.
4. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP

ELECTRICAL AND ELECTRONICS ENGINEERING
ENERGY FROM WASTE
(Open Elective – II)

Prerequisite: Renewable Energy Sources, Physics, Environmental Studies

Course Objectives:

- To classify solid waste sources

- To identify methods of solid waste disposal

- To study various energy generation methods
- To analyse biogas production methods and recycling of e-waste

Course Outcomes: Upon the completion of the subject, the student will be able to
- Understand technologies for generation of energy from solid waste
- Compare methods of solid waste disposal
- Identify sources of energy from bio-chemical conversion
- Analyze methods for management of e-waste

UNIT- I

Solid Waste Sources Solid Waste Sources, types, composition, Properties, Global warming, Municipal Solid Waste: Physical, chemical and biological properties , Waste Collection and, Transfer stations, Waste minimization and recycling of municipal waste, Segregation of waste, Size Reduction , Managing Waste. Status of technologies for generation of Energy from Waste Treatment and Disposal Aerobic composting, incineration, Furnace type and design, Medical waste /Pharmaceutical waste treatment Technologies, incineration, Environmental impacts, Measures to mitigate environmental effects due to incineration .

UNIT – II

Land Fill method of Solid waste disposal Land fill classification, Types, methods and Sitting consideration, Layout and preliminary design of landfills: Composition, characteristics, generation, Movement and control of landfill leach ate and gases, Environmental monitoring system for land fill gases.

UNIT – III
Energy Generation from Waste Bio-chemical Conversion: Sources of energy generation, anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, Industrial waste, agro residues, Anaerobic Digestion.

UNIT – IV
Biogas production, Land fill gas generation and utilization, Thermo-chemical conversion: Sources of energy generation, Gasification of waste using Gasifiers, Briquetting, Utilization and advantages of briquetting, Environmental benefits of Bio-chemical and Thermo- chemical conversion.

UNIT – V

E-waste: e-waste in the global context – Growth of Electrical and Electronics Industry in India – Environmental concerns and health hazards – Recycling e-waste: a thriving economy of the unorganized sector – Global trade in hazardous waste – impact of hazardous e-waste in India. Management of e-waste: e-waste legislation, Government regulations on e-waste management – International experience – need for stringent health safeguards and environmental protection laws of India.

TEXT BOOKS:
1. Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003).
2. P. Aarne Vesilind, William A. Worrell and Debra R. Reinhart. Solid Waste Engineering. Thomson Asia Pte Ltd. Singapore (2002)
3. M. Dutta , B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi (1999).
4. "E-waste in India: Research unit, Rajya Sabha Secretariat, New Delhi, June 2011"
5. Amalendu Bagchi. Design, construction and Monitoring of Landfills. John Wiley and Sons. New York. (1994)
6. M. L. Davis and D. A. Cornwell. Introduction to environmental engineering. Mc Graw Hill International Edition, Singapore (2008)
7. C. S. Rao. Environmental Pollution Control Engineering. Wiley Eastern Ltd. New Delhi (1995)
8. S. K. Agarwal. Industrial Environment Assessment and Strategy. APH Publishing Corporation. New Delhi (!996)
9. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), "Biomass Conversion Processes for Energy and Fuels", New York, Plenum Press, 1981
10. Hagerty, D.Joseph; Pavoni, Joseph L; Heer, John E., "Solid Waste Management", New York, Van Nostrand, 1973
11. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, Hillary Vigil, Samuel, "Integrated Solid Waste management: Engineering Principles and Management issues", New York, McGraw Hill, 1993.

REFERENCES:
1. C Parker and T Roberts (Ed), Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
2. KL Shah, Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, 2000
3. M Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
4. G Rich et.al, Hazardous Waste Management Technology, Podvan Publishers, 1987
5. AD Bhide, BB Sundaresan, Solid Waste Management in Developing Countries, INSDOC, New Delhi,1983 FUEL CELL AND

ELECTRICAL AND ELECTRONICS ENGINEERING
DISTRIBUTED GENERATION AND MICROGRID
(Open Elective – II)

Course Objectives

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• To illustrate the concept of distributed generation
   To analyze the impact of grid integration.
• To study concept of Micro grid and its configuration
   To find optimal size, placement and control aspects of DGs

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Course Outcomes: Upon the Completion of the course student will be able to

- Find the size and optimal placement DG
- Analyze the impact of grid integration and control aspects of DGs
- Model and analyze a micro grid taking into consideration the planning and operational issues of the DGs to be connected in the system.
- Describe the technical impacts of DGs in power systems

UNIT – I

Need for distributed generation - Renewable sources in distributed generation - Current scenario in distributed generation - Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

UNIT – II

Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Energy storage elements - Batteries, ultracapacitors, flywheels.

UNIT – III

Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

UNIT-IV
Economic and control aspects of DGs – Market facts, issues and challenges - Limitations of DGs - Voltage control techniques, Reactive power control, Harmonics, Power quality issues - Reliability of DG based systems – Steady state and Dynamic analysis.

UNIT – V

Introduction to micro-grids – Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids - Modeling & analysis - Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units - Transients in micro-grids - Protection of micro-grids – Case studies.

TEXT BOOKS:

1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M.Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
3. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.
4. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
5. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.

ELECTRICAL AND ELECTRONICS ENGINEERING
RELIABILITY ENGINEERING
(Open Elective – II)

Course Objectives:

- To comprehend the concept of Reliability and Unreliability
- Derive the expressions for probability of failure, Expected value and standard deviation of Binominal distribution, Poisson distribution, normal distribution and weibull distributions.

- Formulating expressions for Reliability analysis of series-parallel and Non-series parallel systems
- Deriving expressions for Time dependent and Limiting State Probabilities using Markov models.

Course Outcomes: Upon the completion of this course, the student will be able to
- Apply fundamental knowledge of Reliability to modeling and analysis of seriesparallel and Non-series parallel systems.
- Solve some practical problems related with Generation, Transmission and Utilization of Electrical Energy.
- Understand or become aware of various failures, causes of failures and remedies for failures in practical systems.

UNIT – I

Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in the definition. Probability distributions: Random variables, probability density and distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, weibull distribution.

UNIT – II

Hazard rate, derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

UNIT – III

Classification of engineering systems: series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations. Reliability evaluation of Non-series-parallel configurations: Decomposition, Path based and cutest based methods, Deduction of the Paths and cutsets from Event tree.

UNIT – IV

Discrete Markov Chains: General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one component repairable model. Absorbing states. Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating time dependent and limiting state Probabilities of one component repairable model. Evaluation of Limiting state probabilities of two component repairable model.

UNIT – V

Approximate system Reliability analysis of Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutest/failure mode approach.

TEXT BOOKS:
1. "Reliability evaluation of Engineering systems", Roy Billinton and Ronald N Allan, BS Publications.
2. "Reliability Engineering", Elsayed A. Elsayed, Prentice Hall Publications.

REFERENCES:
1. "Reliability Engineering: Theory and Practice", By Alessandro Birolini, Springer Publications.
2. "An Introduction to Reliability and Maintainability Engineering", Charles Ebeling, TMH Publications.
3. "Reliability Engineering", E. Balaguruswamy, TMH Publications.

MECHANICAL ENGINEERING
ENGINEERING RESEARCH METHODOLOGY
(Open Elective – II)

UNIT – I

Research Methodology: Objectives and Motivation of Research, Types of Research,Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Important of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.

Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

UNIT – II

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. **Literature Review**: Need of Review, Guidelines for Review, Record of Research Review.

UNIT – III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

UNIT – IV

Data Collection: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software.
Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chisquare, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

UNIT – V

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. **Research Proposal Preparation**: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

REFERENCES:
1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. Ratan Khananabis and Suvasis Saha, Research Methodology, Universities Press, Hyderabad, 2015.
4. Y. P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs.,Pvt., Ltd., New Delhi, 2004
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd.,New Delhi, 2009
6. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications,Hyderabad, 2012.
7. Naval Bajjai "Business Research Methods" Pearson 2011.
8. Prahalad Mishra " Business Research Methods " Oxford 2016

COMPUTER SCIENCE AND ENGINEERING
MACHINE LEARNING
(Open Elective - II)

Prerequisites:

- Data Structures

- Knowledge on statistical methods

Course Objectives:
- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

Course Outcomes:
- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
- Understand the Neural Networks and its usage in machine learning application.

UNIT – I

Introduction - Well-posed learning problems, designing a learning system Perspectives and issues in machine learning **Concept learning and the general to specific ordering** – Introduction, A concept learning task,concept learning as search, Find-S: Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination algorithm, Remarks on Version Spaces and Candidate Elimination, Inductive Bias. **Decision Tree Learning** – Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning, The Basic Decision Tree Learning Algorithm Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning.

UNIT – II

Artificial Neural Networks Introduction, Neural Network Representation, Appropriate Problems for Neural Network Learning, Perceptions, Multilayer Networks and the Back propagation Algorithm. Discussion on the Back Propagation Algorithm, An illustrative Example: Face Recognition **Evaluation Hypotheses** – Motivation, Estimation Hypothesis Accuracy, Basics of Sampling Theory, A General Approach for Deriving Confidence Intervals, Difference in Error of Two Hypotheses, Comparing Learning Algorithms.

UNIT – III

Bayesian learning - Introduction, Bayes Theorem, Bayes Theorem and Concept Learning Maximum Likelihood and Least Squared Error Hypotheses, Maximum Likelihood Hypotheses for Predicting Probabilities, Minimum Description Length Principle , Bayes Optimal Classifier, Gibs Algorithm, Naïve Bayes Classifier, An Example: Learning to Classify Text, Bayesian Belief Networks, EM Algorithm.
Computational Learning Theory – Introduction, Probably Learning an Approximately Correct Hypothesis, Sample Complexity for Finite Hypothesis Space, Sample Complexity for Infinite Hypothesis Spaces, The Mistake Bound Model of Learning.
Instance-Based Learning – Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

UNIT – IV

Pattern Comparison Techniques, Temporal patterns, Dynamic Time Warping Methods, Clustering, Codebook Generation, Vector Quantization

Pattern Classification: Introduction to HMMS, Training and Testing of Discrete Hidden Markov Models and Continuous Hidden Markov Models, Viterbi Algorithm, Different Case Studies in Speech recognition and Image Processing

UNIT – V

Analytical Learning – Introduction, Learning with Perfect Domain Theories : PROLOG-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operations.

Combining Inductive and Analytical Learning – Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis.

TEXT BOOKS:
1. Machine Learning – Tom M. Mitchell,- MGH
2. Fundamentals of Speech Recognition By Lawrence Rabiner and Biing – Hwang Juang.

REFERENCE BOOK:
1. Machine Learning : An Algorithmic Perspective, Stephen Marsland, Taylor & Francis