ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

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

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

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

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

4 Course Registration

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

4.2 Academic Section of the College invites 'Registration Forms' from students with in 15 days from the commencement of class work through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

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

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

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

5 <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 below65% in each subject shall not be condoned.

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

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

5.6 A candidate shall get minimum required attendance at least in three (3) theory subjects in the present semester to get promoted to the next semester. In order to qualify for the award of the M.Tech Degree, The candidate shall complete all the academic requirements of the subjects, as per the course structure.

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

6 EVALUATION

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

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

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

- Part-A is a compulsory question consisting of 5 questions, one from each

unit and carries 4 marks each.

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

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

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

6.4 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.

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

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

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

6.8 A candidate shall be given one chance to re-register for the subjects if the internal marks secured by a candidate is less than 50% and failed in that subject for maximum of two subjects and should register within four weeks of

commencement of the class work. In such a case, the candidate must re-register for the subjects and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the Semester End Examination in those subjects. In the event of the student taking another chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stands cancelled.

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

7. Examinations and Assessment - The Grading System

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

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

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

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

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

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

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

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

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

7.8 The Student passes the Subject/ Course only when he **gets GP $\geq$ 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

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

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

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

Semester onwards, at the end of each Semester, as per the formula

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

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

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

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

8. EVALUATION OF PROJECT/DISSERTATION WORK

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

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

8.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

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

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

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

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

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

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

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

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

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

8.12 The thesis shall be adjudicated by one examiner selected by the Institution. For this, Chairmen, BOS of the respective departments shall submit a panel of 3 examiners, who are eminent in that field with the help of the concerned guide and senior faculty of the department.

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

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

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

9. AWARD OF DEGREE AND CLASS

9.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of **88** Credits (with CGPA ≥ 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≤CGPA < 7.75
Second Class	6.00≤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

11.2 The candidate who fails in any subject will be given two chances to pass the same Subject; otherwise, he has to identify an equivalent subject as per R15 Academic Regulations.

12 GENERAL

12.1 **Credit**: A unit by which the course work is measured. It determines the number of 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, ANURAG ENGINEERING COLLEGE.

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

		connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant-Superintendent/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes 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, ANURAG ENGINEERING COLLEGE for further action to award suitable punishment.	

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M.TECH (MACHINE DESIGN)

COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Sub. Code	Category	Course Title	L	P	C
A31001	Core Course I	Advanced Mechanical Engineering Design	4	--	4
A31002	Core Course II	Advanced Mechanics of Solids	4	--	4
A31003	Core Course III	Fatigue & Fracture Mechanics	4	--	4
A31004	Core Elective I	1. Advanced Finite Element Analysis	4	--	4
A31005	Core Elective I	2. Applied Tribology			
A31006	Core Elective I	3. Theory of Elasticity & Plasticity			
A31007	Core Elective II	1. Concurrent Engineering	4	--	4
A31008	Core Elective II	2. Advanced Mechanics of Composite Materials			
A31009	Core Elective II	3. Advanced Computer Aided Design			
A31010	Open Elective I	1. Computational Methods in engineering	4	--	4
A31011	Open Elective I	2. Database Management System			
A31201	Lab	Dynamics & Analysis of Structure Lab	--	4	2
A31202	Seminar	Seminar	--	4	2
	Total Credits		**24**	**8**	**28**

I Year II Semester

Sub. Code	Category	Course Title	L	P	C
A32001	Core Course IV	Advanced Mechanics of Machinery	4	--	4
A32002	Core Course V	Mechanical Vibrations	4	--	4
A32003	Core Course VI	Experimental Stress Analysis	4	--	4
A32004	Core Elective III	1. Pressure Vessel Design	4	--	4
A32005	Core Elective III	2. Design Synthesis			
A32006	Core Elective III	3. Industrial Robotics			
A32007	Core Elective IV	1. Mechatronics	4	--	4
A32008	Core Elective IV	2. Computational Fluid Dynamics			
A32009	Core Elective IV	3. Theory of plates and Shells			
A32010	Open Elective II	1.Advanced Optimization Techniques and Applications	4	--	4
A32011	Open Elective II	2.Signal Analysis and Condition Monitoring			
A32201	Lab	Computer Aided Testing , Analysis & Modeling Lab	--	4	2
A32202	Seminar	Seminar	--	4	2
	Total Credits		24	8	28

II Year I Semester

Subject Code	Category	Subject Name	L	P	C
A33201		Comprehensive Viva-Voce	-	-	4
A33202		Project work Review I	-	24	12
		Total Credits	-	24	16

II Year II Semester

Subject Code	Category	Subject Name	L	P	C
A34201		Project work Review II	-	8	4
A34202		Project Evaluation (Viva-Voce)		16	12
		Total Credits	-	24	16

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M.Tech I Year I Sem (MD)

ADVANCED MECHANICAL ENGINEERING DESIGN

Course Objectives:

1. Review concept of design models and product design.
2. Introduce manufacturing process for plastic, rubber, ceramic, wood and glass.
3. Explain basic concept of theories of failures.
4. Identify the surface failure for dynamic contact stress, adhesive wear abrasive, wear, corrosion wear and surface fatigue.
5. Give an overview of economic factors influencing design

UNIT I

DESIGN PHILOSOPHY: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability

UNIT II

PRODUCT DESIGN: Product strategies, value, planning and specification, concept generation, concept selection, concept testing.

Design for manufacturing: Forging design, Casting design, Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood and Glass parts like. Material selection in machine design

UNIT III

FAILURE THEORIES: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory., Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation

UNIT IV

SURFACE FAILURES: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength,

UNIT V

ECONOMIC FACTORS INFLUENCING DESIGN: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

Course Outcomes:

1. To know concept of various design models and introduced the concept of product design.
2. To introduced the concept of design for manufacturing process for plastic, rubber, ceramic, wood and glass.
3. To know concept of all theories of failures and creep.
4. To know the concept of surface failure for dynamic contact stress, adhesive wear abrasive wear, corrosion wear and surface fatigue.
5. To know the concept for break even analysis and value engineering.

REFERENCES:

3.0 Machine Design An Integrated Approach / Robert L. Norton / Prentice-Hall New Jersey, USA.

4.0 Engineering Design / George E Dieter / McGraw Hill /2008

2. Mechanical Engineering Design / J.E. Shigley and L.D. Mitchell / McGraw Hill International Book Company, New Delhi.
3. Fundamentals of machine elements/ Hamrock, Schmid and Jacobian/ 2nd edition /McGraw-Hill International edition.
4. Product design and development / Karl T. Ulrich and Steven D. Eppinger / 3rd edition/ Tata McGraw Hill.
5. Product Design and Manufacturing /A.K. Chitale and R.C. Gupta / Prentice Hall

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

ADVANCED MECHANICS OF SOLIDS

Course Objectives:

1. Solve problems on center-shear center for axi-symmetric and unsymmetrical sections.
2. Develop the equation for winklers bach formula for circumferential stressess
3. Evaluate the stressess in different cross sections.
4. Analyze the stresses in the plate.
5. Evaluate the contact stresses developed in the two bodies in contact.

UNIT - I

SHEAR CENTRE: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.

Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

UNIT - II

CURVED BEAM THEORY: Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform lads- stresses in chain links.

UNIT - III

TORSION: Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends

Axi-Symmetric Problems: Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.

UNIT - IV

THEORY OF PLATES: Introduction; Stress resultants in a flat plate; Kinematics: Strain-Displacement relations for plates; Equilibrium equations for small displacement theory of flat plates; Stress – Strain – Temperature relation for Isotropic plates: Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem; Solution of circular plate problem.

Beams on Elastic Foundation: General theory; Infinite Beam subjected to Concentrated load; boundary conditions; Infinite beam subjected to a distributed lad segment; Semi-infinite beam with concentrated load near its end; Short Beams.

UNIT - V

CONTACT STRESSES: Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact. Normal and Tangent to contact area.

Course Outcomes:

1. To determine the shear center for axi-symmetrice and un-symmetrical section.
2. To determine stress for Winkler batch formula, radial stress in curved beams.
3. To derive the expression for saint venant semi inverse method, prandtle elastic numbrane, narrow rectangular cross-section.
4. To know concept of flat plate, kinematics strain displacement relation for plates, strain energy of plate, boundary centers for plates.
5. To know the concept of contact stress for deflection of bodies in point contact, stress for two bodies in contact over narrow rectangular area.

REFERENCES:

1. Advanced Mechanics of materials/Seely and Smith/ John Willey
2. Advanced Mechanics of materials / Boresi & Sidebottom/wiely international
3. Advanced strength of materials / Den Hortog J.P./Torrent
4. Theory of Plates /Timoshenko/
5. Strength of materials / Sadhu singh/ Khanna Publishers
6. Mechanics of Materials / Beer & Jhonson / McGraw Hill
7. Theory of Plates & Shells / Timoshenko/ McGraw Hill/ 2nd Edition

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

FATIGUE & FRACUTRE MECHANICS

Course Objectives:

1. Evaluate principal stresses by using Mohr's circle theory.
2. Develop the relations for J-integra and R-curve.
3. Develop the relations between Goodman,Sodaberg and Gerberman stress.
4. Give an overview of welded structure.
5. Analyze the stress intensity factor.

UNIT-I:

INTRODUCTION: Fracture behaviour of metals and alloys. The ductile/brittle transition temperatures for notched and un-notched components, Ductile rupture as a failure mechanism Fracture at elevated temperature.
Definitions of types of fracture and failure, Introduction to stress intensity factor and strain energy release rate, Equivalence of energy approach and stress intensity approach.
Basic stress analysis and mechanical properties: Elasticity, General 3-D relations, Plane stress and plane strain, Mohr's circle-principal stresses, Yield in materials, Tresca and Von Mises criteria, Ideal and actual strength of materials. Typical stress/strain curves for different classes of materials.

UNIT-II:

STRESS INTENSITY FACTOR AND ITS USE IN FRACTURE MECHANICS: Early concepts of stress concentrators and flaws, Ingles solution to stress round an elliptical hole-implications of results. Stress intensity factor for a crack. Westergaard's solution for crack tip stresses. Stresses and displacement in Cartesian and polar coordinates, Linear Elastic Fracture Mechanics. Typical values of fracture toughness, Different modes of crack opening. Superposition of crack tip stress fields, Direction of crack growth under mixed mode loadings.
Crack tip plasticity, Early estimates of plastics zone, Irwin plastic zone correction and Dugdale approach, Plastic zone shape in three dimensions and shape under plane stress and plane strain conditions, Allowable plasticity for LEFM to apply, the thickness criterion Experimental methods for measuring Kic.

UNIT-III:

ELASTIC/PLASTIC FRACTURE MECHANICS: Elastic/plastic fracture mechanics: The crack opening displacement and J-integral approaches, R-curve analysis Testing procedures, Measurement of these parameters, RAD, Fail sage and safe life design approaches, Practical applications. Advanced topics in EOFM.

UNIT-IV:

FATIGUE: Importance of fatigue in engineering, Low cycle fatigue, Coffin-Manson law, Cyclic work hardening and softening. Micro structural models of crack initiation. Stage I, II and III crack growth.

Analysis of Fatigue: The empirical laws of fatigue failure. High cycle-low strain fatigue, Basquin's law, Goodman, Soderberg and Gerber mean stress corrections, Miner's law of damage summation. Low cycle fatigue, Crack growth and application of fracture mechanics to fatigue, Paris-Ergodan law, Threshold stress intensity range. Crack closure and its theories Cycle counting methods, Developments in using rain-flow counting methods to recreate fatigue standard spectra. Standard spectra suitable for different applications.

UNIT-V:

FATIGUE OF WELDED STRUCTURES: Factors affecting the fatigue lives of welded joints, the codes and standards available to the designer, the use of fracture mechanics to supplement design rules. Practical examples.

Creep: Phenomenology, Creep curves, Creep properties, Multi-axial creep, Creep-fatigue interaction, Creep integrals.

Course Outcomes:

1. To know the concept of fracture behavior of metals and alloys and concept for basic stress analysis for Mohr's circle and mechanical properties.
2. To know the concept of stress intensity factor and its use in fracture mechanics.
3. To know the concept of elastic for plastic fracture mechanics for crack opening displacement, J-integral, R-curve analysis.
4. To know concept of fatigue for co-efficient for Manson law and determine the expressions for Basque's law, Goodman, Soderberg and Gerbermean stress.
5. To know the concept of fatigue of welded structure in creep.

REFERENCES:

1. Mechanical Metallurgy / Dieter / McGraw Hill
2. Fracture Mechanics: Fundamental and Applications /Anderson T.L & Boca Raton/ CRC Press, Florida, 1998.
3. Deformation and Fracture mechanics of Engineering Materials / Richard W Hertz /Wiley
4. Plasticity for structural Engineers / W.F. Chen and D.J,. Ha,
5. Engineering Fracture Mechanics/D.R.J. Owen and A.J.Fawkes/Pincridge press, Swansea, U.K.
6. Fracture and fatigue control in structures/ S.T. Rolfe and J.M. Barsom/ Printice Hall, Eglewood cliffs, N.J..
7 Fracture of brittle solids/ B.R. Lawn and T.R. Wilshaw/ Cambridge university press.
8. Plastic deformation of Metals/ R.W.K. Honeycombe/ 2nd edition, Edward Arnold

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

ADVANCED FINITE ELEMENT ANALYSIS

Course Objectives:

1. Give an overview of FEM application, shape function, boundary condition
2. Evaluate the stiffness matrix of axial bar element.
3. Evaluate the stresses and strains by using Jacobian matrix.
4. Evaluate the temperature of the 1-D and 2-D heat conduction.
5. Evaluate the frequency of the 1-D and 2-D bar elements.

UNIT-I:

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations.

UNIT-II:

1-D STRUCTURAL PROBLEMS: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.
ANALYSIS OF TRUSSES : Plane Trusses and Space Truss elements and problems **ANALYSIS OF BEAMS** : Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT-III:

2-D PROBLEMS: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration.
Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.
3-D PROBLEMS: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT-VI:

SCALAR FIELD PROBLEMS: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems
– Introduction to Torsional problems.

UNIT-V:

Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

Course Outcomes:

1. To know the concept of FEM application, shape function, boundary condition.
2. To know the concept of axial bar element, stiffness matrix and analysis of stresses.
3. To know the concept of CST, LST, force terms numerical integration, Jacobian matrix.
4. To know concept of I-Dof heat conduction slab fins 2-D heat conduction.
5. To know concept of Eigen values, Eigen vector, natural frequency.

REFERENCES:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
4. Finite Element Method – Zienkiewicz / Mc Graw Hill
5. Introduction to Fininte element analysis- S.Md.Jalaludeen,Anuradha Publications, print-2012
6. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
7. Finite Element Method – Krishna Murthy / TMH
8. Finite Element Analysis – Bathe / PHI

ANURAG ENGINEERING COLLEGE

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M.Tech I Year I Sem (MD)

APPLIED TRIBOLOGY

UNIT – I

Historical background - Viscosity - Viscometry - Effect of temperature on viscosity - Effect of pressure in viscosity - Other physical properties of mineral oils - The generalized Reynolds equation - Flow and shear stress - The energy equation - The equation of state - Mechanism of pressure development.

UNIT – II

Circumferential Flow - Oil flow through a bearing having a circumferential oil groove – Heat generation and lubricant temperature - Heat balance and effective temperature - Bearing design: Practical considerations - Design of journal bearings - Parallel surface bearing - Step bearing - Some situations under squeeze film lubrication - The mechanism of hydrodynamic instability - Stiffness and damping coefficients - Stability.

UNIT – III

ELASTOHYDRODYNAMIC LUBRICATION: Theoretical consideration - Grubin type solution - Accurate solution - Point contact - Dimensionless parameters - Film thickness equations - Different regimes in EHL contact - Deep-groove radial bearings - Angular contact bearings - Thrust ball bearings - Geometry - Kinematics - Stress and deformations - Load capacity.

UNIT – IV

Surface Topography - Surface characterization - Apparent and real area of contact - Derivation of average Reynolds equation for partially lubricated surface - Effect of surface roughness on journal bearings

UNIT – V

Laws of friction - Friction theories - Surface contaminants - Frictional heating - Effect of sliding speed on friction - Classification of wear - Mechanisms of wear - Quantitative laws of wear – Wear resistance materials.

REFERENCES:

1. Introduction to Tribology of Bearings / Majumdar, B.C.
2. Friction. Wear, Lubrication : A Text book in Tribology / Kenneth C Ludema / CRC Press / 1st Edition
3. Engineering Tribology / John Williams / Cambridge University Press / 2005

4. Introduction to Tribology / Bharat Bhushan / Wiley / 2nd Edition
5. Engineering Tribology / Prasanta Sahoo / PHI Learning
6. Engineering Tribology / Stachowiak & Batchelor / Butterworth – Heinimann / 2005

ANURAG ENGINEERING COLLEGE

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M.Tech I Year I Sem (MD)

THEORY OF ELASTICITY AND PLASTICITY

Course Objectives:

1. Relate the concept of elasticity for 2D dimensional stress analysis Plane stress and plane strains.
2. Examine the performance of three dimensions Strain spherical and deviatory stress.
3. Give an overview of bending of prismatic bars.
4. Identify the Plastic deformation of metals -,Structure of metals Creep stress and Approximate equation of plasticity.
5. Analyze Compression of metal under press.

UNIT - I

ELASTICITY: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.
PROBLEM IN RECTANGULAR COORDINATES - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.
PROBLEMS IN POLAR COORDINATES - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT - II

ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS: Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.
General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

UNIT - III

BENDING OF PRISMATIC BARS: Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

UNIT - IV

PLASTICITY: Plastic deformation of metals - Structure of metals - Deformation - Creep stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of constant strain energy - Approximate equation of plasticity.

UNIT - V

METHODS OF SOLVING PRACTICAL PROBLEMS: The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

Course Outcomes:

1. To know the concept elasticity for 2D dimensional stress analysis Plane stress , Plane strain problem in rectangular and polar coordinates.
2. To understand the concept analysis of stress and strain in three dimensions Strain spherical and deviatoric stress.
3. To understand the concept bending of prismatic bars.
4. To know the concept Plastic deformation of metals -,Structure of metals ,Deformation Creep stress and Approximate equation of plasticity.
5. To analyze Compression of metal under press.

REFERENCES:

1. Theory of Elasticity/Timoshenko S.P. and Goodier J.N./Koakusha Publishers
2. An Engineering Theory of Plasticity/E.P. Unksov/Butterworths
3. Applied Elasticity/W.T. Wang/TMH
4. Theory of Plasticity for Engineers/Hoffman and Sacks/TMH
5. Theory of Elasticity and Plasticity/Sadhu Singh/ Khanna Publishers
6. Theory of Elasticity and Plasticity/Harold Malcolm Westergaard/Harvard University Press

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

CONCURRENT ENGINEERING

UNIT – I

Introduction **-** Concurrent design of products and systems - Product design - Fabrication and assembly system design - designing production systems for robustness and structure.

UNIT – II

STRATEGIC APPROACH AND TECHNICAL ASPECTS OF PRODUCT DESIGN: Steps in the strategic approach to product design - Comparison to other product design methods – Assembly sequence generation - Choosing a good assembly sequence - Tolerances and their relation to assembly - Design for material handling and part mating - Creation and evaluation of testing strategies.

UNIT – III

BASIC ISSUES IN MANUFACTURING SYSTEM DESIGN: System design procedure – Design factors - Intangibles - Assembly resource alternatives - Task assignment - Tools and tool changing - Part feeding alternatives - Material handling alternatives - Floor layout and system architecture alternatives.

UNIT – IV

ASSEMBLY WORKSTATION DESIGN: Strategic issues - Technical issues analysis.

Design of automated fabrication systems: Objectives of modern fabrication system design - System design methodology - Preliminary system feasibility study - Perform detailed work content analysis - Define alternative fabrication configurations - Configuration design and layout – Human resource considerations - Evaluate technical performance of solution.

UNIT - V

CASE STUDIES: Automobile air conditioning module - Robot assembly of automobile rear axles.

REFERENCE:

1. Concurrent Design of Product and Processes/James L. Nevins and Daniel E. Whitney, /McGraw-Hill Publishing Company, 1989.
2. Concurrent Engineering: Automation, Tools and Techniques/ Andrew Kusiak/Johan Wiley & Sons.

3. Concurrent Engineering Fundamentals: Integrated Product Development/Biren Prasad/ PH.
4. Concurrent Engineering/ Johan R Hartley/Productivity Press.
5. Concurrent Engineering: Concepts, Implementation and Practice/ Chanan & Menon/ Chapman & Hall.

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

ADVANCED MECHANICS OF COMPOSITE MATERIALS

Course Objectives:

1. Examine the performance of composite material and their reinforcements.
2. Give an overview of constituent materials glass, carbon, aramid, ceramic fibers and resins.
3. Analysis of composites.
4. Develop and processing of metal- matrix, ceramic -matrix and carbon- carbon composites
5. Describe the performance of composites.

UNIT – I

BASIC CONCEPTS AND CHARACTERISTICS: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements: Fibres – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT – II

MICROMECHANICS: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT – III

COORDINATE TRANSFORMATION: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off – axis, stiffness modulus, off – axis compliance.

Elastic behavior of unidirectional composites: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

UNIT – IV

STRENGTH OF UNIDIRECTIONAL LAMINA: Micro mechanics of failure, Failure mechanisms, strength of an orthotropic lamina, strength of a lamina under tension

and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micros mechanical predictions of elastic constants.

UNIT – V

ANALYSIS OF LAMINATED COMPOSITE PLATES:

Introduction thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

Course Outcomes:

1. Understand composite material and their reinforcements
2. Select constituent materials glass, carbon, aramid, ceramic fibers and resins
3. Understand engineering mechanics, analysis and design, macro and micro mechanics of composites
4. Develop and processing of metal- matrix, ceramic -matrix and carbon- carbon composites
5. Understand and analyze the properties and performance of composites

REFERENCES:

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
3. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ Wiley-Interscience, New York, 1980.
4. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)/ Autar K. Kaw, Publisher**:** CRC
5. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, New York, 1969.
6. Advanced Mechanics of Composite Materials/ Vasiliev &Morozov/Elsevier/Second Edition

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

ADVANCED COMPUTER AIDED DESIGN

Course Objectives:

1. Give an overview of computer graphics.
2. Understand the different cad tools and geometric modeling.
3. Understand the concept of surface modeling.
4. Understand the concept of parametric representation of synthetic surfaces.
5. Understand the concept of geometricmodelling-3d and Collaborative Engineering.

UNIT- I:

PRINCIPLES OF COMPUTER GRAPHICS : Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of characters.

UNIT- II:

CAD TOOLS: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software. **GEOMETRICMODELLING:** Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves.

UNIT- III:

SURFACE MODELING :Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

UNIT- IV:

PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES:

Hermite Bicubic surface, **Bezier** surface, **B-** Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation — Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

UNIT- V:

GEOMETRICMODELLING-3D: Solid modeling, Solid Representation, Boundary Representation (13-rep), Constructive Solid Geometry (CSG).

CAD/CAM Exchange : Evaluation of data - exchange format, IGES data

representations and structure, STEP Architecture, implementation, ACIS & DXF. Design Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.

Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design
Systems.

Course Outcomes:

1. To know the concept of principles of computer graphics
2. To study the different cad tools and geometric modeling
3. To know the concept of surface modeling
4. To understand the concept of parametric representation of synthetic surfaces
5. To understand the concept of geometricmodelling-3d and Collaborative Engineering

REFERENCES:

1. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill International.
2. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition
3. CAD/CAM /Groover M.P./ Pearson education
4. CAD/CAM Concepts and Applications/ Alavala/ PHI
5. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
6. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
7. Computer Numerical Control Concepts and programming/ Warren S Seames/ Thomson.

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

COMPUTATIONAL METHODS IN ENGINEERING

Course Objectives:

1. Evaluate the matrix inversion, iterative method, relaxation method.
2. Develop the expression for 1D unconstrained optimization.
3. Develop the boundary conditions for bars.
4. Solve problem on numerical method and regression analysis.

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.
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.

Course Outcomes:

1. To determine matrix inversion, iterative method, relaxation method and Newton cotes integration formula.
2. To derive the expression for ID un certained optimization.
3. To know the concept of law-places equation, boundary condition, explicitly method- crank nickelson method
4. To determine the wave equation by finite difference stability of numerical method – regression analysis- multiply linear and non-linear regression

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.

ANURAG ENGINEERING COLLEGE

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M.Tech I Year I Sem (MD)

DATA BASE MANAGEMENT SYSTEM

Course Objectives:

1. Give an overview of Database System Applications and Database languages.
2. Understand the concept of introduction to the relational model.
3. Understand the concept of Relational Algebra and Calculus.
4. Evolutes' the programmes by using normal forms
5. Understand the concept of storage and indexing and Tree structure Indexing

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.

Course Outcomes:

1. To know the concept Database System Applications and Database languages
2. To know the concept of introduction to the relational model
3. To understand the concept of Relational Algebra and Calculus.
4. To know the concept Form of basic SQL Query, multi valued dependencies forth normal form.
5. To understand the concept of storage and indexing and Tree structure Indexing

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.

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year I Sem (MD)

DYNAMICS & ANALYSIS OF STRUCTURES LABARATORY

Course Objectives:

1. Determine of damped natural frequency of vibration of the vibrating system.
2. Determine the study state amplitude of forced vibrating system.
3. Examine the natural frequency of given suitable using FFT analyzer.
4. Analyze the direct kinematic analysis of a robot.

(A Minimum of 10 experiments is to be conducted)

List of Experiments:

Secion - A

Dynamics Lab

1) To Studey the damped torsional oscillations and determine the damping co-efficient.
2) To study the Un-damped free vibration of equivalent spring mass system.
3) To Study the forced vibration of equivalent of the beam for different damping.
4) To study the forced lateral vibrations of the beam for different damping.
5) Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
6) Static and Dynamic Balancing apparatus – Rotating Masses.

Section - B:

ANALYSIS OF STRUCTURES USING FEA PACKAGES

1) Static Analysis
2) Modal Analysis
3) Harmonic Analysis
4) Spectrum Analysis
5) Buckling Analysis
6) Analysis of Composites
7) Fracture mechanism
8) Transient Analysis.

Note: Any 10 experiments are to be conducted from the above taking at least 4 from each section.

Course Outcomes:

1. To understand and determination of damped natural frequency of vibration of the vibrating system.
2. To determine the study state amplitude of forced vibrating system.
3. To determine the natural frequency of given suitable using FFT analyzer.
4. To know and understand about dire

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M.Tech I Year II Sem (MD)

ADVANCED MECHANICS OF MACHINERY

Course Objectives:

1. Understand the concept of Euler Savery equation, collination axis, harts manns construction.
2. Understand the concept of plain motion for polode curvature in the four bar mechanism.
3. Understand the concept of synthesis graphical method for overlays methods, horns and nelson motion atlas and Roberts theorems .
4. Develop the four bar mechanism by using two position, three position and four position synthesis.
5. Develop the four bar mechanism.

UNIT – I

ADVANCED KINEMATICS OF PLANE MOTION- I: Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Analytical and graphical determination of d_i , Bobillier's Construction , Collineation axis , Hartmann's Construction ,Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

UNIT - II

ADVANCED KINEMATICS OF PLANE MOTION - II: Polode curvature, Hall's Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Determination of the output angular acceleration and its Rate of change, Freudenstein's collineation –axis theorem, Carter –Hall circle, The circling – point curve for the Coupler of a four bar mechanism.

UNIT – III

INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS - I: The Four bar linkage ,Guiding a body through Two distinct positions, Guiding a body through Three distinct positions, The Roto center triangle , Guiding a body through Four distinct positions, Burmester's curve.

UNIT - IV

INTRODUCTION TO SYNTHESIS-GRAPHICAL METHODS - II: Function generation- General discussion, Function generation: Relative – Roto center method, Overlay's method, Function generation- Velocity – pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT – V

INTRODUCTION TO SYNTHESIS - ANALYTICAL METHODS: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation, Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

Course Outcomes:

1. To understand the concept of Euler Savery equation, collination axis, harts manns construction.
2. To understand the concept of plain motion for polode curvature in the four bar mechanism.
3. To understand the concept of synthesis graphical method for overlays methods, hroness and nelson motion atlas and Roberts theorems .
4. To introduced the concept of synthesis graphical method for four bar linkage, rotocenter triangle burmister curve
5. To determine the synthesis for four bar mechanism and path generation.

REFERENCE:

1. Kinematics and Dynamics of plane mechanisms/ Jeremy Hirschhorn/McGraw-Hill, 1962.
2. Theory of Machines and Mechanisms/ J.E Shigley and J.J . Uicker Jr./ McGraw-Hill, 1995
3. Theory of Mechanisms and Machines/ Amitabh Ghosh and Ashok Kumar Mallik/ E.W.P.Publishers.
4. Kinematics and Linkage Design/ Allen S.Hall Jr./ PHI,1964.
5. Kinematics and Dynamics of Machinery/Charles E Wilson/Pearson/3rd Edition

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M.Tech I Year II Sem (MD)

MECHANICAL VIBRATIONS

Course Objectives:

1. Understand the concept of single degree of freedom vibrations.
2. Understand the concept of two degree of freedom vibrations.
3. Understand the concept of multi degree of freedom vibrations.
4. Determine the frequency domain vibration analysis.
5. Derive Raylegh's and Stodola's method.

UNIT- I:

SINGLE DEGREE OF FREEDOM SYSTEMS : Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility- Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT- II:

TWO DEGREE FREEDOM SYSTEMS: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers.

UNIT-III:

MULTI DEGREE FREEDOM SYSTEMS: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers.

UNIT- IV:

FREQUENCY DOMAIN VIBRATION ANALYSIS: Over view, machine-train monitoring parameters-Data base development-vibration data acquisition-trending analysis-failure- node analysis-signature analysis-root cause analysis.

UNIT V:

NUMERICAL METHODS: Raleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

Course Outcomes:

1. To understand the concept of single degree of freedom vibrations.
2. To understand the concept of two degree of freedom vibrations.
3. To understand the concept of multi degree of freedom vibrations.
4. To determine the frequency domain vibration analysis.
5. To derive Raylegh's and Stodola's method.

REFERENCES:

1. Mechanical Vibrations/Groover/Nem Chand and Bros
2. Elements of Vibration Analysis by Meirovitch, TMH, 2001
3. Mechanical Vibrations/Schaum Series/ McGraw Hill
4. Mechanical Vibrations / SS Rao/ Pearson/ 2009, Ed 4,
5. Mechanical Vibrations/Debabrata Nag/Wiley
6. Vibration problems in Engineering / S.P. Timoshenko.
7. Mechanical Vibrations and sound engineering/ A.G.Ambekar/ PHI
8. Theory and Practice of Mechanical Vibrations/JS Rao & K. Gupta/New Age Intl.Publishers / Revised 2nd Edition

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

EXPERIMENTAL STRESS ANALYSIS

Course Objectives:

1. Understand the concept of strain measurement methods.
2. Understand the concept of static and data logging, dynamic recording.
3. Investigate the cracks by using brittle coating for crack patterns, ceramics and moiré fringe analysis.
4. Investigate the cracks by using photo elasticity, polariscope plane and circular polarized light.
5. Investigate the cracks by using 3-D photo elasticity for frozen stress methods.

UNIT-I

Introduction**,** Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations.

Strain measurement methods: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.

UNIT-II

RECORDING INSTRUMENTS: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

UNIT-III

BRITTLE COATINGS: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometarical approach to moiré-fringe analysis, the displacement field approach to Moire-fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of moiré-fringes, experimental procedure and techniques.

UNIT-IV

PHOTO ELASTICITY: Photo elasticity, polariscope, plane and circularly polarized light, bright and dark filed setup, photo elasticity materials,, Isochromatic fringes – Isoclinics.

UNIT-V

THREE DIMENSIONAL PHOTO ELASTICITY: introduction, locking in model deformation, materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method

Birefringent coating: Introduction, coating stress and stains, coating sensitivity, coating materials, application of coatings, effective of coating thickness, fringe-order determinations in coatings, stress separation methods.

Course Outcomes:

1. To introduced the concept of plain stress and plain strain and strain measurement methods.
2. To know the concept of recording instrument for static and data logging, dynamic recording.
3. To know the concept of brittle coating for crack patterns, ceramics and moirefringer analysis.
4. To understand the concept of photo elasticity, polariscope plane and circular polarized light.
5. To understand the concept of 3-D photo elasticity for frozen stress methods, stress separation method.

REFERENCES:

1. Theory of elasticity / Timoshenko and Goodier Jr.
2. Experimental Stress analysis/ Dally and Riley, Mc Graw-Hill
3. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
4. Photo Elasticity / Frocht/ Wiley / 3rd Edition Experimental Stress Analysis / Sadhu singh / Khanna Publications

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

PRESSURE VESSEL DESIGN

Course Objectives:

1. Understand the concept of Materials- shapes of Vessels –stresses in cylindrical spherical and arbitrary.
2. Understand the theory of rectangular plates and Theory of circular plates.
3. Evolute the concept of discontinuity stresses in pressure vessels and Pressure vessel materials.
4. Understand the concept of stress concentrations factors.
5. Give an overview of design features in cylindrical vessel, circular hole.

UNIT – I

Introduction, Materials- shapes of Vessels –stresses in cylindrical spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load bending and torque-ilation of pressure vessels –conical and tetrahedral vessels.

Theory of thick cylinders; Shrink fit stresses in built up cylinders – auto freltage of thick cylinders Thermal stresses in Pressure Vessels.

UNIT – II

THEORY OF RECTANGULAR PLATES : Pure bending – different edge conditions.

Theory circular plates: Simple support and clamped ends subjected to concentrated and uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.

UNIT – III

DISCONTINUITY STRESSES IN PRESSURE VESSELS: Introduction beam on an elastic foundation, infinitely long beam semi infinite beam, cylindrical vessel under axially symmetrical loading, extent and significance of load deformations on pressure vessels, discontinuity stresses in vessels, stresses in a bimetallic joints, deformation and stresses in flanges.

Pressure vessel materials and their environment : Introduction ductile material tensile tests, structure and strength of steel Leuder's lines determination of stress patterns from plastic flow observations, behavior of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels fracture types in tension. Toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue erack growth fatigue life prediction cumulative fatigue damage stress theory of failure of vessels subject to steady state and fatigue conditions.

UNIT IV

STRESS CONCENTRATIONS: Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life thermal stress fatigue creep and rupture of metals at elevated temperatures, hydrogen embitterment of pressure vessel steels brittle fracture effect of environment on fracture toughness, fracture toughness relationships criteria for design with defects, significance of fracture mechanics evaluations, effect of warm prestressing on the ambient temperature toughness of pressure vessel steels.

UNIT V;

DESIGN FEATURES: Localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subject to tension, elliptical openings, stress concentration, stress concentration factors for position , dynamic and thermal transient conditions, theory of reinforced openings and reinforcement, placement and shape fatigue and stress concentration.

Course Outcomes:

1. To know the concept of Materials- shapes of Vessels –stresses in cylindrical spherical and arbitrary.
2. To study the theory of rectangular plates and Theory of circular plates.
3. To understand the concept of discontinuity stresses in pressure vessels and Pressure vessel materials and their environment.
4. To understand the concept of stress concentrations factors.
5. To know the concept of design features in cylindrical vessel, circular hole and elliptical openings.

REFERENCES:

1. Theory and design of modern Pressure Vessels / John F. Harvey 'Van/ Nostrand Reihold company / New York.
2. Pressure Vessel Design and Analysis / Bickell M. B. Ruizes / Macmillan Publishers
3. Process Equipment design / Beowll & Yound Ett.
4. Indian standard code for unfired Pressure vessels IS 2825.
5. Pressure Vessels Design Hand Book Henry H. Bednar PE / CB S Publishers / New Delhi.
6. Theory of plates and shells / Timoshenko& Noinosky / Dover Publications.
7. Stress in Beams, Plates and Shells / Ansel C. Ugural / CRC Press / 3rd Edition.

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

DESIGN SYNTHESIS

Course Objectives:

1. Give an overview of Design process and methodologies of systematic design conceptual design variants.
2. Understand the concept of Tolerance from process and function.
3. Give an overview of forged sheet metal parts and welded constructions machine considerations.
4. Understand the concept of design for assembly.
5. Analyze the concept of problems formulation for design optimization

UNIT – I

Design process and methodologies of systematic design conceptual design variants and evaluation Standardization and its exploitation in design.

UNIT – II

Tolerance from process and function, interchangeability and selective assembly, selection of fits for different design situations, surface finish.
Load transmission, load equalization light weigh and rigid constructions.

UNIT – III

Design of case, forged sheet metal parts and welded constructions Machine considerations.

UNIT – IV

Design for assembly and dismantling Modular constructions erection, operation inspection and maintenance considerations, Ergonomics Design of accuracy Location pins and registers, Machining in assembly, adjustment, Backlash and Clearance adjustment.

UNIT – V

Problems formulation for design optimization Example illustration the various principles available design variants for some of the common basic functional requirements.

Course Outcomes:

1. To study the Design process and methodologies of systematic design conceptual design variants.
2. To understand the concept of Tolerance from process and function,
3. To know the concept of design of case, forged sheet metal parts and welded constructions machine considerations.

4. To know the concept of design for assembly and dismantling modular constructions erection.
5. To understand the concept of problems formulation for design optimization

REFERENCES:

1. Engineering Design a systematic approach/ G. Phal W. Beitz/ Springer /3rd Edition
2. Engineering Design a material and processing approach/ George Dieter/ McGraw Hi8ll international book company 1983
3. Mechanical Design Theory Methodology/ Manjula B. Waldron and Kenneth J. Waldron/ Springer Verlag New York 1996.

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

INDUSTRIAL ROBOTICS

Course Objectives:

1. Give over view on automation, anatomy configuration, motion joints, drive systems for a robots.
2. Evaluate the motion analysis and control systems for robot.
3. Analyze the end effectors and machine vision for robot .
4. Know the concepts on robot programming languages.
5. Understand the working principle of cell design, control and application of robot.

UNIT - I

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

CONTROL SYSTEM AND COMPONENTS: basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

ROBOT LANGUAGES: Textual robot Languages, Generation, Robot language structures, Elements in function.

UNIT - V

ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller.

ROBOT APPLICATION: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

Course Outcomes:

1. To know and understand about automation, anatomy configuration, motion joints, drive systems for a robots.
2. To know and understand the motion analysis and control systems for robot.
3. To know and understand about the end effectors and machine vision for robot .
4. To write and understand about the robot programming languages.
5. To understand the working principle of cell design, control and application of robot .

REFERENCES:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control / J J Craig/ Pearson / 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall
5. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.
7. Robotics and Control / Mittal R K & Nagrath I J / TMH

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

MECHATRONICS

Course Objectives:

1. Performs the levels of systems, design process, measurement, control system, micro process-based controller of mechatronics systems.
2. Introduce the concepts on PN-junction diode, BJT, FET,DIA &TRIAC
3. Understand about the hydraulic, pneumatic, mechanical and electrical actuating systems.
4. Understand about the digital electronic, logic control, micro processes and PLC
5. Analyze the general design guide line for manual assembly processing.

UNIT-I

Mechatronics systems, elements, levels of Mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of Mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT-II

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

UNIT-III

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems:
Mechanical actuating systems and electrical actuating systems.

UNIT-IV

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-V

System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of Mechatronics systems & future trends.

Course Outcomes:

1. To know and understand about the levels of systems, design process, measurement, control system, micro process-based controller of mechatronics systems.
2. To know and understand about PN-junction diode, BJT, FET,DIA &TRIAC .

3. To understand about the hydraulic, pneumatic, mechanical and electrical actuating systems.
4. To understand about the digital electronic, logic control, micro processes and PLC
5. To know the general design guide line for manual assembly processing.

REFERENCES:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
4. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
5. Mechatronics System Design / Devdas shetty/Richard/Thomson.
6. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
7. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton
8. Mechatronics – Principles and Application Godfrey C. Onwubolu, Elsevier, 2006 Indian print

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

COMPUTATIONAL FLUID DYNAMICS

Course Objectives:

1. Explain the differential equations for flow phenomena and numerical methods for their solution
2. Critically analyze different mathematical models and computational methods for fluid flow and heat transfer simulations
3. Solve computational problems related to fluid flows and heat transfer.
4. Analyze the accuracy of a numerical solution by comparison to known solutions of simple test problems and by mesh refinement studies
5. Evaluate forces in both internal and external flows. Use and develop flow simulation software for the most important classes of flows in engineering and science.

UNIT – I

INTRODUCTION: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT - II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - III

FORMULATIONS OF INCOMPRESSIBLE VISCOUS FLOWS: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods. **Treatment of compressible flows:** potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT - IV

FINITE VOLUME METHOD: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT - V

STANDARD VARIATIONAL METHODS: Linear fluid flow problems, steady state problems, Transient problems.

Course Outcomes:

1. To Explain the differential equations for flow phenomena and numerical methods for their solution
2. To Critically analyze different mathematical models and computational methods for fluid flow and heat transfer simulations
3. To Solve computational problems related to fluid flows and heat transfer.
4. To Analyze the accuracy of a numerical solution by comparison to known solutions of simple test problems and by mesh refinement studies
5. To Evaluate forces in both internal and external flows. Use and develop flow simulation software for the most important classes of flows in engineering and science

REFERENCES:

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
4. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications
5. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
6. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
7. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University Press/2nd Edition

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

THEORY OF PLATES AND SHELLS

Course Objectives:

1. Determine the Slope and curvature of slightly bent plates
2. Know the concept of symmetrical bending of circular plates
3. Analyze the Rectangular plates with various edge conditions
4. Study the concept of Approximate design of continuous plates with equal spans
5. Understand the concept of general theory of cylindrical shells

UNIT -I

BENDING OF LONG RECTANGULAR PLATES TO A CYLINDRICAL SURFACE: Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported edges - Cylindrical bending of uniformly loaded rectangular plates with built-in edges

Pure bending of plates: Slope and curvature of slightly bent plates - Relations between bending moments and curvature in pure bending of plates - Particular cases of pure bending - Strain energy in pure bending of plates.

UNIT -II

SYMMETRICAL BENDING OF CIRCULAR PLATES: Differential equation for symmetrical bending of laterally loaded circular plates - Uniformly loaded circular plates - Circular plate with a circular hole at the center - Circular plate concentrically loaded - Circular plate loaded at the center.

Small deflections of laterally loaded plates: The differential equation of the deflection surface - Boundary conditions - Alternate method of derivation of the boundary condition - Reduction of the problem of bending of a plate to that of deflection of a membrane

UNIT -III

SIMPLY SUPPORTED RECTANGULAR PLATES: Simply supported rectangular plates under sinusoidal load - Navier solution for simply supported rectangular plates.

Rectangular plates with various edge conditions: Bending of rectangular plates by moments distributed along the edges - Rectangular plates with two opposite edges simply supported and the other two edges clamped.

UNIT -IV

CONTINUOUS RECTANGULAR PLATES: Simply supported continuous plates - Approximate design of continuous plates with equal spans - Bending symmetrical with respect to a center.

Deformation of shells without bending: Definition and notation - Shells in the form of a surface of revolution and loaded symmetrically with respect to their axis - Particular cases of shells in the form of surfaces of revolution - Shells of constant strength.

UNIT -V

GENERAL THEORY OF CYLINDRICAL SHELLS: A circular cylindrical shell loaded symmetrically with respect to its axis - Particular cases of symmetrical deformation of circular cylindrical shells - Pressure vessels.

Course Outcomes:

1. To determine the Slope and curvature of slightly bent plates
2. To know the concept of symmetrical bending of circular plates
3. To analyze the Rectangular plates with various edge conditions
4. To study the concept of Approximate design of continuous plates with equal spans
5. To understand the concept of general theory of cylindrical shells

REFERENCES:

1. Theory of Plates and Shells / Timoshenko, S. and Woinowsky-Krieger, S/McGraw Hill
2. Stress in Beams, Plates and Shells / Ansel C. Ugural / CRC Press / 3rd Edition.

ANURAG ENGINEERING COLLEGE

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M.Tech I Year II Sem (MD)

ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATION

Course Objectives:

1. Determine the single variable 1-D optimization methods, unimodal function quadratic and cubic interpolation method.
2. Understand the multivariable non-linear unconstrained optimization for Powell's Hook jeevs Rosen rock search method, gradient method.
3. Evolute the multistage desion process principle of optimality.
4. Analysis the change in the constraints cost co-efficient and co-efficient constraints
5. Evolute the constraints by using Gomory cutting plane method.

UNIT- I

SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMITION: One dimensional Optimization methods:- Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation 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.

Course Outcomes:

1. To determine the single variable I-D optimization methods, unimodal function quadratic and cubic interpolation method.
2. To understand the multivariable non-linear unconstrained optimization for Powell's Hookjeevs Rosen rock search method, gradient method.
3. To understand the multistage desion process principle of optimality.
4. To analysis the change in the constraints cost co-efficient and co-efficient constraints
5. To determine the basic concept of Gomory cutting plane algorithm.

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

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M.Tech I Year II Sem (MD)

SIGNAL ANALYSIS AND CONDITION MONITORING

Course Objectives:

1. Analyze on maintenance strategies to various problems in the industrial sectors.
2. Analyze for machinery condition monitoring and explain how this compliments monitoring the condition.
3. Develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
4. Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
5. Identify vibration measurement, lubrication oil analysis.

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.

Course Outcomes:

1. To understand the maintenance scheme, their scope and limitations – apply the maintenance strategies to various problems in the industrial sectors.
2. To analyze for machinery condition monitoring and explain how this compliments monitoring the condition.
3. To develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
4. To Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
5. To identify vibration measurement, lubrication oil analysis.

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

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

M.Tech I Year II Sem (MD)

COMPUTER AIDED TESTING AND MODELING LABORATORY

Course Objectives:

1. Identify the microstructure for ferrous, non-ferrous and its analysis.
2. Design and analyze the modeling of surface solid drafting and assembling system
3. Analysis the various structures by using a FEA packages.

TESTING:

1. Preparation and study of the Micro Structure of ferrous metals and alloys.
2. Preparation and study of the Microstructure of nonferrous metals and alloys.
3. Effect of tempering time on the hardness of quenched carbon steels.
4. Effect of tempering temperature on the hardness of a hardened carbon steels.

MODELING:

1. Surface modeling.
2. Solid modeling.
3. Drafting.
4. Assembling.

Course Outcomes:

1. To know and study of the microstructure for ferrous, non-ferrous and its analysis.
2. To know and modeling of surface, solid drafting and assembling system.
3. To analysis the various structure by using a FEA packages.