ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
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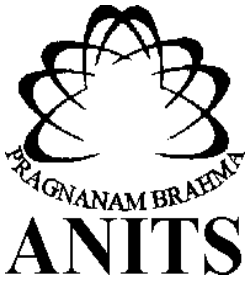

Mechanical Engineering Department

Vision and Mission of ANITS

Vision

ANITS envisions to emerge as a world-class technical institution whose products represent a good blend of technological excellence and the best of human values.

Mission

To train young men and women into competent and confident engineers with excellent communicational skills, to face the challenges of future technology changes, by imparting holistic technical education using the best of infrastructure, outstanding technical and teaching expertise and an exemplary work culture, besides molding them into good citizens.

Foreword
by Principal

MECHANICAL ENGINEERING DEPARTMENT – ANITS

The Genesis and Growth:

The Mechanical Engineering Department of ANITS was started in the academic year 2005-06 with an intake of 60 for B Tech programme and the present in-take is 210. The department also offers M Tech (Machine Design) and the in-take is 18. The department is autonomous and NBA accredited.

The Human resources and Infrastructure:

The department is presently having 37 highly qualified faculty members who are having rich academic and industrial experience. To make teaching and learning processes more effective, 1:15 faculty student ratio is being maintained in the department since inception. The department posses best infrastructure facilities in various labs like Workshop, Strength of Material lab, Thermal Engineering lab, Industrial engineering lab, Metrology lab, Manufacturing Technology lab, Fluid Mechanics lab, CAD/CAM Lab, Heat transfer lab, Mechatronics Lab and Experimental stress analysis lab. To serve the student needs beyond curriculum and make them industry ready, additional experiments are being conducted in the labs and softwares were installed which are beyond the prescribed syllabus.

The faculty strongly believe that for disseminating knowledge to the students and to make them abreast with latest developments, good research activities are the need of the day along with regular teaching. About 60 papers were published by the faculty in various international peer reviewed journals and Conferences in the last 2 years. Faculty are dynamic and regularly upgrade their skills by attending various workshops and seminars. The departments activities and infrastructure are being further improved with funding from agencies like AICTE, UGC etc., under various schemes like MODROBS, Travel grants and Seminar grants.

The students and the outcomes:

Due to the subtle efforts of faculty and the infrastructure available, the department attracts students of good EAMCET ranks in this region. The academic performance of the students is also a matter of prestige to the department as it stands first amongst all the affiliated colleges of Andhra University on the basis of student pass percentage. Special impetus is given to students to improve their managerial skills. They are motivated to organize various events in the department by themselves which includes national seminars and technical symposiums. They

are also encouraged to participate in various events organized by reputed colleges and have won many prizes every year bringing laurels to the department.

To make the students aware of latest technologies and also industrial needs, guest lectures by eminent persons from academics and industry, industrial visits etc., are being organized regularly in the department. Apart from this, Mechanical Engineering department has started ISHRAE {Indian Society for Heating, Refrigerating and Air Conditioning Engineers} student chapter in 2009, IE student chapter in 2013 and COMSOI chapter in 2014-15 which organizes various industry oriented programs in the field of Refrigeration & Air Conditioning and other technical knowledge related activities . The department is also having entrepreneurship development cell (EDC) and encourages for start-ups and motivates the students to become entrepreneurs.

Vision

ANITS, Mechanical Department envisages to become a premier centre of learning for knowledge seekers with state of art laboratories, research facilities and highly competent luminaries in the faculty ranks.

Mission

- To make our students competent and build their career upon a solid foundation of knowledge.
- To make our students future leaders for industry, academia and society whose ideas are based on fundamental knowledge, analytical skills, creativity and ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO - 1 To enable the students to address the challenges faced in mechanical and other allied streams with a solid foundation on the principles of mechanical engineering, mathematics, sciences and with good knowledge in modern computational, analytical and simulation tools and techniques.

PEO -2 To educate the students to design, construct, manage and develop mechanical engineering systems with a research orientation, in a way such that the systems are strong technically, viable economically and accepted socially to enhance quality of life.

PEO - 3 To enable the students to communicate effectively to excel in their profession, pursue life-long learning, good at teamwork and adhere to ethics to achieve their career and organizational goals.

PROGRAMME OUTCOMES (POs)

PO-1 An ability to independently carry out research /investigation and development work to solve practical problems.

PO-2 An ability to write and present a substantial technical report/document.

PO-3 Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1 Student will be able to design and develop mechanical components and system, innovate, conduct research on latest advancements in the field of Mechanical Engineering and allied industry for the society betterment.

ACADEMIC REGULATIONS FOR M.TECH PROGRAMME UNDER AUTONOMOUS STATUS

I. Admissions:

Admissions into first year of M.Tech Programme of the Institute will be as per the norms stipulated by Andhra University & Andhra Pradesh State Council for Higher Education (APSCHE), Govt. of Andhra Pradesh.

II. Programmes Offered:

The following are the M.Tech. Programmes offered by the Institute:

01. Food Processing Technology - Chemical Engineering Department
02. Soil Mechanics - Civil Engineering Department
03. Data Science - CSE (AI&ML, DS) Department
04. AI&ML - CSE (AI&ML, DS) Department
05. VLSI & Embedded Systems - ECE Department
06. Control Systems - EEE Department
07. Machine Design - Mechanical Engineering Department

III. Structure of The M. Tech. Programme:

The normal duration of the course is 2 academic years for M.Tech Degree. Candidates should pursue a regular course of study, as detailed below, for not less than two academic years which consists of 4 semesters and should fulfill the academic requirements and pass all the prescribed examinations for the award of the degree.

The curriculum of M.Tech programme is designed to have a total of about 80 credits of which a student should acquire a minimum of 74 credits to get the degree awarded. If a student earns all the total credits, then the best 74 credits are considered to determine the final CGPA. However, the credits which a student can forego will be in accordance with the mandatory courses and electives offered by the individual departments.

IV. Duration of the Programme:

The duration of the programme is 2 academic years consisting of 2 semesters in each academic year. A student is permitted to complete the Programme in a stipulated time frame of 4 consecutive academic years from the date of initial admission and if fails will forfeit his seat in M. Tech Programme.

V. Medium of Instruction:

The medium of instruction and examination is English.

VI. Minimum Instruction Days:

Each semester normally consists of a minimum of 16 weeks of instruction.

VII. Academic Calendar:

The dates of all important events, such as commencement of class work, examinations, vacations, etc., during the academic year will be specified in the Academic Calendar of the Institute, as approved by the Academic Council.

VIII. Examinations & Evaluation Process:

The performance of a student in each semester shall be evaluated course-wise with a maximum of 100 marks each for theory and practical courses.

(a) Theory Course:

For all lecture based theory courses, the assessment shall be for 40 marks through internal evaluation and 60 marks through external semester-end examination of three hours duration.

The sessional marks shall be awarded through internal evaluation by the teachers concerned based on the continuous assessment which includes class tests, quiz, viva-voce, assignments, student regularity, two mid-examinations etc., according to a scheme notified by the department at the beginning of the semester.

Out of the 40 internal evaluation marks, 20 marks are assigned for 2 internal-mid exams, 10 marks are assigned for assignments, 5 marks are assigned for projects/ case studies

/quiz/tests and 5 marks are assigned for attendance. The average of 2 internal-mid exams is considered for the 20 marks allocated.

Under any circumstances, no re-examination shall be conducted for the internal mid examinations.

ii) External evaluation:

The question paper shall be set externally and the answer scripts are valued through a double valuation system.

The average of the two valuations will be taken for award of marks. In case, the difference of the marks obtained in the two valuations is more than 20% then a third examiner shall value the script. Out of the three valuations, the average of marks obtained in third valuation and the marks obtained nearer to third valuation out of first two valuations shall be considered. No revaluation for any subject/course shall be entertained as already double valuation system is in existence. However, recounting is allowed on the request of the candidate on payment of specified fee. Challenge valuation shall also be entertained on payment of specified fee.

(b) Laboratory Course:

Each student will perform about 10 to 12 experiments in each laboratory course. Laboratory course will be evaluated for 100 marks, out of which 50 marks are for external examination and 50 marks are for internal evaluation. The internal marks are awarded based on continuous assessment, record work, internal lab examination and student regularity. The external examination will be conducted by two examiners, one of them being laboratory class teacher as internal examiner (nominated by the Principal on recommendation of HOD) and an external examiner nominated by the Principal from the panel of experts recommended by the HOD.

A candidate shall be declared to have passed in any theory subject/course if he secures not less than 40% in external theory examination and also a minimum of 50% of total marks of that course which assures a minimum of 'E' grade.

A candidate shall be declared to have passed in any practical course if he secures not less than 50% of total marks of that course which assures a minimum of 'E' grade.

Any student appearing for the semester-end practical examination is eligible only if he submits the bonafide record certified by the laboratory class teacher and the HOD.

(C) Thesis Work:

The thesis work shall be carried out in two semesters of one full academic year. The students will be allotted for thesis by the Department committee to various faculty members who act as guides. However, a student can carry-out his thesis work either in the Department or in any other industry / research institute. In any such request to carryout thesis work outside the college, the permission of the Principal and an internal guide is mandatory. Such students should report to the internal guide once in a week essentially through mail or other communication.

The progress report of such work is to be submitted by the guide/external guide every month to the HOD. If the work is not found satisfactory, the HOD has the right to call back the student with the permission of the Principal. In any case the time and conditions for submission of the thesis will be same as for the regular candidates working in the college.

The third semester work is evaluated internally by the committee nominated by the HOD consisting a minimum of four members (concerned in area of specialization) including the HOD. If the work is not satisfactory, the candidate has to improve to the satisfaction of the committee within one month from the end of the semester to carry on his fourth semester work. If he fails to satisfy the committee in the second attempt he has to get readmitted into the third semester as per college norms. The grades will be awarded just as in the case of laboratory work. An internal viva voce by a committee nominated by the HOD is a prerequisite for the submission of the thesis. The fourth semester evaluation will be done through the viva voce examination on the thesis by a board consisting of the following four examiners after submission of the thesis by the candidate duly certified by the Guide and the HOD.

1. The Head of the Department as Chairman
2. Senior Professor in the Department
3. Internal Guide and External Guide (if any)
4. External examiner nominated by the Principal from a panel recommended by the HOD.

The panel of the external subject experts shall be submitted to the Principal by the HOD in mutual consent with the guide and other subject experts of the Department.

The valuation of the thesis shall be as specified in the scheme of examination of the laboratory course.

If the candidate fails in the viva voce examination of the thesis he has to reappear for the viva voce. The candidate has to bear the charges for re-conducting the viva voce.

The prerequisite for submission of the M.Tech. thesis is that one should have published a paper in a reputed international journal/ proceedings of an annual conference.

IX. Attendance Regulations:

Attendance of a student is computed by considering total number of periods conducted in all courses as the denominator and the total number of periods actually attended by the student in all courses, as the numerator. It is desirable for a student to put in 100% attendance in all the subjects. However, a candidate shall be permitted to appear for the semester end examination provided he/she maintains a minimum of 75% overall attendance in the semester.

The shortage of attendance on medical grounds can be condoned up to a maximum of 9% provided the student puts in at least 66% attendance and provided the Principal is satisfied with the genuineness of the reasons. The Medical Certificates are to be submitted to the Head of the Department when the candidate reports to the classes immediately after the leave. Certificates submitted afterwards shall not be entertained.

Condonation fee as fixed by the college for those who put in attendance between ≥ 66% and <75% shall be charged before the semester-end examinations.

In the case of students who participate in co-curricular, extra-curricular activities like student seminars, N.S.S, N.C.C, Inter-collegiate tournaments and any such other activities involving the representation of the Institute, with the prior approval of the Principal, the candidate may be deemed to have attended the classes during the actual period of such activity, solely for the purpose of attendance.

A student, who could not satisfy the minimum attendance requirement of 66% in any semester, shall be declared 'Detained'. He/she is not eligible to appear for the semester end examinations. He will not be promoted to the next semester and shall have to repeat that semester with the next batch(es) of students. Such students who are detained and seek readmission, should submit undertaking/declaration that they will abide by the regulations existing at the time of readmission.

X. Minimum Academic Requirements:

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item No. IX.

- A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory subject if only he secures not less than 40% marks in the semester-end examination and a minimum of 50% marks in the sum of the internal evaluation and semester-end examination taken together. In the labs/projects, the student should secure a minimum of 50% marks in the external examination and a minimum of 50% marks in the sum of internal evaluation and external examination evaluation taken together.

- A student will be promoted to the next semester, if only he satisfies the minimum attendance requirement.
- Students, who fail to complete their two year course study within Four academic years from the year of their admission or fail to acquire the credits stipulated for the course shall forfeit their seat in M. Tech course and their admission shall stand cancelled.

XI. Award Of Grades:

The absolute grading system is adopted as follows:

S.No.	Range of Marks {%}	Grade	Description	Grade Points
1	90-100	O	Outstanding	10
2	80-89	A	Excellent	9
3	70-79	B	Very Good	8
4	60-69	C	Good	7
5	55-59	D	Fair	6
6	50-54	E	Satisfactory	5
7	49 and below	F	Fail	0
8	The grade 'I' represents absent (subsequently changed into pass or higher grades.)	I	Absent	0

The performance of a student at the end of the each semester is indicated in terms of Semester Grade Point Average (SGPA). The SGPA is calculated as below:

$$\text{SGPA} = \frac{\Sigma \text{ (Credits of a course x Grade points awarded for a course)}}{\Sigma \text{ (Credits of a course)}}$$

SGPA is calculated for the candidates who have passed in all the courses in that semester.

Cumulative Grade Point Average (CGPA) will be calculated from II semester onwards up to the final semester and its calculation is similar to that of SGPA, considering all the courses offered from the first semester onwards.

CGPA is calculated for those who clear all the courses in all the previous semesters.

XII. Award of Class:

For the award of class, a total of best 74 credits are considered. A candidate, who becomes eligible for the award of M.Tech. Degree, shall be placed in one of the following classes.

S.No.	Class	CGPA
1	First Class with Distinction	7.5 or more*
2	First Class	6.5 or more but less than 7.5
3	Second Class/Pass	5.0 or more but less than 6.5

***First class with Distinction will be awarded only to those students who clear all the subjects of the program in first attempt of regular examinations.**

The CGPA can be converted to aggregate percentage by multiplying CGPA with 10, in case of requirement by any other university or for any other purpose.

XIII. Eligibility for Award of M.Tech. Degree:

A student shall be eligible for the award of the M.Tech degree if he/she fulfils all the following conditions:

1) Registered and successfully completed all the components prescribed for eligibility in the programme of study to which he/she is admitted within the stipulated period,
2) Obtained CGPA greater than or equal to 5.0 (Minimum requirement for Pass),
3) No disciplinary action is pending against him/her and
4) Has no dues to the Institute including hostels.

XIV. Malpractices:

The Controller of Examinations/Dean of Examinations shall refer the cases of suspected malpractices in mid examinations and semester-end examinations to Malpractice Enquiry Committee constituted by the Institute. Such committee shall follow the approved scales of punishment. The Principal shall take necessary final action against the erring students based on the recommendations of the committee.

XV. Amendments to Regulations:

The Institute may, from time to time, revise, amend, or change the Regulations, Schemes of Examinations, and / or Syllabi and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Institute.

XVI. General:

(i) Where the words 'he', 'him', 'his', occur in the regulations, they include 'she', 'her', 'hers'.

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

(iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

R-23 COURSE STRUCTURE

M TECH (Machine Design)

DEPT. OF MECHANICAL ENGINEERING: ANITS

I Year – I Semester

Course Code	Title of the Course	Category	Periods per week			Max. marks		Total Marks	Credits
			L	T	P	Sess.	End Exam		
23MD111	Theory of Elasticity & Plasticity	PC	3	0	0	40	60	100	3
23MD112	Mechanics of Machinery	PC	3	0	0	40	60	100	3
23MD113	Professional Elective – I	PE	3	0	0	40	60	100	3
23MD114	Professional Elective – II	PE	3	0	0	40	60	100	3
23MD115	Research Methodology & IPR	MC	3	0	0	40	60	100	3
23MD116	CAD Lab	PC	0	0	4	50	—	50	2
23MD117	Seminar-I	SC	0	0	2	50	—	50	1
23MD118	Constitution of India	Audit	2	0	0	50	—	50	0
	Total		**17**	**0**	**6**	**350**	**300**	**650**	**18**

I Year – II Semester

Course Code	Title of the Course	Category	Periods per week			Max. marks		Total Marks	Credits
			L	T	P	Sess.	End Exam		
23MD121	Mechanical Vibrations	PC	3	0	0	40	60	100	3
23MD122	Instrumentation & Experimental StressAnalysis	PC	3	0	0	40	60	100	3
23MD123	Advanced Finite Element Analysis	PC	3	0	0	40	60	100	3
23MD124	Professional Elective – III	PE	3	0	0	40	60	100	3
23MD125	Professional Elective – IV	PE	3	0	0	40	60	100	3
23MD126	Instrumentation & Experimental Stress Analysis Lab	PC	0	0	4	50	—	50	2
23MD127	Seminar-II	SC	0	0	2	50	—	50	1
23MD128	English for Research Paper Writing	Audit	2	0	0	50	—	50	0
	Total		**17**	**0**	**6**	**350**	**300**	**650**	**18**

Professional Elective–I:	A. Integrated Computer Aided Design C. Fatigue, Creep & Fracture Mechanics	B. Pressure Vessel Design D. Design Engineering
Professional Elective–II:	A. Robotics C. Advanced Optimization Techniques	B. Computational Methods in Engg. D. Vehicle Dynamics
Professional Elective–III:	A. Advanced Mechanics of Solids C. Computational Fluid Dynamics	B. Mechatronics D. Tribology
Professional Elective – IV:	A. Gear Engineering C. Condition Monitoring & Signal analysis	B. Reliability Engineering D. Composite Materials

II Year – I Semester

Course Code	Title of the Course	Category	Periods per week			Total	Max. marks		Total Marks	Credits
			L	T	P		Sess.	End Exam		
23MD211	MOOCs-I	OE	0	0	0	0	100	—	100	3
23MD212	MOOCs-II	OE	0	0	0	0	100	—	100	3
23MD213	Dissertation Phase-I	PR	0	0	20	20	100	—	100	10
Total			**0**	**0**	**20**	**20**	**300**	**—**	**300**	**16**

II Year – II Semester

Course Code	Title of the course	Category	Periods per week			Total	Max. Marks		Total Marks	Credits
			L	T	P		Sess.	End Exam		
23MD221	Dissertation Phase-II	PR	0	0	32	32	100	100	200	16
Total			**0**	**0**	**32**	**32**	**100**	**100**	**200**	**16**

The prerequisite for submission of the M Tech thesis is that one should communicate his/her work to any referredjournal or Publication in a conference/journal.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

THEORY OF ELASTICITY AND PLASTICITY

Course Code: 23MD111	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the classical theory of linear elasticity for two and three dimensional state of stress and obtain solutions for selected problems in rectangular and polar coordinates as well as torsion of prismatic bars.
- To understand the plastic stress strain relations, criteria of yielding and elasto- plastic Problems.

COURSE OUTCOMES:

The students will be able to:

CO 1	Form various equations to study the effect of forces on two dimensional and three dimensional type problems.
CO2	identify the stresses induced in curved bars, rings by considering the stresses induced in the polar coordinate system
CO3	Write down stress-strain and displacement components equations in rectangular and polar coordinate system for various types of problems.
CO4	Understand the concepts of plastic deformation of metals, Creep.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

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.

UNIT-II:

Problems in polar coordinates - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

Analysis of stress and strain in three dimensions - Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.

UNIT-III:

General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

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.

REFERENCE BOOKS:

1. Theory of Elasticity by Timoshenko, S.P. and Goodier, J.N.
2. An Engineering Theory of Plasticity by E.P. Unksov.
3. Applied Elasticity by W.T. Wang.
4. Theory of Plasticity by Hoffman and Sacks.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

MECHANICS OF MACHINERY

Course Code: 23MD112	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make the students to understand synthesis and analysis of complex mechanisms and concepts of cam dynamics.

COURSE OUTCOMES

The student will be able to

CO 1	Determine velocity and acceleration of various components in complex mechanisms by applying graphical and analytical methods
CO 2	Understand the concepts of synthesis and use it for the design of mechanical systems
CO 3	Understand Cam dynamics and use it in designing of Cams

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

. **SYLLABUS**

UNIT-I:

Kinematics of complex mechanisms - Complex mechanisms, Low and high degree of complexity, Goodman's indirect acceleration analysis, Method of normal accelerations, Hall and Ault's auxiliary point method, Carter's method and comparison of methods.

UNIT-II:

Advanced kinematics of plane motion - The inflexion circle - Euler-Savary equation, Analytical and graphical determination of diameter of inflection circle - Bobbileier's construction, Collineation axis - Hartman's construction, Application of inflection circle to kinematic analysis - Polode curvature - General case and special case, Polode curvature in the four-bar mechanism - Coupler motion, Relative motion of the output and input links, Freudenstein's collineation axis theorem - Carter Hall circle, Circling-point curve (general case).

UNIT-III:

Introduction to synthesis (graphical methods) guiding a point through two, three and four distinct positions - Burmaster's curve, Function generation - Overlay's method, Path generation - Robert's theorem.

UNIT-IV:

Introduction to synthesis (analytical methods) - Freudenstein's equation - Precision point approximation - Precision derivative approximation - Method of components - Bloch synthesis.

UNIT-V:

Cam dynamics - Forces in rigid systems, Mathematical models, Response of a uniform - Motion undamped cam mechanism - Analytical method, Follower response by phase - Plane method - Position error, Jump, Crossover shock - Johnson's numerical analysis.

REFERENCE BOOKS:

1. Kinematics and Dynamics of Plane Mechanisms by J. Hirschhorn, McGraw Hill Book Co., 1962.
2. Theory of Mechanics by J.E. Shigley, McGraw Hill Book Co., 1961 .
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

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

PROFESSIONAL ELECTIVE-I A

INTEGRATED COMPUTER AIDED DESIGN

Course Code: 23MD113	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

To make students

- Learn advanced concepts of feature based modeling
- Understand the methods of representation of wireframe, surface, and solid modeling systems.
- Learn role of CAD in MDO (Multidisciplinary Design Optimization).
- Gain extensive hands-on experience with two commercial CAD systems to gain proficiency in using the systems at advanced levels, migrating and sharing data between systems, and applying the theory covered in this course.
- Understand the tools and techniques used to come up with a proper design
- Better communicate their design to an audience

COURSE OUTCOMES:

The students will be able to:

CO1	Develop capacity for creativity and innovation.
CO2	Apply knowledge of basic science and engineering fundamentals
CO3	Utilize systems approach to design and operational performance
CO4	Use appropriate techniques and resources
CO5	Conduct an engineering project

.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3
CO5	3	3	3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

UNIT-I

Fundamentals of CAD: Introduction, Design process, Application of computer for design, Creating the manufacturing database, Benefits of CAD, Design work station, CAD hardware.

UNIT-II

Geometric modeling: Geometric modeling techniques - Multiple view 2D input, Wire frame geometry, Surface models, Geometric entities - Curves and Surfaces, Solid modelers, Feature recognition.

Computer aided drafting: AutoCAD tools, 3D model building using solid primitives and boolean operations, 3D model building using extrusion, Editing tools, Multiple views: Orthogonal, Isometric.

UNIT-III

Visual realism: Shading solids, Coloring, Color models, Using interface for shading and coloring.

Graphic aids: Geometric modifiers, Naming scheme, Layers, Grids, Groups, Dragging and rubber banding.

UNIT-IV

Computer animation: Conventional animation, Computer animation - Entertainment animation,Engineering animation, Animation types, Animation techniques.

Mechanical assembly: Assembly modeling, Part modeling, Mating conditions, Generation of assembling sequences, Precedence diagram, Liaison-sequence analysis.

UNIT-V

Mechanical tolerancing: Tolerance concepts, Geometric tolerancing, Types of geometric tolerances, Location tolerances, Drafting practices in dimensioning and tolerancing, Tolerance analysis.

Mass property calculations: Geometrical property formulation - Curve length, Cross-sectional area, Surface area, Mass property formulation - Mass, Centroid, Moments of inertia, Property mapping. Properties of composite objects.

REFERENCE BOOKS:

1. CAD/CAM Theory and Practice by Ibrahim Zeid.
2. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill Publishing Company Ltd.
3. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover and Emory W. Zimmer, Jr.
4. Computer Integrated Design and Manufacturing by David D. Bedworth, Mark R. Henderson, Philip M. Wolfe.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

PROFESSIONAL ELECTIVE-I B
PRESSURE VESSEL DESIGN

Course Code: 23MD113	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

To make students:

- Develop an ability to apply knowledge of mathematics, science, and engineering.
- Develop an ability to design a pressure vessel system, component, or process to meet desired needs within realistic constraints.
- Develop an ability to identify, formulate, and solve engineering problems.
- Develop an ability to identify discontinuity stresses in pressure vessels.

COURSE OUTCOMES:

The students will be able to:

CO1	Analyze the stress and strain on cylindrical, spherical and arbitrary shaped shells subjected to internal pressure, wind load bending etc.
CO2	Understand the theory of Rectangular and circular plates subjected to pure bending and different edge conditions.
CO3	Understand the effect of stress concentration influencing various factors such as surface, thermal stress ,fatigue, creep ,hydrogen embrittlement of pressure vessels.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

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 frettage 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.

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 inflanges.

Unit-III

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 crack growth fatigue life. Prediction cumulative fatigue damage stress theory of failure of vessels subject to steady stateAnd 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.

REFERENCE BOOKS:

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

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

PROFESSIONAL ELECTIVE-I C
FATIGUE, CREEP AND FRACTURE MECHANICS

Course Code: 23MD113	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

To make students:

- Develop an ability to apply knowledge of mathematics, science, and engineering.
- Develop an ability to design a system, component, or process to meet desired needs within realistic constraints
- Develop an ability to identify the Crack growth in fracture mechanics.
- Develop an object or component subjected to creep and fluctuating loads.

COURSE OUTCOMES:

The students will be able to:

CO1	Analyze the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts.
CO2	Understand the Crack growth and Energy release rate and establishing a relationship between Crack tip stress and Displacement fields.
CO3	Design the welded structures subjected to fatigue with the use of fracture mechanics to supplement design rules with practical Examples.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

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.

REFERENCE BOOKS:

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

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

PROFESSIONAL ELECTIVE-I D

DESIGN ENGINEERING

Course Code: 23MD113	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

To develop the ability:

- To identify different design models, steps involved in it and he ability to apply the fundamentals of product design and manufacturing design techniques for metallic and non metallic parts along with material selection criteria in design.
- To gain knowledge of economic factors, human engineering, ergonomics, and value engineering and modern approaches in design.
- To find static failure theories, surface failures and fatigue strengths.

COURSE OUTCOMES:

The students will be able to:

CO1	Approach a design problem successfully, taking decisions when there is not a unique answer.
CO2	Devise a list of concepts for a design application using idea-generation techniques for product design, material selection and design for manufacturing along with their failures and fatigue strengths.
CO3	Use proficiently the economic factors, human engineering, ergonomics, and value engineering and modern approaches in design.

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CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

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, Product value, Product planning, product specifications, concept generation, concept selection, concept testing.

Design for manufacturing: Forging design, Casting design, Design process for non-metallic parts, Plastics, Rubber, Ceramic, Wood, Glass parts. 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.

REFERENCE BOOKS:

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

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-II A

ROBOTICS

Course Code: 23MD114	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To be familiar with the automation and brief history of robot and applications.
- To give the student familiarities with the kinematics of robots.
- To give knowledge about robot end effectors and their design.
- To give knowledge about various Sensors and their applications in robots.
- To learn about Robot Programming methods & Languages of robot.

COURSE OUTCOMES:

The students will be able to

CO 1	Define a robot and identify different robotics components.
CO 2	Describe different mechanical configurations of robot manipulators and undertake kinematics analysis of robot manipulators.
CO 3	Understand the importance of robot dynamics
CO 4	Equip with the automation and brief history of robot and applications.
CO 5	Familiar with robot end effectors and their design concepts.
CO 6	Equip with the principles of various Sensors and their applications in robots.
CO 7	Equip with the Programming methods & various Languages of robots.

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CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3
CO5	3		3	3
CO6	3		3	3
CO7	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

UNIT-I

Introduction: Transformations and kinematics: Historical development, A sense of mechanisms, Robotic systems, Classification of robots, Position, orientation and location of a rigid body, Mechanics of robot manipulators. Objectives, Homogeneous coordinates, Homogeneous transformations, Coordinate reference frames, some properties of transformation matrices, Homogeneous transformations and the manipulator: The position of the manipulator in space, moving the base of the manipulator via transformations, Moving the tool position and orientation.

UNIT-II

Position analysis of serial manipulators: Link parameters and link coordinate systems, Denavit-Hartenberg homogeneous transformation matrices, Loop-closure equations, Other coordinate systems, Denavit-Hartenberg method: Position analysis of a planar 3-DOF manipulator: Direct kinematics, Inverse kinematics, Method of successive screw displacements, Wrist centreposition.

UNIT-III

Position analysis of parallel manipulators: Structure classification of parallel manipulators, Denavit-Hartenberg method versus geometric method, Position analysis of a planar 3RRR parallel manipulator, Geometry, Inverse kinematics and Direct kinematics, Position analysis of a spatial orientation mechanism.

UNIT-IV

Jacobian analysis of serial manipulators: Differential kinematics of a rigid body, Differential kinematics of serial manipulators, Screw coordinates and screw systems, Manipulator Jacobian matrix.

UNIT-V

Trajectory generation: General considerations in path description and generation, Joint space schemes, Cartesian space schemes, Geometric problems with Cartesian paths, Path generation at run time, Description of paths, planning paths using the dynamic model, Collision-free path planning. Robot Programming: Robot languages: AL, AML, RAIL, RPL, VAL, Demonstration of points in space: Continuous path (CP), Via points (VP), Programmed points (PP).

REFERENCE BOOKS:

1. Robot Analysis - The Mechanics of Serial and Parallel Manipulators by Lung-Wen Tsai, John Wiley & Sons, Inc.

2. Introduction to Robotics - Mechanics and Control by John J. Craig, Addison-Wesley Longman Inc., 1999.

3. Robotic Engineering - An Integrated Approach by Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, Prentice-Hall of India Private Limited, 1994.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

PROFESSIONAL ELECTIVE-II B
COMPUTATIONAL METHODS IN ENGINEERING

Course Code: 23MD114	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make students familiar with the numerical methods for scientific and engineering computation.

COURSE OUTCOMES:

The students will be able to:

CO1	Discuss several important methods with widespread application for solving large system of equations.
CO2	Appraise the importance of eigen value problems in engineering sciences.
CO3	Analyze experimental data by fitting a polynomial or estimating the derivative or finding the integrals or performing Fourier analysis.
CO4	Prepare mathematical model for physical situations and numerically analyze the corresponding ordinary linear/nonlinear, initial/boundary value differential equations.
CO5	Prepare mathematical model for physical situations and numerically analyze the corresponding partial linear/nonlinear, initial value/ initial boundary value differential equations.

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CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	2		2	2
CO2	2		2	2
CO3	2		2	2
CO4	2		2	2
CO5	2		2	2

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

UNIT-I

Linear System of Equations: Gauss elimination method, Triangularization method, Cholesky method, Partition method, Error Analysis for Direct Methods. Iteration Methods: Jacobi Iteration Method, Gauss Seidel Iteration Method, SOR Method

UNIT-II

Eigenvalue and Eigen Vectors, Bounds on Eigen values, Jacobi Method for symmetric Matrices, Givens Method for Symmetric Matrices, Householders Method, Power Method

UNIT-III

Numerical differentiation: Introduction, Methods based on undetermined coefficients, Optimum choice of step length, Extrapolation Methods, Partial Differentiation Numerical Integration: Introduction, Open type integration rules, Methods based on undetermined coefficients: Gauss-Legendre, Gauss- Chebyshev, Romberg Integration. Double integration: Trapezoidal method, Simpson s method.

UNIT-IV

Numerical Solutions of Ordinary Differential Equations (Boundary Value Problem): Introduction, Shooting Method: Linear and Non Linear Second order Differential Equations.

UNIT-V

Numerical Solutions of Partial Differential Equations: Introduction, Finite difference Approximation to Derivatives. Laplace equation- Jacobi method, Gauss Seidel Iteration Method, SOR Method. Parabolic Equations, Iterative methods for Parabolic Equations, Hyperbolic equations.

REFERENCE BOOKS:

1. M.K. Jain, S.R.K. Iyengar and R.K.Jain, "Numerical Methods for Scientific and Engineering Computation", New Age International (P) Limited, Publishers, 4th edition, 2003.

2. S.S. Sastry, "Introductory Methods of Numerical Analysis", Prentice Hall India Pvt., Limited, 4th edition, 2009.

3. Samuel Daniel Conte, Carl W. De Boor, "Elementary Numerical Analysis: An Algorithm Approach", 3rd edition, McGraw-Hill, 2005.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

PROFESSIONAL ELECTIVE-II C

ADVANCED OPTIMIZATION TECHNIQUES

Course Code: 23MD114	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

The objective of the course is to provide students

- Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively;
- Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry;
- Skills in the use of optimization approaches and computer tools in solving real problems in industry;
- Ability to develop mathematical models for analysis of real problems in optimization

COURSE OUTCOMES:

The students will be able to:

CO1	Recognize the importance and value of optimization and mathematical modeling in solving practical problems in industry.
CO2	Formulate a managerial decision problem into a mathematical model.
CO3	Understand optimization models and apply them to real-life problems.
CO4	Use computer tools to solve a mathematical model for a practical problem.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

UNIT I

Geometric programming (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P), Complementary Geometric Programming (C.G.P)

UNIT II

Dynamic programming(D.P): Multistage decision processes. Concepts of sub optimization and Principal of optimality, computational procedure in dynamic programming calculus method and tabular methods. Linear programming as a case of D.P. and continuous D.P.

UNIT III

Integer programming(I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Branch-and-bound method, Sequential linear discrete Programming, Generalized penalty function method.

UNIT IV

Stochastic Programming (S.P.): Basic Concepts of Probability Theory, Stochastic Linear programming.

UNIT V

Non-traditional optimization techniques: Multi-objective optimization - Lexicographic method, Goal programming method, Genetic algorithms, Simulated annealing, Neural Networks based Optimization.

REFERENCE BOOKS:

1. Operations Research- Principles and Practice by Ravindran, Phillips and Solberg, John Wiely
2. Introduction to Operations Research by Hiller and Lieberman, Mc Graw Hill
3. Engineering Optimization - Theory and Practice by Rao, S.S., New Age International (P) Ltd. Publishers.
4. Engineering Optimization By Kalyanmanai Deb, Prentice Hall of India, New Delhi.
5. Genetic Algorithms - In Search, Optimization and Machine Learning by David E. Goldberg, Addison-Wesley Longman (Singapore) Pvt. Ltd.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

PROFESSIONAL ELECTIVE-II D

VEHICLE DYNAMICS

Course Code: 23MD114	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make the students understand the intricacies of vehicle dynamics and apply them for road safety and ride comfort.

COURSE OUTCOMES

The student will be able to

CO 1	Understand the mechanisms of pneumatic tyres
CO 2	Understand performance, handling, stability and ride characteristics of road vehicles.

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CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

UNIT-I:

Introduction to Vehicle Dynamics: Various kinds of vehicles, Motions, Mathematical modelling methods, Multibody system approach, Lagrangian formulations, Methods of investigations, Stability concepts.

UNIT-II:

Mechanics of pneumatic tyres: Tyre construction, SAE recommended practice, Tyre forces and moments, Rolling resistance of tyres, Tractive effort and longitudinal slip, Cornering properties of tyres, Performance of tyre traction on dry and wet surfaces, Ride properties of tyres.

UNIT-III:

Performance characteristics of road vehicle: Equation of motion and maximum tractive effort, Aerodynamic forces and moments, Vehicle power plant and transmission characteristics, Prediction of vehicle performance, Operating fuel economy, Braking performance.

UNIT-IV:

Handling and stability characteristics of road vehicles: Steering geometry, Steady state handling characteristics, Steady state response to steering input, Testing of handling characteristics, Transient response characteristics, Directional stability, Effects of tyre factors, Mass distribution and engine location on stability of handling.

UNIT-V:

Vehicle ride characteristics: Human response to vibration, Vehicle ride models, Introduction to random vibration - 1) Road suirface profile as a random function, 2) Frequency response function, 3) Evaluation of vehicle vertical vibration in relation to ride comfort criteria, 4) Active and semi active systems, 5) Optimum design for ride comfort and road holding.

REFERENCE BOOKS:

1. Theory of Ground Vehicles by Wong, J.Y., John Wiley and Sons, NY, 1993.
2. Fundamentals of Vehicle Dynamics by Gillespie, T.D., SAE Publication, Warrendal, USA, 1992.
3. Tyres, Suspension and Handling by Dixon, J.C., SAE Publication, Warrendal, USA and Arnold Publication, London, 1997.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

RESEARCH METHODOLOGY & IPR

Course Code: 23MD115	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objective:

To familiar the students with research fundamental concepts, identification of research areas, development of objective, study of experimental design procedures, analyze and interpretation of results and thereby writing the research paper in concern areas.

COURSE OUTCOMES:

The students will be able to:

CO1	Explain the fundamentals of research
CO2	Identify the research area and testing of its validity and reliability
CO3	Calculate sample size, design experiments with single factor and analyze the variance. Analyze the results based on uni-variate, bi-variate methods
CO4	Write a research paper based on the results
CO5	To emphasize the Intellectual Property Rights

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1		3		2
CO2		3		2
CO3		3		2
CO4		3		2
CO5		3		2

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

Unit-1: Introduction, Problem Identification & Formulation

Introduction to Research: Foundation, Objectives, Motivation, Concept of Utility theory, empiricism, deductive and inductive theories. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Research Process. Problem Identification & Formulation – Research Questionnaires – Investigation Questionnaires – Measurement Issues – Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

Unit-2: Research Design & Qualitative, Quantitative Approaches

Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Unit-3: Experimental Design, Sampling & Data Analysis

Concept of Independent & Dependent variables. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

Unit-4: Interpretation and Writing of Paper

Layout of a Research Paper, Journals in Mechanical Engineering, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic Data bases for Mechanical Engineering Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

Unit-5: Intellectual Property Rights

Introduction to Intellectual Property Rights Concept and Theories Kinds of Intellectual Property Rights Economic analysis of Intellectual Property Rights Need for Private Rights versus Public Interests Advantages and Disadvantages of IPR.

REFERENCE BOOKS:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. D.P. Mittal (Taxman Publication), Indian Patents Law and Procedure.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – I SEMESTER

CAD LAB

Course Code: 23MD116	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To train students in such way that they can prepare Part model, Assembly of parts and obtaining the final production drawing from the assembly.
- To explain basics concepts of 2D drafting using Auto CAD.
- 3D modelling techniques are explained using Autodesk Inventor.
- Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings.
- To enhance the students knowledge in presentation and simulation of the assemblies.
- To impart the analysis skills in student by performing various Finite Element Analysis in ANSYS.

COURSE OUTCOMES:

Student will be able to

CO-1	Experiments in the CAD lab will give better knowledge in 2D drafting
CO 2	Students can prepare 3D Models, Assemblies and Drawings
CO 3	Students can solve Analysis problems.
CO 4	Students can do the real time industrial projects in the lab using the available softwares.
CO 5	Students will become industry ready.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3
CO5	3	3	3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

2D and 3D modeling and assembly modeling using modeling packages like AutoCAD, Auto Desk Mechanical desktop, ProEngineer, IDEAS.

Linear and non-linear static and dynamic analysis using any FEA package ANSYS / CAEFEM / NASTRAN.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

MECHANICAL VIBRATIONS

Course Code: 23MD121	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make students familiar with the concepts of various types of Mechanical vibrations and apply them in various engineering applications

COURSE OUTCOMES:

The student will be able to

CO 1	Measure various vibration parameters of vibrating systems subjected to longitudinal vibrations with different degrees of freedom
CO 2	Understand the concepts of torsional vibrations
CO 3	Apply the principals of vibration to continuous systems

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

. **SYLLABUS**

UNIT I

Single degree freedom systems -Introduction - Single degree freedom systems - free and forced vibrations - Damping classification and damped systems.

UNIT II

Two degree freedom systems - Free, forced damped and undamped motions - Use of influence coefficients, Matrix methods and Lagrange's equations - Phenomenon of beat - Dynamic absorbers – Applications.

UNIT III

Transient (Shock) vibrations as applied to single and two degree freedom systems - Use of mathematics and graphical techniques in the analysis (superposition integral, Laplace transformations, phase plane techniques).

UNIT IV

Multi degree freedom systems - Free and forced motions in longitudinal, torsional and lateral modes - damped and undamped, critical speeds of rotors.

UNIT V

Continuous systems:

Free and forced vibrations of string, bars and beams - Principle of orthogonality Classical and energy methods by Rayleigh, Ritz and Gelerkin.

REFERENCE BOOKS:

1. Mechanical Vibrations by A.H. Church.
2. Vibration Problems in Engineering by Timoshenko and Young.
3. Mechanical Vibrations by Den Hartog.
4. Mechanical vibrations by S S Rao
5. Mechanical vibrations by Grover

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

INSTRUMRNTATION & EXPERIMENTAL STRESS ANALYSIS

Course Code: 23MD122	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To give a brief theoretical knowledge related to Instrumentation.
2. The central purpose of this subject is to help students to develop their understanding and ability to apply, both theoretical and experimental stress analysis techniques to real world engineering design tasks.

COURSE OUTCOMES:

The student will be able to:

CO 1	Use the fundamental knowledge in Instrumentation systems.
CO 2	Understand the concepts of Stress Analysis.
CO 3	Use the experimental techniques on the practical problems

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

. **SYLLABUS**

PART - A (Instrumentation)

UNIT-I

Basic concepts: Calibration - Standards - Basic concepts in dynamic measurements – System response - Distortion.
Sensing devices: Bridge circuits - Amplifiers - Filter circuits - Oscilloscope - Oscillograph - Transducers - variable resistance transducers - LVDT - Capacitive and piezoelectric transducers. **Pressure measurement**: Mechanical pressure measurement devices - Bourdon tube pressure gauge - Diaphragm and bellow gauges - Low pressure measurement - McLeod gauge – Pirani gauge -Ionization gauge.

UNIT-II

Flow measurement: Positive displacement methods - Flow obstruction methods – Flow measurement by drag effect - Hot wire anemometer.
Temperature measurement: Temperature measurements by mechanical effects, Electrical effects and by Radiation - Thermocouples;
Force and Torque measurement; Motion and Vibration measurement.

PART - B (Stress Analysis)

UNIT-III

Brittle lacquer method of stress analysis: Application of lacquer - Stress determination - Dynamic stresses; **Grid methods.**

UNIT-IV

Strain Measurement Methods: Mechanical resistance wire gauges - Types of resistance gauges – Cements and cementing of gauges - Wheatstone bridge - Balanced and unbalanced gauge factor - Calibration of gauges - Strain gauge rosette - Evaluation and principal stresses static and dynamic instrumentation.

UNIT-V

Photo elasticity: Polariscope - Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials - Isochromatic fringes - Isoclinics - Calibration - Isoclines stress determination.

REFERENCE BOOKS:

1. Experimental Stress Analysis and Motion Measurement by Dove and Adams.
2. Experimental Methods for Engineers by Holman, J.P., McGraw Hill Book Company.
3. Experimental stress analysis by Dally and Riley, Mc Graw-Hill.
4. Photo Elasticity by Frocht.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

ADVANCED FINITE ELEMENT ANALYSIS

Course Code: 23MD123	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce students to the basics of theory of elasticity.
- To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and Heat transfer
- To teach students the characteristics of various elements in structural and thermal analysis and selection of suitable elements for the problems being solved.
- To make the students derive finite element equations for different elements.
- To teach students the application of finite element in dynamic analysis and analysis of plates.

COURSE OUTCOMES

The students will be able to:

CO1	Apply the knowledge of Mathematics and Engineering to solve problems in structural mechanics by approximate and numerical methods.
CO2	Solve the problems in solid mechanics and heat transfer using FEM.
CO3	Use commercial FEA packages like ANSYS for solving real life problems.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

.

SYLLABUS

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. Coordinates, 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, BEAMS & FRAMES: : Plane Trusses and Space Truss elements and problems, Hermite shape functions – stiffness matrix – Load vector – Problems, Plane Frames, Three-Dimensional frames.

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, Hexahedral elements – Jacobian matrix – Stiffness matrix.

UNIT-IV:

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

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

UNIT-V

Analysis of Plates:
Introduction, Triangular Membrane element, Quadratic Triangle element, Rectangular plate element(in-plane forces), Bending behavior of plates, finite element analysis of plates in bending, triangular plate bending element.

Introduction to FEA packages: ANSYS, SOLID WORKS

REFERENCE BOOKS:

1. Introduction to Finite Elements in Engineering, by Tirupathi R. Chandrupatla, Ashok D.Belegundu. Third edition, Pearson education.
2. Finite element method in engineering by S.S.Rao.
3. Introduction to Finite Element Method, by Abel & Desai.
4. Finite Element Method, by O.C. Zienkiewicz.

5. Concepts and Applications of Finite Element Analysis, by Robert D. Cook.
6. Finite element method by JN Reddy.
7. Finite element method by P.Seshu.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-III A

ADVANCED MECHANICS OF SOLIDS

Course Code: 23MD124	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make students understand the advanced topics related to flat plates, torsion in rectangular and circular bars, stress concentration and experimental techniques, assumptions and analysis of contact stresses.

COURSE OUTCOMES:

The students will be able to:

CO1	Understand the crack propagations and their testing techniques for an out coming of various structures.
CO2	Design new components based on the concept of contact stresses
CO3	Design various mechanical systems subjected to torsional loads and different types of beams.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

. **SYLLABUS**

UNIT I

Flat 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 relations for isotropic elastic plates - Strain energy of a plate - Boundary conditions for plates - Solutions of rectangular and circular plate problems.

UNIT II

Torsion: Torsion of cylindrical bar of circular cross-section Saint-Venant's semi-inverse method - Linear elastic solution - The Prandtl elastic - Membrane (soap-film) analogy - Narrow rectangular cross-section - Hollow thin-wall torsion members: Multiply connected cross-section - Thin-wall torsion members with restrained ends - Fully plastic torsion.

UNIT III

Beams on elastic foundation: General theory - Infinite beam subjected to concentrated load: Boundary conditions - Infinite beam subjected to a distributed load segment - Semi-infinite beam subjected to loads of its end - Semi-infinite beam with concentrated load near its end - Short beams - Thin-wall circular cylinders.

UNIT – IV

Stress concentrations: Basic concepts - Nature of a stress concentration problem. Stress concentration factor - Stress concentration factor. Theory of elasticity - Stress concentration factors. Experimental techniques - Stress gradients due to concentrated load - The stationary crack - Crack propagation. Stress intensity factor. Effective stress concentration factor: Applications - Stress concentration factor. Combined loads - Effective stress concentration factors - Effective stress concentration factors. Repeated loads - Effective stress concentration factors - Other influences - Effective stress concentration factors - In-elastic strains.

UNIT – V

Contact stresses: Introduction - The problem of determining contact stresses - Assumptions on which a solution for contact stresses is based - Notation and meaning of terms - Expressions for principal stresses - Method of computing contact stresses - Deflection of bodies in point contact - Stress for two bodies in contact over narrow rectangular area (line contact). Loads normal to area - Stresses for two bodies in line contact. Loads normal and tangent to contact area.

REFERENCE BOOKS:

1. Advanced Mechanics of Materials by Boresi, A.P. and Sidebottm, O.M.
2. Advanced Mechanics of Materials by Seely and Smith.
3. Advanced Strength of Materials by Den Hartog.
4. Advanced Strength of Materials by Timoshenko S.P.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-III B
MECHATRONICS

Course Code: 23MD124	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To impart the knowledge of integrated design issues in Mechatronics and Mechatronics design process and the basic knowledge of modelling and simulation of block diagrams and also about sensors, transducers, signals and system controls.
- To make students aware of advanced applications in mechatronics.

COURSE OUTCOMES:

The students will be able to:

CO1	Design the mechatronics systems.
CO2	Model and simulate the block diagrams of systems
CO3	Gain knowledge of operation of different sensors and transducers for various applications.
CO4	Gain knowledge in application of Artificial intelligence and micro sensors in mechatronics.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

.

SYLLABUS

UNIT-I

Mechatronics system design: Introduction to Mechatronics: What is mechatronics, Integrated design issues in mechatronics, Mechatronics key elements, The mechatronics design process, Advanced approaches in mechatronics.

UNIT-II

Modelling and simulation of physical systems: Simulation and block diagrams, Analogies and impedance diagrams, Electrical systems, Mechanical translational systems, Mechanical rotational systems, Electromechanical coupling, Fluid systems.

UNIT-III

Sensors and transducers: An introduction to sensors and transducers, Sensors for motion and position measurement, Force, torque and tactile sensors, Flow sensors, Temperature sensing devices. Actuating devices: Direct current motor, Permanent magnet stepper motor, Fluid power actuation.

UNIT-IV

Signals, systems and controls: Introduction to signals, systems and controls, System representation, Linearization of nonlinear systems, Time delays.
Real time interfacing: Introduction, Elements of a data acquisition and control system, Overview of the I/O process, Installation of the I/O card and software.

UNIT-V

Advanced applications in mechatronics: Sensors for condition monitoring, Mechatronic control in automated manufacturing, Artificial intelligence in mechatronics, Microsensors in mechatronics.

REFERENCE BOOKS:

1. Mechatronics System Design by Devdas Shetty and Richard A. Kolk, P.W.S. Publishing Company, 2001.
2. Mechatronics by W. Bolton, Pearson Education, Asia, II-Edition, 2001.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-III C
COMPUTATIONAL FLUID DYNAMICS

Course Code: 23MD124	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce students to the governing equations of Fluid dynamics and the application of finite difference method for solving partial differential equations.
- The objective is also to equip them to solve incompressible viscous flows, compressible flows, steady state, transient, two dimensional and three dimensional problems.

COURSE OUTCOMES:

The students will be able to:

CO1	Understand the basic concept of fluid dynamics, solution methods & apply it to real time problems to develop mathematical model.
CO2	Solve problems related to Incompressible viscous flows, compressible flows, steady state and transient analysis.
CO3	Apply finite volume method to solve two and three-dimensional problems.

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CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

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, Eluer equations, Navier-stokes system of equations, flowfield-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 - 1: Linear fluid flow problems, steady state problems,

Standard variational methods - 2: Transient problems.

REFERENCE BOOKS:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press, 2002.
2. Text book of fluid dynamics, Frank Chorlton, CBS Publishers & distributors, 1985.
3. D.A. Hoffmann & S.T. Chiang, "Computational Fluid Dynamics", Volume-I, II&III, A publication of Engineering Education SystemTM, Wichita, Kansas, USA.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-III D
TRIBOLOGY

Course Code: 23MD124	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide broad based understanding of the interdisciplinary subject 'Tribology' and its technological significance.
- Understanding the principles for selecting compatible materials for minimizing friction and wear in machinery.
- To understand the genesis of friction, the theories/laws of sliding and rolling friction.
- To understand the principles of bearing selection and bearing arrangement in machines.
- Learn the computations required for selecting and designing bearings in machines.
- To understand the nature of engineering surfaces, their topography and learn about surface characterisation techniques.

COURSE OUTCOMES:

The students will be able to:

CO1	Apply the basic theories of friction, wear and lubrication to predictions about the frictional behaviour of commonly encountered sliding interfaces.
CO2	Learn about the principles of lubrication, lubrication regimes, theories of hydrodynamic, elasto-hydrodynamic and mixed/ boundary lubrication.
CO3	Learn about Tribology of different machine components.
CO4	Optimize existing and new systems to improve performance.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

. **SYLLABUS**

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

Elasto-hydrodynamic 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

Friction & Wear-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.

REFERENCE BOOKS:

1. Introduction to Tribology of Bearings by Majumdar. B.C.
2. Engineering Tribology, Prasanta Sahu, Prentice - Hall of India, 2005
3. Fundamentals of Tribology, S.K.Basu, S.N. Sengupta and B.B.Ahuja, Prentice - Hall of India, 2005

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-IV A
GEAR ENGINEERING

Course Code: 23MD125	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- This advanced course on gear engineering is intended to provide a thorough understanding of the principles involved in gear design, selection of gears, manufacturing techniques and failures in operation.
- The student will be imbibed with the knowledge of analysing gear tooth loads, stresses and methodology of different types of gears.
- The design of gear boxes for automobiles, aircrafts and other systems is also included to acquaint the student with the design of gear trains for any practical applications.
- To introduce optimization techniques in the design of gears and gear trains so as to involve compactness as a feature in the production of gear boxes.

COURSE OUTCOMES:

The student will be able to:

CO1	Get a thorough understanding of the philosophy involved in the design and selection of gears.
CO2	Analyse the different factors to be considered like strength, dynamic loads ,wear etc. in the design of different types of gears.
CO3	Analyse Gear tooth failures like pitting, scoring etc. and their causes like excessive wear, overloading and lubrication failures.
CO4	Handle Design of gear boxes for any application like automobiles, aircrafts and ship propulsion.
CO5	Use optimization as a tool in the design of gears and gear trains.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3
CO5	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

UNIT - I

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.

UNIT – II

Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT – III

Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings.

UNIT – IV

Gear failures, Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures

Gear trains: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

UNIT – V

Optimal Gear design: Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

REFERENCE BOOKS:

1 Machine Design/ Maleev and Hartman/ C.B.S Publishers, India.

2 Gear engineering/ Henry E.Merrit / Wheeler publishing, Allahabad. 1992.

3 Practical Gear design/ DarleW.Dudley/ McGraw-Hill book company.

4 Analytical mechanics of gears/ Earle Buckingham/ Dover publications, New York, 1949.

5 Hand book of gear design/ G.M.Maitha / Tata McGraw Hill publishing company Ltd, NewDelhi, 1994.

6 Machine Design / Shaum series / McGraw Hill

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-IV B
RELIABILITY ENGINEERING

Course Code: 23MD125	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

The course is designed to emphasize the importance of reliability in Engineering, discuss the probability distributions and acquaint the student with different methods of evaluating the reliability of components.

COURSE OUTCOMES:

The students will be able to

CO 1	Understand the importance of reliability, reliability procedure and management
CO 2	Understand the laws of probability
CO 3	Analyse the failure rate of the systems
CO 4	Study the design properties
CO 5	Enhance their knowledge through various case studies.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3
CO5	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

Unit-I

Introduction of Reliability: Uncertainty in Engineering, Definition of Reliability, Importance of Reliability, Pattern of Failures- Component Failures, Mechanical and Structural Failures; Factor of Safety and Reliability, Reliability Analysis Procedure, Reliability Management, Examples of System Failures- Collapse of Tacoma Narrows Bridge in 1940, Crash of El Al *Boeing 747-200* in 1992, Disaster of Space Shuttle *Challenger* in 1986, Fukushima Nuclear Accident in 2011, Breaking of the Tanker S. S. *Schenectady.*

Unit-II

Random Variables and Probability: Basic theory- laws of probability; Probability Mass Function for Discrete Random Variables, Cumulative Distribution Function for Discrete Random Variables, Probability Density Function for Continuous Random Variables, Mean, Mode, and Median, Standard Deviation and Skewness Coefficient, Probability Distributions- Binomial Distribution, Poisson Distribution, Normal Distribution.

Unit III

Time-Dependent Reliability of Components and Systems

Introduction, Failure Rate versus Time Curve, Reliability and Hazard Functions, Modeling of Failure Rates, Estimation of Failure Rate from Empirical Data, Mean Time to Failure (MTTF), Reliability and Hazard Functions for Different Distributions- Exponential Distribution, Normal Distribution,

Weibull Distribution, Uniform Distribution; Expected Residual Life, Series Systems- Failure Rate of the System, MTBF of the System; Parallel Systems- Failure Rate of the System, MTBF of the System.

Unit –IV

Modeling of Geometry, Material Strength, and Loads: Introduction, Modeling of Geometry, Tolerances on Finished Metal Products, Assembly of Components, Modeling of Material Strength, Statistics of Elastic Properties, Statistical Models for Material Strength, Model for Brittle Materials, Model for Plastic Materials, Model for Fiber Bundles, Fatigue Strength, Constant-Amplitude Fatigue Strength, Variable-Amplitude Fatigue Strength, Modeling of Loads: Dead Loads, Live Loads, Wind Loads.

Unit –V

Strength-Based Reliability 343:Introduction, General Expression for Reliability, Expression for Probability of Failure, General Interpretation of Strength and Load, Reliability for Known Probability Distributions of *S* and *L*, Reliability When *S* and *L* Follow Normal Distribution, Approximate Expressions of Reliability for Normal Distribution, Reliability When *S* and *L* Follow Lognormal Distribution, Reliability When *S* and *L* Follow Exponential Distribution, Reliability When *S* and *L* Follow Extreme Value Distributions, When *S* and *L* Follow Type-III Extremal Distributions, Reliability in Terms of Experimentally Determined Distributions of *S* and *L*, Factor of Safety Corresponding to a Given Reliability.

REFERENCE BOOK:

2. Reliability Engineering by Singiresu S.Rao, Pearson.
3. Reliability Engineering by L.S.Srinath.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-IV C
CONDITION MONITORING & SIGNAL ANALYSIS

Course Code: 23MD125	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

To make the student Understand

- The use of advanced instrumentation and sensing methods.
- System integration.
- Apply signal processing methods and system design methods.
- Introduce condition monitoring procedures.

COURSE OUTCOMES:

The students will be able to:

CO1	Apply signal-processing methods, the principles of instrumentation and measurement systems.
CO2	Perform practical analysis on actual machines and systems, Develop a maintenance strategy based on system response.
CO3	Understand the advantages and limitations of a variety of techniques for condition monitoring.
CO4	Understand the environmental benefits of condition monitoring techniques, Condition monitoring approaches, sensor types, sensor placement, data analysis.

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CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3
CO2	3		3	3
CO3	3		3	3
CO4	3		3	3

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

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.

REFERENCE BOOKS:

1. Condition Monitoring of Mechanical Systems by Kolacat.
2. Frequency Analysis by R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory by V. Ramamurti, Narosa Publishing House.

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

PROFESSIONAL ELECTIVE-IV D
COMPOSITE MATERIALS

Course Code: 23MD125	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamentals of composite material strength and its mechanical behavior
- Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

COURSE OUTCOMES:

The students will be able to:

CO 1	Understand the mechanics and design related to layered components such as fiber reinforced polymer composites, isotropic layered structures (example electronic chips) etc and its manufacturing methodologies.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3		3	3

. CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

. **SYLLABUS**

UNIT I

INTRODUCTION TO COMPOSITE MATERIALS

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites.

UNIT II

MANUFACTURING OF COMPOSITES

Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding,Sandwich 15 Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state,vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation- interfaces.

UNIT III

INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT IV

LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

UNIT V

THERMAL ANALYSIS

Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.

REFERENCE BOOKS:

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
5. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
6. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
7. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.
8. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)
9. Chung, Deborah D.L., "Composite Materials: Science and Applications", Ane Books Pvt. Ltd./Springer, New Delhi, 1st Indian Reprint, 2009

MECHANCIAL ENGINEERING DEPARTMENT

I YEAR – II SEMESTER

INSTRUMENTATION & EXPERIMENTAL STRESS ANALYSIS LAB

Course Code: 23MD126	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To demonstrate students, how to measure strain, Vibration parameters, Damped and Undamped frequencies, Velocity of gas by using various instruments.
- And to demonstrate, how the Rotameter and Thermocouples are calibrated.
- To perform Stress analysis experimentally by using Photo elasticity.

COURSE OUTCOMES:

The students will be able to:

CO1	Measure the Rate of Flow, Strain, Vibration Parameters, Velocity of Air, Damped and undamped Frequencies
CO2	Understand, Experimental methods may be used in cases where mathematical approaches are cumbersome.
CO3	Compare the theory and correlate with experiment.

CO\PO	**PO1**	**PO2**	**PO3**	**PSO1**
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3

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List of Experiments:

1. Measurement of strain by Digital strain measuring system on Cantilever beam
2. Calibration of Rotameter
3. Calibration of Thermocouples for Temperature Measurement
4. Experiment with constant voltage/Current Hot-Wire Anemometer
5. Experimental determination of Undamped and Damped frequencies of spring mass system
6. Measurement of Vibration parameters by using Vibrometer setup
7. Study of Photo elastic bench (Plain Polariscope and Circular Polariscope)
8. Photo elastic analysis of disc under diametric compression
9. Photo elastic analysis of ring under diametric compression
10. Ultrasonic flaw detector.