ACADEMIC REGULATIONS

COURSE STRUCTURE AND SYLLABI

FOR

M.TECH.
COMPUTER AIDED ANALYSIS AND DESIGN
(MECHANICAL ENGINEERING)
2012-2013

GAYATRI VIDYA PARISHAD COLLEGE OF ENGINEERING
(AUTONOMOUS)
ACCREDITED BY **NAAC** WITH **A** GRADE WITH A **CGPA** OF **3.47/4.00**
AFFILIATED TO JNTU KAKINADA
MADHURAWADA, VISAKHAPATNAM 530048

Vision

To evolve into and sustain as a Centre of Excellence in Technological Education and Research with a holistic approach.

Mission

To produce high quality engineering graduates with the requisite theoretical and practical knowledge and social awareness to be able to contribute effectively to the progress of the society through their chosen field of endeavor.

To undertake Research & Development, and extension activities in the fields of Science and Engineering in areas of relevance for immediate application as well as for strengthening or establishing fundamental knowledge.

F O R E W O R D

It is three years since the G.V.P College of Engineering has become Autonomous with the appreciation and support of erstwhile JNTU and the fast growing new JNTU-K. The college is progressing well with its programmes and procedures drawing more and more accolades from its sister autonomous colleges and higher authorities. The student community, also could adjust well to the new system without any acrimony.

The College is enriched with the experience of running the Post-graduate programmes under Autonomous stream. It is a moment of pride and achievement that the first Autonomous batch of M.Tech in some branches left the college to the satisfaction of all concerned including firms visited the campus for placements.

Another larger than canvas picture is foreseen for the programmes wherein the college is getting the funds through TEQIP – II for up-scaling the PG education and research under sub- component 1.2. In this connection two new PG Programmes have been introduced in Mechanical, Electrical Engineering.

New set of Boards of Studies, Academic council and Governing Body has further strengthened our hands by endorsing the practices and suggested recommendations.
The encouragement given by the affiliating JNTU-K has left no task insurmountable.

Principal

MEMBERS ON THE BOARD OF STUDIES IN MECHANICAL ENGINEERING

- Head of the Department.

- Sri V. Damodar Naidu, Sujana Towers Ltd., Hyderabad.
- Prof. M.M.M. Sarcar, Dept. of Mechanical Engg., A.U.
- Prof. N. Siva Prasad, Department of Mechanical Engg., IIT-M, Chennai.
- Prof. K.R. Srinivas, Engineering Mechanics Unit, JNCASR, Bangalore.
- Prof. P. Bangaru Babu, Professor in Mechanical Engg., NIT Warangal.
- Sri M. Prasanna Kumar, DGM, O&M, NTPC Simhadri, Parawada.
- Sri P. Srikanth, Project Manager, Parabola Software Development Private Ltd., Visakhapatnam.

All faculty of the department.

ACADEMIC REGULATIONS

(Effective for the students admitted into
first year from the academic year 2012-2013)

The M.Tech. Degree of JNTU-KAKINADA shall be recommended to be conferred on candidates who are admitted to the program and fulfill all the requirements for the award of the Degree.

1.0 ELGIBILITY FOR ADMISSION:

Admission to the above program shall be made subject to the eligibility, qualifications and specialization as per the guidelines prescribed by the APSCHE and AICTE from time to time.

2.0 AWARD OF M.TECH. DEGREE:

a. A student shall be declared eligible for the award of the M.Tech. degree, if he pursues a course of study and completes it successfully for not less than two academic years and not more than four academic years.
b. A student, who fails to fulfill all the academic requirements for the award of the Degree within four academic years from the year of his admission, shall forfeit his seat in M.Tech. Course.
c. The duration of each semester will normally be 20 weeks with 5 days a week. A working day shall have 7 periods each of 50minutes.

3.0 COURSES OF STUDY:

M.TECH. COURSES	INTAKE
Chemical Engineering	18
Computer Science and Engineering	18
CAD/CAM	18
Infrastructural Engineering and Management	18
Structural Engineering	18
Power System Control and Automation	18
Embedded Systems & VLSI Design	18
Communications & Signal Processing	18
Software Engineering	18
Power Electronics & Drives	18
Computer Aided Analysis And Design (CAAD)	18

4.0 ATTENDANCE:

The attendance shall be considered subject wise.

a. A candidate shall be deemed to have eligibility to write end semester examinations in a subject if he has put in at least 75% of attendance in that subject.

b. Shortage of attendance up to 10% in any subject (i.e. 65% and above and below 75%) may be condoned by a Committee on genuine and valid reasons on representation by the candidate with supporting evidence.

c. Shortage of attendance below 65% shall in no case be condoned.

d. A student who gets less than 65% attendance in a maximum of two subjects in any semester shall not be permitted to takethe end- semester examination in which he/she falls short His/her registration for those subjecWts will be treated as cancelled. The student should re-register and repeat those subjects as and when offered next.

e. If a student gets less than 65% attendance in more than two

subjects in any semester he/she shall be detained and has to repeat the entire semester.

f. A stipulated fee shall be payable towards condonation of shortage of attendance.

5.0 EVALUATION:

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

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

b. For the theory subjects 60 marks shall be awarded based on the performance in the End Semester Examination, 40 marks shall be awarded based on the Internal Evaluation. One part of the internal evaluation shall be made based on the average of the marks secured in the two Mid–Term Examinations of 30 each conducted one in the middle of the Semester and the other immediately after the completion of instruction. Each mid-term examination shall be conducted for a duration of 120 minutes with 4 questions without any choice. The remaining 10 marks are awarded through an average of continuous evaluation of assignments / seminars / any other method, as notified by the teacher at the beginning of the semester.

c. For Practical subjects, 50 marks shall be awarded based on the performance in the End Semester Examinations, 50 marks shall be awarded based on the day-to-day performance as Internal marks**.** A candidate has to secure a minimum of 50% in the external examination and has to secure a minimum of

50% on the aggregate to be declared successful.

d. There shall be a seminar presentation during III semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee consists of the Head of the Department, supervisor and two other senior faculty members of the department. For Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful.

e. For Seminar in I, II Semesters in case of the course structure of having 5 Theory + 2 Labs. + 1 Seminar, a student has to deliver a seminar talk in each of the subjects in that semester which shall be evaluated for 10 marks each and average marks allotted shall be considered. A letter grade from A to C corresponding to the marks allotted may be awarded for the two credits so as to keep the existing structure and evaluation undisturbed.

A – Excellent	(average marks > 8
B – Good	(6< average marks <8)
C – Satisfactory	(5< average marks <6)

If a satisfactory grade is not secured, one has to repeat in the following semester.

f. In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.0 a, c) he has to reappear for the End Examination in that subject.

A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are

less than 50% and he has failed in the subject(s). In such a case the candidate must re-register for the subject (s) and secure required minimum attendance. Attendance in the re-registered subject (s) has to be calculated separately to become eligible to write the end- examination in the re-registered subject(s). In the event of re-registration, the internal marks and end examination marks obtained in the previous attempt are nullified.

g. In case the candidates secure less than the required attendance in any subject(s), he shall not be permitted to appear for the End Examination in that subject(s). He shall re-register for the subject(s) when next offered.
h. Laboratory examination for M.Tech subjects must be conducted with two Examiners, one of them being Laboratory Class Teacher and second examiner shall be other than Laboratory Teacher.

6.0 EVALUATION OF PROJECT / DISSERTATION WORK:

Every candidate shall be required to submit the thesis or dissertation after taking up a topic approved by the Departmental Research Committee (DRC).

a. A Departmental Research Committee (DRC) shall be constituted with the Head of the Department as the chairman and two senior faculty as members to oversee the proceedings of the project work from allotment to submission.
b. A Central Research Committee (CRC) shall be constituted with a Senior Professor as chair person, Heads of all the Departments which are offering the M.Tech. programmes and two other senior faculty members.
c. Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance

requirement of all the subjects (theory and practical subjects.)

d. After satisfying 6.0 c, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the DRC for its approval. Only after obtaining the approval of DRC the student can initiate the Project work
e. If a candidate wishes to change his supervisor or topic of the project he can do so with approval of DRC. However, the Departmental Project Review Committee shall examine whether the change of topic/supervisor leads to a major change in his initial plans of project proposal. If so, his date of registration for the Project work shall start from the date of change of Supervisor or topic as the case may be whichever is earlier.
f. A candidate shall submit and present the status report in two stages at least with a gap of 3 months between them after satisfying 6.0 d.
g. The work on the project shall be initiated in the beginning of the second year and the duration of the project is for two semesters. A candidate shall be permitted to submit his dissertation only after successful completion of all theory and practical subject with the approval of CRC but not earlier than 40 weeks from the date of registration of the project work. For the approval by CRC the candidate shall submit the draft copy of the thesis to the Principal through the concerned Head of the Department and shall make an oral presentation before the CRC.
h. Three copies of the dissertation certified by the supervisor shall be submitted to the College after approval by the CRC.
i. The dissertation shall be adjudicated by one examiner selected by the Principal. For this HOD shall submit in consultation with the supervisor a panel of 5 examiners, who

are experienced in that field.

j. If the report of the examiner is not favorable, the candidate shall revise and resubmit the dissertation, in a time frame as prescribed by the CRC. If the report of the examiner is unfavorable again, the dissertation shall be summarily rejected then the candidate shall change the topic of the Project and option shall be given to change the supervisor also.

k. If the report of the examiner is favorable, viva-voce examination shall be conducted by a board consisting of the supervisor, Head of the Department and the examiner who adjudicated the dissertation. The Board shall jointly report candidate's work as:

A. Excellent
B. Good
C. Satisfactory

7.0 AWARD OF DEGREE AND CLASS :

A candidate shall be eligible for the respective degree if he satisfies the minimum academic requirements in every subject and secures satisfactory or higher grade report on his dissertation and viva-voce.

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

% of Marks secured	Class Awarded
70% and above	First Class with Distinction
60% and above but less than 70%	First Class
50% and above but less than 60%	Second Class

The marks in internal evaluation and end examination shall be shown separately in the marks memorandum.

The grade of the dissertation shall also be mentioned in the marks memorandum.

8.0 WITHHOLDING OF RESULTS:

If the candidate has not paid any dues to the college or if any case of indiscipline is pending against him, the result of the candidate will be withheld and he will not be allowed into the next higher semester. The recommendation for the issue of the degree shall be liable to be withheld in such cases.

9.0 TRANSITORY REGULATIONS:

A candidate who has discontinued or has been detained for want of attendance or who has failed after having studied the subject is eligible for admission to the same or equivalent subject(s) as and when subject(s) is/are offered, subject to 6.0 e and 2.0

10.0 GENERAL

1. The academic regulations should be read as a whole for purpose of any interpretation.

2. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman Academic Council is final

3. The College may change or amend the academic regulations and syllabus at any time and the changes amendments made shall be applicable to all the students with effect from the date notified by the College.

4. Wherever the word he, him or his occur, it will also include she, hers.

COURSE STRUCTURE

I SEMESTER

COURSE CODE	Theory / Lab	L	P	C
12ME2201	Advanced Mechanics of Materials	4	-	4
12ME2202	Finite Element Analysis	4	-	4
12ME2203	Computer Aided Modeling	4	-	4
12ME2204	Design for Manufacturing, Assembly & Environment	4	-	4
	Elective - I	4	-	4
12ME2205	Advanced Mechanism Design			
12ME2206	Failure Analysis and Design			
12ME2207	Pressure Vessels and Piping Design			
12ME2208	Tribology			
12ME2209	Aircraft Systems			
12ME2210	Computer Aided Modeling Lab	-	3	2
12ME2211	Finite Element Analysis Lab	-	3	2
	Total	**20**	**6**	**24**

II SEMESTER

COURSE CODE	Theory / Lab	L	P	C
12ME2212	Experimental Stress Analysis	4		4
12ME2213	Mechanics of Composite Materials	4		4
12ME2214	Mechanical Vibrations	4		4
12ME2215	Optimization methods in Engineering	4		4
	Elective - II	4	-	4
12ME2216	Design of Fluid Power Systems			
12ME2217	Computational Fluid Dynamics			
12ME2218	Industrial Robotics			
12ME2219	Acoustics and Noise Control			
12ME2220	Aircraft Structures			
12ME2221	Advanced Mechanical Design Lab	-	3	2
12ME2222	Design Optimization Lab	-	3	2
	Total	**20**	**6**	**24**

III SEMESTER

COURSE CODE	THEORY/LAB	L	P	C
	Commencement of Project Work			
12ME22S1	SEMINAR	**-**	**-**	**2**

IV SEMESTER

COURSE CODE	THEORY/LAB	L	P	C
12ME2223	PROJECT WORK DISSERTATION / THESIS EXCELLENT/GOOD/SATISFACTORY/ NON-SATISFACTORY	**-**	**-**	**56**

ADVANCED MECHANICS OF MATERIALS

Course Code: 12ME2201

L	P	C
4	0	4

Aim and Objective:

This subject describes the concepts of Theory of elasticity and Shear centre in thin walled sections. It also gives the analysis of the torsion of prismatic bars for different cross-sections like rectangular and circular sections. It gives the insight to design the mechanical structures in the view point of both strength and deformation including the design by means of numerical simulation.

UNIT -I

Analysis of stress and strain: Introduction, Stress components on an arbitrary plane, principal stresses, stress invariants, the plane state of Stress, octahedral stress, rectangular strain components, the state of strain at a point, principal strains, plane state of strain, stress-strain relations for isotropic materials

UNIT- II

Theories of failure: Significance of the Theories of failure, Use of Factor of Safety in design, Mohr's Theory of failure, Ideally plastic solid, stress-strain relations(Plastic flow), saint venant –Von Moises Equations.

UNIT- III

Columns: Rankine formula, Eulers buckling load, Beam column with a concentrated load, Straight & initially curved columns, Columns subjected to eccentric loading

UNIT -IV

Torsion on non circular members: Rectangular, Elliptical and Equilateral triangular cross-sections, Membrane analogy, Torsion of thin walled tubes

UNIT -V

Unsymmetrical Bending: Regarding Euler-Bernouli Hypothesis, Shear Centre, Shear stresses in Thin walled Open sections

UNIT -VI

Bending of Curved Beam: Winkler-Bach formula, Determination of factor h2 for various sections and resultant stresses in a Hook and a Circular ring.

UNIT -VII

Energy Methods: Strain energy principles, virtual work, Castigliano's first and second theorem,

Applications to cases in axial and bending loadings. Applications to statically indeterminate problems.

UNIT -VIII

Rotating Discs: Introduction, Rotating ring, Rotating thin disc, Disc of Uniform Strength, Rotating long cylinders, Solid and Hollow cylinders.

Text Books:

1. L. S. Srinadh, Advanced Mechanics of Solids, 2nd edition, Tata Mc Graw Hill, 2004, New Delhi.
2. Beer,P.F. and Johnston, E.R: Mechanics of Materials,5th edition, Mc Graw Hill,2005,New York.

References:

1. Gere and Timoshenko: Mechanics of Materials, 2nd edition, CBS Publishers, 2004, New Delhi.
2. R. C. Hibbeler, Mechanics of Materials, 2nd edition, Prentice Hall Inc., 2005.

3. J. R. Barber, Intermediate Mechanics of Materials, Mc Graw Hill, International Edition, Mechanical Engineering Sciences 2000.
4. B. C. Punmia: Mechanics of Materials, Laxmi Publications, First Edition, 2010, New Delhi.
5. R. K. Bansal,Strength of Materials, Laxmi Publications, Fourth Edition, 2010, New Delhi.

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FINITE ELEMENT ANALYSIS

	L	P	C
Course Code: 12ME2202	**4**	**0**	**4**

Aims and Objectives:

Aims: The aims of this module are to: (i) Provide an understanding of fundamental knowledge and technique of FEM, (ii) To develop tools to analyze engineering problems using FEM and typical commercial FEA package.

Objectives: Having successfully completed the module students will be able to demonstrate knowledge and understanding of: (i) Fundamental concept and method of FEA, (ii) Direct stiffness, Rayleigh-Ritz methods and FEM, (iii) FE formulation in solid mechanics and heat transfer problem, (iv) Fundamentals of isoparametric elements, (v) FE for dynamic analysis, and (vi) Nonlinear FEA

UNIT-I

Fundamental Concepts: Engineering problems and governing differential equations, finite elements, Variational methods, Potential energy method, Rayleigh-Ritz method, Weak forms, Galerkin Method and weighted residual methods, essential and natural BCs One-dimensional problems: FE Modeling, Coordinates and Shape functions, PE approach, element stiffness matrix and force terms, Assembly of Global Stiffness Matrix and Load Vector, Properties of K, FE equations, treatment of BCs, elimination approach, penalty approach, multipoint constraints, Quadratic Shape Functions

UNIT-II

Trusses: Plane trusses, local and global coordinate systems, element stiffness matrix, stress calculations, assembly of global stiffness matrix

UNIT-III

Two-dimensional problems using CST: FE modeling, isoparametric representation, PE approach, element stiffness, force terms, stress calculations, temperature effects, Problem solving and BCs, Axisymmetric Formulation, FE Modeling using CST- PE approach, body force terms, rotating flywheel, surface traction, stress calculations, temperature effects, Problem Modeling and Boundary Conditions-cylinder subjected to internal pressure, infinite cylinder, press fit on a rigid shaft, press fit on an elastic shaft

UNIT-IV

Isoparametric formulation: 4-node quadateral-shape functions, element stiffness matrix, element force vectors, Numerical Integration-1D and 2D integrations, stiffness integration, stress calculations, nine-node quadrilateral, eight-node quadrilateral, six-node triangle, sub parametric, super parametric elements, serendipity elements

UNIT-V

Beams and frames: Finite Element Formulation, Load Vector, Boundary Considerations, Shear Force and Bending Moment, and plane frames

UNIT-VI

Scalar field problems: Steady State Heat Transfer-one-dimensional heat conduction, one-dimensional heat transfer in thin films, Torsion-triangular element, Galerkin approach

UNIT-VII

Convergence: Requirements for convergence, h refinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle

UNIT-VIII

Dynamic analysis and Nonlinear FEA: Formulation-solid body with distributed mass, Element Mass Matrices, Evaluation of Eigen Values

and Eigen Vectors for a stepped bar and a beam, Introduction, non-linear problems, geometric nonlinearity, non-linear dynamic problems, analytical problems

Text Books:

1. Tirupathi K. Chandrupatla and Ashok D. Belegundu, " Introduction to finite elements in engineering", Pearson Education, Third Edition, 2002

2 J. N. Reddy, "An introduction to finite element methods", McGraw Hill, 3rd Edition, 2005. (For UNIT VII and Nonlinear FEA portion of UNIT VIII)

Reference Books:

1. Cook, R.D., "Finite element modeling for stress analysis", Wiley Interscience, 1995

2. C. S. Krishnamurthy, "Finite Element Analysis: Theory and Programming", McGraw-Hill, Second Edition, 2005.

3.S.S.Rao, "The finite element methods in engineering",Pergamon, New York, 5th Edition, 2012

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COMPUTER AIDED MODELING

Course Code: 12ME2203

L	P	C
4	0	4

Aim and objective:
To impart theoretical knowledge to students about the modeling and design using computer

UNIT-I
Introduction to CAD, product cycle, design process, application of computers for design, benefits of CAD.
CAD hardware: CAD Design workstation, graphics terminal, input devices, output devices, CPU, storage devices

UNIT-II
Geometric transformations: Transformation of geometric models-translation, scaling, rotation, concatenated transformation, projection of geometric models-orthographic, perspective, design and engineering applications.

UNIT-III
Wire frame modeling: wireframe entities, curve representation, parametric representation: analytic curves-line, circle, ellipse, synthetic curves-cubic spline, Bezier curves, B-Spline curves.

UNIT-IV
Surface modeling: surface entities, surface representation, parametric representation: analytic surface- plane surface, ruled surface, surface of revolution, synthetic surface-Bicubic surface, Bezier surface, B-Spline surface.

UNIT-V
Solid modeling: solid entities, solid representation, B-rep, CSG,

sweep representation, analytic solid modeling, solid manipulations-displaying, segmentation, trimming, intersection, transformation, editing, design and engineering applications.

UNIT-VI

Graphic aids: geometric modifiers, names, layers, colors, grids, clipping.

Mechanical assembly: part modeling - assembly modeling, hierarchical relationship, mating conditions

UNIT-VII

CAD software - Capabilities of CAD packages, Graphics standards-GKS IGES, PDES, Computer aided design of mechanical parts and Interference detection by motion analysis.

UNIT-VIII

Computer animation: conventional animation, computer animation, animation systems, animation types, animation techniques, design and engineering applications.

Text Book:

1. Ibrahim Zeid, CAD / CAM Theory and Practice,TMH, special Indian edition,2007
2. M.P. Groover and E.W. Zimmers, CAD/CAM , PHI, First edition, 1995

Reference Books

1. P.N. Rao, CAD / CAM Principles and Applications, TMH, second edition, 2008
2. David F. Rogers and J. Alan Adams, Mathematical Elements for Computer Graphics, TMH, second edition, 2002

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DESIGN FOR MANUFACTURING, ASSEMBLY &ENVIRONMENT

Course Code: 12ME2204

L	P	C
4	0	4

Aim and Objectives:

To teach the students to adopt a systematic design approach that address issues related to manufacture, assembly, environment, recyclability and other factors from conceptual design stage to product manufacture.

UNIT-I

INTRODUCTION: Design philosophy – steps in Design process — creativity in design.

Materials: Selection of Materials for design – Developments in Material technology – criteria for material selection – Material selection interrelationship with process selection.

UNIT-II

DESIGN FOR MANUFACTURE: General Design rules for manufacturability – basic principles of designing for economical production. General design recommendation for machined parts

UNIT-III

DFM - METAL CASTING: Appraisal of various casting processes, selection of casting process, - general design considerations for casting – casting tolerances – use of solidification simulation in casting design – product design rules for sand casting.

UNIT-IV

DFM - METAL JOINING: Appraisal of various welding processes, Factors in design of weldments – general design guidelines – pre and post treatment of welds – effects of thermal stresses in weld joints – design of brazed joints.

UNIT-V

DFM - EXTRUSION & SHEET METAL WORK: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing – Keeler Goodman Forming Line Diagram – Component Design for Blanking.

UNIT-VI

DESIGN FOR ASSEMBLY: Compliance analysis and interference analysis for the design of assembly – Design and development of features for automatic assembly – liaison diagrams.

UNIT-VII

DESIGN FOR REUSE/REUSABILITY: Introduction to DFRR; Heuristics; Key Principles of DFRR – Modular design, Standards, Recycle; DFRR Procedures – Analysis, Design, Development, testing; Examples - Engine Controls, Fuel Pump Driver Module.

UNIT-VIII

DESIGN FOR ENVIRONMENT: Introduction to DfE; Motivations for DfE; Key Principles of DfE - Eco-Efficiency Approaches, Product Life Cycle Perspective, Integrated Cross-Functional Product Development; DfE Tools and Processes, DfE Design Guidelines.

Text Books:

1. Karl T, Ulrich and Steven D. Eppinger, "Product Design and Development", 3rd Edition, , McGraw Hill, 2000.
2. Boothroyd G at al., "Product design for Manufacture and Assembly", First Edition, Marcel Dekker Inc, New York, 1994.
3. PPTs on DFX: http://weaverjm.faculty.udmercy.edu/dfx.html

Reference Books:

1. George Q. Huang, “Design for X: Concurrent Engineering Imperatives”, First edition, Spinger, 1996
2. George E Deiter, “Engineering Design – A Material and Processing Approach”, Third Edition, McGraw Hill Intl, Singapore, 2000.
3. ASM International, “Material Selection and Design Handbook”, Vol. 20, 1997.
4. Chitale A K, R C Gupta, “Product Design and Manufacturing”, Second Edition, PHI, New Delhi, 2002.

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ADVANCED MECHANISM DESIGN
(Elective – I)

Course Code: 12ME2205 **L P C**
4 0 4

Aim and objective: This one semester course gives necessary background for understanding both analytical and synthesis of mechanisms so that he/she can attempt kinematic design of mechanisms. In addition the requisite knowledge of force analysis is also conveyed so that design of all links can also be attempted.

UNIT– I

Introduction – Review of fundamentals of kinematics - Analysis and Synthesis – Terminology, Definitions and Assumptions – planar, spherical and spatial mechanisms' mobility – classification of mechanisms – kinematic Inversion – Grashof`s law.

UNIT– II

Position and displacement – complex algebra solutions of planar vector equations – coupler curve generation velocity – analytical methods - vector method – complex algebra methods – Freudenstein's theorem.

UNIT– III

Planar complex mechanisms - Kinematic analysis - low degree complexity and high degree complexity. Hall and Ault`s auxiliary point method – Goodman's indirect method for low degree of complexity mechanisms.

UNIT – IV

Acceleration – Analytical methods – Chase solution - Instant centre of acceleration. Euler-Savary equation - Bobillier construction.

UNIT - V

Synthesis of mechanisms: Type, Number and Dimensional synthesis –

Function generation – two position synthesis of slider crank and crank rocker mechanisms with optimum transmission angle – Three position synthesis – Structural error – Chebychev spacing - Cognate linkages – Robert-Chebychev theorem – Block's method of synthesis. Freudenstein's equation.

UNIT - VI

Static force analysis of planar mechanism – Static force analysis of planar mechanism with friction – Method of virtual work.

UNIT - VII

Dynamic force analysis of planar mechanisms - Combined static and inertia force analysis

UNIT - VIII

Kinematics analysis of spatial Revolute-Spherical-Spherical-Revolute mechanism – Denavit-Hartenberg parameters – Forward and inverse kinematics of Robotic manipulators.

Text Books

1. Shighley Joseph Edward and Uicker John Joseph, Theory of Machines and Mechanisms, McGraw Hill, 1985.

Reference books

1. Amitabha Ghosh and Ashok kumar Mallik, Theory of Mechanisms and Machines, EWP, 1999.
2. Sandor G.N. and Erdman. A.G., Advanced Mechanism Design Analysis and Synthesis, Vol.-I and Vol.-II, PHI, 1984.
3. R. K Mittal and I J Nagarath, Robotics and control, Tata McGraw Hill Co. 1e, 2004

FAILURE ANALYSIS AND DESIGN
(Elective – I)

Course Code: 12ME2206

L	P	C
4	0	4

Aim: In engineering practice, loads on machine members are predominantly variable and they cause fatigue failure. This subject is intended to introduce analysis and study of fatigue in machine components.

Objective: In the undergraduate engineering course, the student is given a brief introduction to fatigue of machine members. This course expands this knowledge in a wider perspective. It enabled the student to deal with real – time fatigue problems during studies and also in practice. Topics like crack propagation and fracture mechanics are discussed in detail.

UNIT- I

Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Design for Reliability – Introduction to Robust Design-Failure mode Effect Analysis.

UNIT - II

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders –Buckling under combined External pressure and axial loading.

UNIT - III

Approach to fatigue control, Introduction to failure, low cycle & high cycle fatigue, Cyclic stresses & strain fatigue, Fatigue life prediction-Cumulative fatigue damage-Stress theory of failure vessels-Thermal stress fatigue

UNIT - IV

Introduction –Through cracks emanating from holes – Corner cracks at holes – Cracks approaching holes-Combined loading-Fatigue crack growth binder- Mixed mode loading-Fracture toughness of weld metals-Service failure analysis

UNIT - V

Solution of fracture mechanics, fatigue testing methods- statistical nature of fatigue data, theories of fatigue-crack initiation and growth in fatigue; Fractorgraphy, structure modes and types.

UNIT - VI

Elements of elasticity-linear elastic crack tip fields. Stress intensity stator-energetic of fracture; nery release rate. Small-scale yielding (SSY) crack growth relation in SSY; Stable crack growth in SSY.

UNIT - VII

Nonlinear fracture mechanics – J integral – Elastic – plastic stationary crack tip fields; ductile structure criterion; J-controlled crack growth ad stability – Tearing modulus – the x factor.

UNIT - VIII

Engineering approach to plastic fracture. J-integral – testing single specimen testing; Standard test methods. Fixed mode mechanics. Recent developments in elastic-plastic fracture mechanics.

Text books:

1. David Broek, Fifthoff and Noerdhoff, Elementary Engineering Fracture Mechanics, International Publisher, 1978.

Reference books:

1. Preshant Kumar, Elements of Fracture Mechanics, Wheeler Publishing, 1999

PRESSURE VESSELS AND PIPING DESIGN
(Elective – I)

Course Code: 12ME2207

L	P	C
4	0	4

Aim and Objective: The aim and objective of the present course is to introduce codes and basic design procedure used for design pressure vessels and pipes

UNIT –I

Introduction to basic pressure vessels and piping design criteria, codes used for design of pressure vessels and pipes. Stresses in thick walled cylinders

UNIT –II

Pressure Design: Wall thickness determination under external pressure, internal pressure and vacuum pressure, design of penetration, design of flanges, cone cylinder junctions.

UNIT –III

External Loads and Fatigue Design: Flexibility, fatigue, stress intensity factors, combined load (sustained wind, earth quake), Cold spring.

UNIT –IV

Factors influencing the design of vessels, design criterion of elliptical, hemispherical, conical, toriconical and torispherical heads, Stresses in pressure vessels, Autofrettage, Thermal stresses

UNIT –V

Design of pressure vessel components such as shell, heads, Nozzles, Flanges as per ASME & IS codes, Elastic buckling of circular ring and cylinders under external pressure –Stiffeners

UNIT –VI

Pipe Support Design: Support types assumptions, load combinations, variable supports, lugs and
attachments, pressure relief, Materials, Fabrication, Inspection and Testing.

UNIT –VII

Piping- Flow diagram- piping elements- piping layout and piping stress Analysis- Flexibility analysis- Codes.

UNIT –VIII

Prediction of thermal and hydraulic loads, Materials, Fabrication, Inspection and Testing of pressure vessels and pipes

Text Books:

1. John .F.Harvey, Theory and Design of Pressure Vessels, CBS Publisher and Distributors. 1e, 1987
2. Somnath Chattopadhyay , Pressure vessels Design and Practice, CRC Press, 1e. 1988

References:

1. ASME Pressure Vessel Codes Section VIII, 1998
2. Dennis Moss, Pressure Vessel Design manual Gulf publishing, 2003.
3. Henry H. Bedner, "Pressure vessels, Design Hand Book, CBS Publishers and distributors, 1987
4. Stanley, M. Wales, "Chemical process equipment, Selection and Design. Butterworths series in Chemical Engineering,1988

TRIBOLOGY
(Elective – I)

Course Code: 12ME2208

L	P	C
4	0	4

Aim & Objective: The aim of the subject is to provide an immense help to the students at postgraduate level to understand the conceptual fundamentals in tribology. The objective of this subject is to provide an overview of technology of lubrication, control of friction and prevention of wear of interacting surfaces in relative motion.

UNIT-I

Properties and Testing of lubricants: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers,

UNIT-II

Friction: Introduction, Laws of friction, kinds of friction, causes of friction, friction measurement, theory of friction. Friction characteristics of metals, friction of Non metals, ceramics and polymers. Study of current concepts of boundary friction and dry friction.

UNIT-III

Lubrication:

Hydrodynamic theory of lubrication: Various theories of lubrication, Petroff's equation, Reynolds equation in two dimensions. Effects of side leakage - Reynolds equation in three dimensions, Somerfield number. Friction in sliding bearing, hydro dynamic theory applied to journal bearing.

UNIT-IV

Hydrostatic lubrication: Hydrostatic step bearing, application to fixed and pivoted pad thrust bearing and other applications, hydrostatic

lifts, hydrostatic squeeze films and its application to journal bearing. Hydrostatic thrust bearings, Hydrostatic bearing analysis including compressibility effects.

UNIT-V

Gas Lubrication: Introduction, Governing Equation, limiting solutions, infinitely long plane slider, infinitely long journal bearings. Externally pressurized gas bearings. Dynamic characteristics of gas lubricated bearings. Whirl instability of journal bearings. Stability of gas bearings supported on rubber 'O' rings.

UNIT-VI

Elastohydrodynamic Lubrication: Introduction, Theoretical considerations, Grubin type solutions, accurate solutions, point contact, dimensionless parameters, film thickness equations. Different regimes in EHL contact

UNIT-VII

Wear of Metals:. Introduction, Definition, Scope, Classification of wear, Adhesive, Delamination, Fretting, Abrasive, Erosive and Corrosive wear. Mechanism of Wear, Wear resistant materials, Wear testing methods, Wear reduction by surface improvement, Introduction to wear of polymers and ceramics.

UNIT-VIII

Nano Tribology: Introduction, measurement tools, Surface force operators, scanning tunneling microscope, friction force microscope, Atomic force microscope, Fabrication techniques for MEMS/NEMS.

Text Books:

1. Basu Sen Gupta and Ahuja, Fundamentals of Tribology, Prentice Hall, 1e, 2006.
2. Prasanth Schoo, Engineering Tribology, PHI Learning Publishing, 1e, 2005.

3. Kenneth C Ludema, Friction, Wear, Lubrication, CRC Press, 1996.

Reference Books:

1. B.C Majumdar, Tribology, C Publications, 2e, 2007.
2. R. Suresh kumar, Tribology, C Publications, 1e, 2011.
3. Barath Bhushan, Introduction to Tribology, Wiley 2002.

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AIRCRAFT SYSTEMS
(Elective – I)

Course Code: 12ME2209

L	P	C
0	3	2

Aim & Objective: The aim and objective of the present course is to provide the basic knowledge of aircraft industry and aircraft systems

UNIT- I

Aircraft industry overview: Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, Industry Supply Chain, Prime contractors, Tier 1 Suppliers, Key challenges in Industry Supply Chain, OEM Supply Chain Strategies, Mergers and Acquisitions, Aerospace Industry Trends, Advances in Engineering/CAD/CAM/CAE Tools and Materials technology, Global and Indian Aircraft Scenario

UNIT- II

Introduction to Aircrafts: Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices.

UNIT- III

Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations- Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft, Advantages and disadvantages of these configurations.

UNIT- IV

Basic Principles of Flight: Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, Bernoulli's Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift.

UNIT- V

Drag, Pitching moments: Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag, Center of Pressure and its effects

Aerofoil Nomenclature: Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, Effects of lift, Drag, speed, Air density on drag. Mach Waves, Mach Angles, Sonic and Supersonic Flight and its effects

UNIT- VI

Mechanics of Flight

Aircraft Performance: Taking-off, Climing,cruise, Landing, Power Curves.

Manoeuvres: Pull out dives, the load Factor, Loads during a Turn, Correct and Incorrect Angles of Bank, Control and steep Banks, Inverted Maneuvers, Maneuverability"

Aircraft Performance and Maneuvers: Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on a Aeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability

UNIT- VII

Stability and Control: Meaning of Stabillity and Control, Degree of Stability- Lateral, Longitudinal and Directional Stability, Dihedral and Anhedral Angles, Control of an Aeroplane"

Introduction to Aircraft Systems: Types of Aircraft Systems. Mechanical Systems. Electrical and Electronic Systems. Auxiliary systems.

UNIT- VIII

Mechanical Systems: Environmental control systems (ECS), Pneumatic systems, Hydraulic systems, Fuel systems, Landing gear systems, Engine Control Systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems Auxiliary Power Unit,

Electrical systems: Avionics, Flight controls, Autopilot and Flight Management Systems, Navigation Systems, Communication, Information systems, Radar System,

Text Books

1. Flight without Formulae by A.C Kermode, Pearson Education,10th Edition
2. Mechanics of Flight by A.C Kermode, Pearson Education,5th Edition
3. Fundamentals Of Flight, Shevell, Pearson Education, 2nd Edition
4. Introduction to Flight by Dave Anderson
5. Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration by Ian moir, Allan Seabridge

Web Resources

1. http://www.aero.org/
2. http://www.rl.af.mil/rrs/resources/griffiss_aeroclub/aircraft.html
3. http://en.wikipedia.org/wiki/Tesla_turbine
4. http://ameslib.arc.nasa.gov/randt/1999/aero/aero.html
5. http://www.ctas.arc.nasa.gov/project_description/pas.html
6. http://www.moog.com/noq/_acoverview__c463/

7. http://www.dcmt.cranfield.ac.uk/aeroxtra/e339.htm
8. http://www.aeromech.usyd.edu.au/structures/as/acs1-p4.htm
9. http://www.av8n.com/how/htm/xref.html.
10. http://www.aviation-history.com/video.html

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COMPUTER AIDED MODELING LAB

Course Code: 12ME2210

L	P	C
4	3	2

Aim and Objective:
To impart the knowledge to students about how to use the software for modeling, drafting and animation of the mechanical components.

Note: Any ten exercises from the following

1. Introduction to various commands in solid modeling
2. Part modeling of fasteners like nut, bolt, screw, rivet etc.
3. Part modeling of flywheel and spur gear
4. Part modeling of I. C. engine parts (cylinder, piston)
5. Part modeling of I. C. engine parts (connecting rod and crank)
6. Drafting of cylinder and piston
7. Drafting of connecting rod and crank
8. Assembly of screw jack
9. Assembly of tailstock
10. Assembly of lathe tool post
11. Animation of four bar mechanism
12. Animation of crank and slotted lever quick return mechanism
13. Animation of slider crank mechanism
14. Introduction to various commands in surface modeling
15. Surface modeling of boiler

Software Packages: CATIA, UG/NX, Pro-E

FINITE ELEMENT ANALYSIS LAB

Course Code: 12ME2211

L	P	C
4	3	2

Introduction to FEA

1. Introduction to Finite Element Analysis Software.
2. Solid modeling
3. Descritization

List of Exercises

Structural Analysis

1. Static analysis of a corner bracket.
2. Statically indeterminate reaction force analysis.
3. Determination of Beam stresses and Deflection.
4. Bending analysis of a Tee-shaped beam.
5. Analysis of cylindrical shell under pressure.
6. Bending of a circular plate using axi-symmetric shell element.
7. Stress analysis in a long cylinder.

Harmonic Analysis

1. Vibration analysis of a simply supported beam.
2. Natural frequency of a motor generator.

Fluid Analysis

Drop test of a container (Explicit Dynamics).

Thermal Analysis

1. Transient Heat transfer in an infinite slab.
2. Transient Thermal stress in a cylinder.

Contact Analysis

Thermal – structural contact of two bodies.

FEA Tools : ANSYS and Unigraphics

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EXPERIMENTAL STRESS ANALYSIS

Course Code: 12ME2212 **L P C**
4 0 4

Aim and objective: This subject provides the basic knowledge of instruments and techniques used for stress measurement and analysis of structures subjected to static and dynamic loads.

UNIT-I
Strain Measurement, ideal strain gauge, mechanical, optical, acoustical, pneumatic, dielectric and electrical strain gauges. Differential transformer and piezoelectric transducers.

UNIT-II
Electrical Wire Resistance Strain Gauges: bonded type gauges, bonding agents, foil gauges, gauge materials. Weldable gauges.

UNIT-III
Strain gauge- adhesive. Fixing of gauges. Temperature effects in bonded gauges. Gauge factor and gauge sensitivity. Measurement of stress, Stress gauge.

UNIT-IV
Measuring Circuits and Strain Gauge Rosette: Potentiometer circuit, Wheatstone bridge, circuit sensitivity and out put, temperature compensation and signal addition. Rectangular, delta and tee- delta rosette. Application of strain gauge in practical problems.

UNIT-V
Whole Field Methods: Photoelasticity, stress loci, isoclinics, isostatics and isochromatics, stress optic law and strain optic law, photoelestic materials, polarization of light, plane polarized and elliptically polarized light.

UNIT-VI

Brittle coating, crack pattern and crack detection in coating. Moire Fringe, geometry. Analysis of Photoelasticity Data, polariscope, fringes due to principal stress direction and difference, model making,

UNIT-VII

Interpretation of isoclinics and isochromatics and fractional fringe order. Calibration through tension, beam and disc models. Reflection polariscopy.

UNIT-VIII

Application to stress concentration and stress intensity factor. Separation of stresses.

Text Books:

1. Experimental Stress Analysis, by JW Dally and WF Riley; McGraw-Hill, 2003
2. K. Ramesh, Computer Aided Photo elastic methods, e-book, IITM, Chennai

Reference Books:

1. CC Perry and HR Lissner, The Strain Gage Primer, McGraw-Hill, 2000
2. Abdul Mubeen, Experimental Stress Analysis, Dhanpat Rai and Sons, 2001
3. PS Theocaris, Moire Fringes in Strain Analysis, Pergammon Press, 2002

MECHANICS OF COMPOSITE MATERIALS

Course Code: 12ME2213

L	P	C
4	0	4

Aim and Objective:

Composite Materials have been extensively used in Aerospace and other allied industries because of their inherent advantages over the conventional metallic materials. So basic understanding and information regarding state of the art in this area is very important and need to be conveyed to the postgraduate engineering students as well as the practicing engineers.

UNIT-I

Introduction: classification of composites: fibrous composites, particulate composites, Applications.

Raw materials: Resins: polyester, epoxy, metal matrices.

Reinforcement: glass fibers, boron fibers, silicone carbide, carbon and graphite fibers, Kevlar, sisal and other vegetable fibers, whiskers, fillers and parting agents.

UNIT-II

Coordinate transformations: Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off -axis, stiffness modulus,

Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites,

UNIT-III

Micro mechanics: Introduction, weight and volume fractions, properties of lamina, representative volume element, micro mechanics, analysis of continuous and discontinuous fibers, reinforced composites, failure modes of unidirectional composites.

UNIT- IV

Fabrication methods: Hand lay-up: materials, molding, bag molding, mating molds, spray up molding, matched - die molding, perform molding, filament winding, winding patterns and winding machines, pultrusion,

UNIT- V

Experimental characterization and testing methods of composites: Properties of constituents: Single filament tensile properties, matrix tensile properties, density, volume fractions, coefficient of thermal and moisture expansions, properties of composites: tensile test method, compression test method

UNIT-VI

Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure free-edge effects.

UNIT- VII

Analysis of laminated composite plates: introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, bending and vibration analysis of laminated composite plates using finite element method.

UNIT - VIII

Fiber composites

Tensile and compressive strength of unidirectional fiber composites, fracture modes in composites: Single and multiple fracture, de-bonding, fiber pullout and de-lamination failure, fatigue of laminate composites.

Text books

1. R.M. Jones, Mechanics of composite Materials, Scripta Book company, Washington DC, 1999

2. Madhujit Mukhopadhyay, Mechanics of composite materials and structures, Universalities press, 2e, 2004

Reference books

1. Isaac and M Daniel, Engineering Mechanics of Composite Materials, Oxford University Press, 1994.

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MECHANICAL VIBRATIONS

Course Code: 12ME2214 **L P C**
4 0 4

AIM: To make the students have clear insight into the phenomenon of vibrating systems under different conditions. It also gives the exact solutions to response problems associated with continuous systems such as springs, rods, shafts and bars.

OBJECTIVES:

To explain the physical system before deriving the mathematical equation for various vibrating systems.

It also gives the importance of damping in a vibrating system under exciting conditions.

The response of undamped and damped systems to initial excitations can be determine for single, two degree freedom system and multi degree of freedom systems

UNIT – I

Introduction – Types of Vibration – Free, Forced and damped vibrations- longitudinal, transverse and torsional vibrations – terminology – single degree of freedom systems – spring mass system – derivation of differential equation – solution – torsional vibration – equivalent stiffness – spring combinations – springs in series and springs in parallel.

UNIT – II

Free vibrations of damped single degree of freedom systems – different types of damping – logarithmic decrement – frequency of damped vibrations. Forced vibration of single degree of freedom system –constant harmonic excitation – steady state vibrations – forced vibrations with rotating and reciprocating unbalance – forced vibration due to excitation of support – vibration isolation – transmissibility

UNIT – III

Two degree of freedom systems – Principal modes of vibration - Twomasses fixed on tightly stretched string – Double pendulum – Torsional system with damping – Forced vibration with harmonic excitation –undamped dynamic vibration absorber – untuned viscous damper.

UNIT – IV

Multi degree of freedom systems – exact analysis - free vibrations – equations of motion – influence coefficients - generalized co-ordinates –Co-ordinate coupling – Natural frequencies and mode shapes –eigenvalues and eigenvectors - orthogonal properties of normal modes –modal analysis

UNIT – V

Continuous systems – vibration of strings – longitudinal vibrations of bars – torsional vibrations of circular shafts - lateral vibration of beams.

UNIT – VI

Multi degree of freedom systems – Numerical methods – Rayleigh`s method – Dunkerley`s method – Stodola`s method – Rayleigh Ritz method – Method of matrix iteration – Holzer's method for natural frequencies of multi rotor systems.

UNIT-VII

Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence. Subspace iteration and Lanczo's method, Eigen value problems applied to stepped beams and bars.

UNIT-VIII

Dynamic Analysis: Direct integration method, Central difference method, Wilson-θ method, Newmark method, Mode superposition, Single degree of freedom system response, Multi degree of freedom system response, Rayleigh damping.

Text books:

1. S.S Rao, “Mechanical Vibrations” , Pearson education, 4e, 2004
2. V. Rammurti, Computer Aided Mechanical Design and Analysis, Tata Mc Graw Hill-1992. (Unit VII and VIII)

References:

1. William T Thomson & Marie Dillon Dahleh, “Theory of Vibrations with application,” Pearson Education Publication – 5th Edition, 2001
2. Tse, Morse and Hinkel, “Mechanical Vibrations”, Chapman and Hall, 1991.
3. Den Hartong J.P., “Mechanical Vibrations”, McGraw Hill, 1986.
4. G.K. Grover, “Mechanical Vibrations,” , Nemchand & Bros, Roorkee, 8e, 2004

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OPTIMIZATION METHODS IN ENGINEERING

Course Code: 12ME2215

L	P	C
4	0	4

Aim & Objectives

- To provide the insights into different optimization methods, technology and terminology.
- Analyse, formulate and solve optimization problems.

UNIT-I

Introduction: Principles of optimization, formulation of objective function, design constraints, classification of optimization problems
Classical optimization techniques: single variable optimization– multivariable with no constraints-multivariable with equality constrained-Direct substitution method, Method of Lagrange multipliers.

UNIT-II

One-dimensional unconstrained optimization: Unimodal function, Methods of single variable optimization -, Bi-section method, Unrestricted, Dichotomous, Fibonacci, Golden Section, Quadratic search, Newton method, Secant method, Cubic search methods.

UNIT-III

Non-linear multivariable optimization without constraints: Univariate search, Pattern search methods- Hookes-Jeeves method, Powells method – Descent methods: Steepest descent method - Fletcher-Reeves method, Newton's method.

UNIT-IV

Non-linear multivariable optimization with constraints: Characteristics of a constrained optimization problem – Penalty approach- Interior and exterior penalty function methods, Augmented Lagrange Multipliers method.

UNIT- V

Geometric Programming: Solution from differential calculus point of view – Solution from arithmetic-geometric inequality point of view- Degree of difficulty- Optimization of zero degree of difficulty problems with and without constraints- Optimization of single degree of difficulty problems without constraints

UNIT-VI

Dynamic programming: Introduction, Representation of a Multistage Decision process-Basic concepts of stochastic programming, stochastic dynamic programming.

UNIT-VII

Genetic Algorithm (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA.

UNIT-VIII

Engineering Applications: Some typical applications like minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters and general procedure in optimizing machining operations sequence.

Text books:

1. Singiresu S. Rao, "Engineering Optimization -Theory and Practice", Wiley, 4th edition, 2009.

References:

1. Kalyanmoy Deb, "Optimization for Engineering Design-Algorithms and Examples", PHI, 8th reprint, 2005.
2. Ashok D. Belegundu, Tirupathi R.Chandrupatla, "Optimization concepts and applications in engineering", PHI, 2nd edition, 2011.

DESIGN OF FLUID POWER SYSTEMS
(Elective – II)

Course Code: 12ME2216

L	P	C
4	0	4

Aim & Objective

To Provide the student with an in – depth background in the field of fluid power. To Provide knowledge related to the design analysis operation maintenance and application of fluid power systems.

UNIT-I: Introduction to Hydraulic Systems and Ancillary Hydraulic Systems

Introduction to Hydraulic Systems, Design and Construction of Hydraulic Reservoir and Sizing, Gravity type, Spring-loaded and Gas loaded type Accumulators

UNIT-II: Hydraulic Pumps

Gear pumps, Vane pumps and Piston pumps, Sizing of Hydraulic Pumps, Selection of Hydraulic Pumps

UNIT-III: Hydraulic Control Valves

Direction Control Valves, Pressure Control Valves, Flow Control Valves, Servo Valves

UNIT-IV: Hydraulic Cylinders and Hydraulic Motors

Hydraulic cylinder operation and cylinder mountings, Hydraulic cylinder Design and Cushions, Hydraulic Motors operation- Gear, Vane and Piston motors, Hydraulic Motor performance, Hydrostatic Transmissions

UNIT- V: Hydraulic circuit Design & Analysis

Control of single and double acting cylinders, Regenerative and pump unloading circuit, Hydraulic Cylinder Sequence and Synchronizing Circuits, Speed Control of Hydraulic Cylinder and motor, Hydraulic Motor breaking system

UNIT-VI: Pneumatics: Circuits and Applications
Introduction to Pneumatics, Pneumatic Circuit Design considerations, Basic Pneumatic Circuits and Analysis

UNIT-VII: Maintenance and Trouble shooting of hydraulic & pneumatic circuits and Components
Oxidation and Corrosion of Hydraulic Fluids, Maintaining and Deposing of Fluids, Wear of moving parts due to solid particle contamination of the fluid, Problems caused by gases in Hydraulic Fluids, Troubleshooting of Hydraulic System, Common problems in Pneumatic
Systems, Troubleshooting of Pneumatic Systems

UNIT – VIII: Advanced Electrical controls for fluid power systems
Components of Electro-Hydraulic Servo Systems, Analysis of Electro- Hydraulic Servo Systems, Programmable Logic Controllers (PLCs)

Text Books:

1. "Fluid Power with Applications" by Anthony Esposito, PHI, New Delhi, 1e, 2005
2. "Hydraulics and Pneumatics" by Andrew Parr, Jaico Publishing house,9e, 2005

References:

1. S.R.Majumdar, " Oil Hydraulic Systems" , Tata Mc Graw Hill,1e,2002
2. S.R.Majumdar, " Pneumatic Systems" , Tata Mc Graw Hill,1e,2002
3. www.pneumatics.com
4. www.fluidpower.com.

COMPUTATIONAL FLUID DYNAMICS
(Elective – II)

Course Code: 12ME2217

L	P	C
4	0	4

Aim and objective:
To familiarize students with mathematical modeling of physical problems and teach some numerical solution methods

UNIT-I
Conservation of mass, momentum and energy balance equations used in fluid flow - Definitions of stream function and vorticity. Classification of second order partial differential equations as hyperbolic, parabolic and elliptic equations.

UNIT-II
Numerical integration - Trapezoidal and Simpson rules. Roots of a function - bisection method, method of false position, Newton-Raphson scheme.

UNIT III
Solution of a system of linear algebraic equations: Iterative methods - Jacobi method - Gauss-Siedel method. Direct methods - Gaussian elimination and Gauss-Jordan method. Solution of a tri-diagonal matrix - Thomas algorithm.

UNIT-IV
Numerical solution of ordinary differential equations by fourth-order Runge-Kutta method: Solution of a first order differential equation - Solution of two simultaneous first order differential equations - Solution of a second order differential equation.

UNIT-V
Three selected finite difference applications in heat conduction: Heat

dissipation through a straight fin - Two dimensional heat conduction in rectangular geometry - One-dimensional transient heat conduction in a rectangular slab.

UNIT-VI

Fundamentals of fluid flow modeling - Conservative property - Transportive property - Second upwind differencing or hybrid scheme.

Solution of viscous incompressible flows by the stream function-vorticity formulation - Two dimensional incompressible viscous flow in a lid-driven cavity in Cartesian coordinates.

UNIT VII

Solution of Navier-Stokes equations for incompressible flows - Governing continuity and momentum balance equations in conservative form - Concept of staggered grid - SIMPLE formulation for one-dimensional convection-diffusion equation -

UNIT VIII

Extension to two dimensional equation with pressure gradient - Discussion on various differencing schemes - central difference approximation - upwind scheme - hybrid scheme.

Text Book

K. Muralidharan and T. Sundararajan, Computational Fluid Flow and Heat Transfer, Second Edition, Narosa Publishing House, New Delhi, 2003.

Reference Books

1) Suhas V. Patankar, Numerical heat transfer and fluid flow, Taylor & Francis, 1980

2) John D. Anderson, Jr., Computational fluid dynamics - The basics with applications, McGraw-Hill,1995
3) H.K. Versteeg and W. Malalasekera, An introduction to computational fluid dynamics -The finite volume method, Pearson Education Limited, England,(1995
4) S.S. Sastry, Numerical Analysis.

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INDUSTRIAL ROBOTICS
(Elective – II)

Course Code: 12ME2218

L	P	C
4	0	4

Aims and Objectives:

1. To impart the knowledge about various robot configurations used in industries and its Kinematic analysis.
2. To make students aware of robot vision system, control system, feedback systems, actuators etc.
3. To give some preliminary idea about robot programming and languages.

UNIT–I

Introduction: Automation and Robotics. Robot anatomy, Robot configuration motions. Joint notation, work volume, robot drive systems, control systems and dynamic performance, precision of movement.

UNIT–II

Control Systems and Components: Basic concepts and models, controllers. control system analysis, Robot Activation and feedback components. Position sensors, Velocity sensors, Actuators. Power, Transmission systems.

UNIT–III

Motion Analysis and Control: Manipulator Kinematics, Position Representation Forward Transformation, Homogenous Transformations, Manipulator path control Robot Dynamics, Configuration of a Robot Controller.

UNIT–IV

End Effectors: Grippers-Types, operation, mechanism, Force analysis, Tools as end effectors, Considerations in gripper selection and design. SENSORS-Desirable features, Tactile, Proximity and Range sensors,

Uses of sensors in Robotics.

UNIT–V

Machine Vision: Functions, Sensing and Digitizing-Imaging, devices, lighting techniques, Analog to digital signal conversion, Image storage, Image processing and Analysis-Image Data Reduction, Segmentation, Feature, Extraction, Object Recognition, Training the vision system, Robotics Applications.

UNIT-VI

Robot Programming: Lead through programming, Robot programming as a path in space, mation interpolation, WAIT, SIGNAL and DELAY commands, branching capabilities and limitations. Robot Languages: Textual Robot languages, generations, Robot language structures, Elements in functions.

UNIT-VII

Robot Cell Design and Control: Robot cell layouts-Robot centered cell. Inline Robot cell, Mobile Robot Cell, Considerations in work design, work cell control, Inter locks, Errors detection, Work cell controller.

UNIT-VIII

Robot Applications: Material transfer, Machine Loading/ Unloading, Processing Operations, Assembly and Inspections.

Text Books:

1. M.D Groover, M Weiss, R M gnagel and N G Ordrey,Industrial Robotics, McGraw Hill, 1986.

Reference Books:

1. R.K. Mittal, I J Nagrath, Robotics and Control, Tata Mc Graw Hill, 2003.

ACOUSTICS AND NOISE CONTROL
(Elective – II)

Course Code: 12ME2219 **L P C**
4 0 4

Aim and objective: This subject provides the basic knowledge of acoustics and techniques used for noise measurement and methods of noise control.

UNIT -I

Introduction –Basic acoustic principles-acoustic terminology and definitions-Plane waves-harmonic solution-velocity of sound in inviscid fluids-relationship between wave length particle velocity, acceleration – Energy density – acoustic intensity – reference standards and measurement-

UNIT -II

Transmission through one, two and thee media. Transmission through pipes-branched and unbranched-resonators-Transmission loss reflection at plane surface-standing waves and standing wave apparatus

UNIT -III

Spherical waves – radiation – simple source –hemispherical source-radiating piston-pressure intensity distribution-Beam width and directivity index-sound absorbing materials.

UNIT -IV

Noise measurement: Decibel scale-relationship between pressure, intensity and power-sound level meter, noise analyzer and graphic level recorder-measurement in anechoic and reverberation chambers, machinery noise control.

UNIT -V

Environmental noise control: Human reaction to sound-definitions of

speech interference level, perceived noise level, phon and sone etc, hearing loss-principles of noise control-control at source, during transmission and at receiver-protection of receiver.

UNIT -VI

Acoustic insulation-acoustic materials-acoustic filter and mufflers – plenum chamber-noise criteria and standards.

UNIT -VII

Noise and number index guide lines for designing quieter equipments – machinery noise such as pumps, rotating machines, reciprocating machines etc.

UNIT -VIII

Methods of control of noise using baffles, coverings, perforations etc. Transmission through structures – control vibration by damping and other methods. Principles of noise control in an auditorium-requirements of a good auditorium

Text Books:

1. Kinsler and frey, Fundamental of Acoustics, Wiley, 1e, 2008
2. Berenek, L.L, Noise and Vibration control, McGraw Hill,1e, 1971

References:

1. Petrusowicz and Longmore, Noise and Vibration control for industrialists, American Elsevier Pub. Co., 1e, 1974
2. Thumann and Miller, Secrets of noise control, Fairmont Press, U.S.; 2nd edition, 1976

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AIRCRAFT STRUCTURES
(Elective – II)

Course Code: 12ME2220 **L P C**
4 0 4

Aim & Objective: The aim and objective of the present course is to provide the basic methodologies to design and analysis of aircraft structures

UNIT-I

Aircraft Design Process: Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies

Fundamentals of Structural Analysis: Review of Hooke's Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, St Venant's Principle, Conservation of Energy, Stress Transformation, Stress Strain Relations

UNIT-II

Introduction to Aircraft Structures: Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, Types of structural joints, Type of Loads on structural joints

Aircraft Loads, Duration: Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads

UNIT-III

Aircraft Materials and Manufacturing processes: Material selection criteria, Aluminum Alloys, Titanium Alloys, Steel Alloys, Magnesium Alloys, copper Alloys, Nimonic Alloys, Non Metallic Materials, Composite Materials, Use of Advanced materials Smart materials, Manufacturing of A/C structural members, Overview of Types of manufacturing processes for Composites, Sheet metal Fabrication ,Machining, Welding, Superplastic Forming And

Diffusion Bonding

UNIT-IV

Structural Analysis of Aircraft Structures: Theory of Plates- Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysis of stiffened panels in buckling, Rectangular plate buckling, Analysis of Stiffened panels in Post buckling, Post buckling under shear. Sample Exercises.

UNIT-V

Theory of Beams-Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams, Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed Section Beams, Shear Stresses due to Torsion in Thin Walled Beams. Sample Exercises.

UNIT-VI

Theory of Torsion- Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections, Sample Exercises.

Theory of Shells-Analysis of Shell Panels for Buckling, Compression loading, Shear Loading / Shell Shear Factor, Circumferential Buckling Stress, sample exercises

UNIT-VII

Airworthiness and Aircraft Certification: Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design Covers, Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements

UNIT-VIII

Aircraft Structural Repair: Types of Structural damage, Nonconformance, Rework, Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices

Text Books

1. Aircraft Design-A Conceptual Approach by Daniel P. Raymer, AIAA education series, 6e, 2001
2. Airframe Structural Design by Michael Niu, Conmilit Press, 2e, 1988
3. Airframe Stress Analysis and Sizing by Michael Niu, Conmilit Press, 3e, 1999
4. The Elements of Aircraft Preliminary Design – Roger D. Schaufele, Aries Publications, 2000
5. Aircraft Structural Maintenance by Dale Hurst, Avotek publishers, 2e, 2006
6. Aircraft Maintenance & Repair by Frank Delp, Michael J. Kroes & William A. Watkins, Glencoe &McGraw-Hill,6e,1993
7. An Introduction to Aircraft Certification; A Guide to Understanding Jaa, Easa and FAA by Filippo De Florio, Butterworth-Heinemann

Web resources

1. http://www.aero.org/
2. http://www.rl.af.mil/rrs/resources/griffiss_aeroclub/aircraft.html

3. http://en.wikipedia.org/wiki/Tesla_turbine
4. http://ameslib.arc.nasa.gov/randt/1999/aero/aero.html
5. http://www.ctas.arc.nasa.gov/project_description/pas.html
6. http://www.moog.com/noq/_acoverview__c463/
7. http://www.dcmt.cranfield.ac.uk/aeroxtra/e339.htm
8. http://www.aeromech.usyd.edu.au/structures/as/acs1-p4.htm
9. http://www.av8n.com/how/htm/xref.html
10. http://www.aviation-history.com/video.html

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ADVANCED MECHANICAL DESIGN LAB

Course Code: 12ME2221

L	P	C
4	3	2

Aim and Objective:
To impart the hands on experience in design and analysis of mechanical components

Note: Any **ten** exercises from the following

1. Noise and Vibration measurements
2. Universal Testing Machine– Buckling test
3. Composite Fabrication – Hand lay-up and Resin Transfer Molding (RTM)
4. Fatigue Testing Machine – Axial Tension and Bending
5. Gyroscope
6. Dynamics Balancing
7. Design of parts of IC Engine – crankshaft, connecting rod, piston, valve gears.
8. Design of power transmission systems – complete design of belt drive and gear reducer and Drafting.
9. Creep test.
10. Experiments using strain gauges
11. Load cell and strain gauge based study on cantilever
12. Inductive Pick up Strain Gauge based study on cantilever

DESIGN OPTIMIZATION LAB

Course Code: 12ME2222

L	P	C
4	3	2

Aim and Objective:

- To introduce methods of solving design optimization problems using software packages.
- To enable the student to develop basic numerical techniques and computer codes for Nonlinear Optimization and their application in Engineering Analysis and Design.

Note: Any **ten** of the following exercises to be performed during the semester.

LIST OF EXPERIMENTS:

1. Introduction to MATLAB commands
2. Simple exercises on use of arrays.
3. To carry out unconstrained non-linear single variable optimization. ((Direct method)
4. To carry out unconstrained non-linear single variable optimization. (Descent method)
5. To carry out unconstrained non-linear multivariable optimization. (Direct method)
6. To carry out unconstrained non-linear multivariable optimization (Descent method)
7. To carry out constrained non-linear single variable optimization.
8. Exercise on use of neural network toolbox.
9. Exercise on use of Genetic algorithm toolbox.

10. Exercise on use of fuzzy logic toolbox.

11. Topology optimization.

12. Topography optimization.

13. Shape optimization.

Software Packages: MATLAB/ HYPERMESH/ NX-NASTRAN/ ANSYS