### M.E. COMPUTER AIDED DESIGN

#### Semester No.1

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**E1 Elective I**

**E2 Elective II**

#### Practical

**ED9112 CAD Lab**

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**E3 Elective III**

**E4 Elective IV**

#### Practical

**ED9125 Analysis and Simulation Lab**

| CD9123 Seminar |                               | 0 | 0 | 2 | 1 |

#### Semester No.3

| E5 Elective V  |                               | 3 | 0 | 0 | 3 |
| E6 Elective VI |                               | 3 | 0 | 0 | 3 |
| E7 Elective VII|                               | 3 | 0 | 0 | 3 |

**CD9131 Project Work – Phase I**

| CD9131 Project Work – Phase I | 0 | 0 | 12 | 6 |

#### Semester No.4

| CD9141 Project Work – Phase II | 0 | 0 | 24 | 12 |

*"a Term Project must be given for Assessment – 3 (Compulsory) *(Total number of credits: 21 + 23 + 15 + 12 = 71)
### COMMON ELECTIVES (M.E. – Engineering Design/Computer Aided Design/Product Design and Development)

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UNIT – I  2 – D Random Variables  

UNIT – II  Computational methods in Engineering  
Boundary value problems for ODE – Finite difference methods – Numerical solution of PDE – Solution of Laplace’s and Poisson equation – Liebmann's iteration process – Solution of heat conduction equation by Schmidt explicit formula and Crank-Nicolson implicit scheme – Solution of wave equation

UNIT – III  Tensor analysis  
Summation convention – Contravariant and covariant vectors – contraction of tensors – inner product – quotient law – metric tensor – Christoffel symbols – covariant differentiation – gradient, divergence and curl

UNIT – IV  Calculus of variation  
Variation and its properties – Euler's equation – functionals dependent on first and higher order derivatives – functionals dependent on functions of several independent variables – problems with moving boundaries – direct methods – Ritz and Kantorovich methods

UNIT – V  Fast Fourier Transform  

TOTAL: L: 45 + T: 15 = 60

BOOKS FOR REFERENCE:

UNIT – I Design Fundamentals


UNIT – II Customer Oriented Design & Societal Considerations


UNIT – III Design Methods


UNIT – IV Material Selection Processing and Design


UNIT – V Probability concepts in Design for Reliability


TEXT BOOKS:

REFERENCES:
UNIT – I  Introduction to Computer Graphics Fundamentals  11
Output primitif (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotators) windowing - view ports - clipping transformation.

UNIT – II  Introduction to CAD software  8
Writing interactive programs to solve design problems and production of drawings - using any languages like Auto LISP/C/FORTRAN etc. - creation of surfaces - solids etc. using solid modeling packages (prismatic and revolved parts).

UNIT – III  Solid Modeling  8

UNIT – IV  Visual Realism  9
Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software’s and their principles creation of prismatic and lofted parts using these packages.

UNIT – V  Assembly of Parts  9
Assembly modeling - interferences of positions and orientation - tolerances analysis - mass property calculations - mechanism simulation.

NOTE: LAB PRACTICE OF 30 HRS. TOTAL  45 + 30 = 75 HOURS

REFERENCES:
PD 9111 QUALITY CONCEPTS IN DESIGN

AIM
To study about robust design, embodiment principles, various methods in design of experiments, reliability charts and histograms and six sigma techniques.

1. Design for Quality

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

2. Failure Mode Effect Analysis

Basic methods: Refining geometry and layout, general process of product embodiment-Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling-Case study- computer monitor stand for a docking station.

3. Design of Experiments

Design of experiments-Basic methods- Two factorial experiments-Extended method-reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design-Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual t-test, ANOVA-ratio test, other indicators-residual plots, Advanced DOE method for product testing-Product applications of physical modeling and DOE, Blender panel display evaluation, coffee grinder experimental optimization-Taguchi method.

4. Statistical consideration and Reliability

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control-Scatter diagrams –Multivariable charts –Matrix plots and 3-D plots.- Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution

5. Design for SIX SIGMA

Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services
REFERENCE:


### ED 9112 CAD LAB L T P C 0 0 2 1

- **CAD** Introduction.
- **Sketcher**
- **Solid modeling** – Extrude, Revolve, Sweep, etc and Variational sweep, Loft ,etc
- **Surface modeling** – Extrude, Sweep, Trim ..etc and Mesh of curves, Free form etc
- **Feature manipulation** – Copy, Edit, Pattern, Suppress, History operations etc.
- **Assembly**-Constraints, Exploded Views, Interference check
- **Drafting**-Layouts, Standard & Sectional Views, Detailing & Plotting.

Exercises in Modeling and drafting of Mechanical Components - Assembly using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA / NX etc

**TOTAL-45 HR**
OBJECTIVE:
At the end of this course the students would have developed a thorough understanding of the basic principles of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving practical problems arising in engineering design.

Unit-I: General Introduction * 10

Introduction- structural element and system- assembly and analysis of a structure-boundary conditions- general pattern- standard discrete system- transformation of coordinates- examples – direct physical approach to problems in elasticity- direct formulation- displacement approach – minimization of total potential- convergence criteria – discretization error- nonconforming elements and patch test- solution process- numerical examples

Unit-II: Generalization of Finite Element Concepts and Element Shape Functions* 7


Unit-III: Applications to Field Problems * 9

Solution to problems in linear elasticity- plane problems in elasticity- plates and shells- solution of problems in heat-transfer and fluid mechanics- numerical examples- discussion on error estimates

Unit-IV: Finite Elements in Structural Dynamics and Vibrations ** 10

Dynamic equations- stiffness, mass and damping matrices- consistent and diagonal mass matrices- Extraction of natural frequencies and modes- Reduction of number of degrees of freedom - modal methods - component mode synthesis- harmonic analysis- response history- explicit and implicit direct integration- stability and accuracy- analysis of response spectra- example problems
Unit-V: Non-linear Analysis

Non-linear problems in elasticity- some solution methods- plasticity: introduction, general formulation for small strains- formulation for von Mises theory- computational procedure- problems of gaps and contact- geometric non-linearity- modelling considerations

Note
At the post-graduate level of instruction the contact hours are to be supplemented by self study by students. As for the examination, modelling considerations, choice of elements, boundary conditions, loading conditions, and basic procedures only need to be emphasized without expecting a complete numerical solution to practical problems.

REFERENCES


OBJECTIVE:
(i). To understand the Fundamentals of Vibration and its practical applications.
(ii). To understand the working principle and operations of various vibrations measuring instruments.
(iii). To understand the various Vibration control strategies.

1. Fundamentals of Vibration


2. Two Degree Freedom System

Introduction - Free Vibration Of Undamped And Damped - Forced Vibration With Harmonic Excitation System - Coordinate Couplings And Principal Coordinates.

3. Multi-Degree Freedom System and Continuous System


4. Vibration Control


5. Experimental Methods in Vibration Analysis


45 + 15 Lab Hours Total 60

** a Term Project must be given for Assessment – 3 (Compulsory)
Text book:


References:


CD 9121                   INTEGRATED MECHANICAL DESIGN
(Use of Approved Data Book Is Permitted)                        L T P C
                                                      3 1 0 4

1. Fundamentals and Design of Shafts                                  8

   Phases of design – Standardization and interchangeability of machine elements
   - Process and Function Tolerances – Individual and group tolerances – Selection
   of fits for different design situations – Design for assembly and modular
   constructions – Concepts of integration –BIS, ISØ, DIN, BS, ASTM Standards.
   Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear
   stress - Theories of Failure – Ductile vs. brittle component design -
   Analysis and Design of shafts for different applications – integrated design of
   shaft, bearing and casing – Design for rigidity

2. Design of Gears and Gear Boxes                                    12

   Principles of gear tooth action – Gear correction – Gear tooth failure modes –
   Stresses and loads – Component design of spur, helical, bevel and worm gears –
   Design for sub assembly – Integrated design of speed reducers and multi-speed
   gear boxes – application of software packages.

3. Brakes                                                           7

   Dynamics and thermal aspects of vehicle braking – Integrated design of brakes
   for machine tools, automobiles and mechanical handling equipments.

4 Integrated Design                                                18

   Integrated Design of systems consisting of shaft, bearings, springs, motor,
   gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example -
   Design of Elevators, Escalators, Gear Box, Valve gear Mechanisms,
   Machine Tools
Total No of periods: 45+15=60

The Pattern of Question Paper will consist one Question from Unit – 4 for 50% of total marks.

"a Term Project must be given for Assessment – 3 (Compulsory)

REFERENCES:

Approved Data Books


CD9122 COMPUTER AIDED TOOLS

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1. **Computer Aided Manufacturing**


2. **Computer Aided Process Planning**


3. **Computer Aided Inspection**

   9

4. Reverse Engineering 9


5. Data Management 9


Total: 45 Hours

Text Books


References

Analysis of Mechanical Components – Use of FEA Packages like ANSYS/ NASTRAN etc., Exercises shall include analysis of

i) Machine elements under Static loads
ii) Thermal Analysis of mechanical systems
iii) Modal Analysis
iv) Machine elements under Dynamic loads
v) Non-linear systems

Use of kinematics and dynamics simulation software like ADAMS, MATLAB. Analysis of velocity and acceleration for mechanical linkages of different mechanisms.

Total 45
ED 9150  OPTIMIZATION TECHNIQUES IN DESIGN  

L T P C  

3 0 0 3  

1. **Unconstrained Optimization Techniques**  
   
   Introduction to optimum design - General principles of optimization – Problem formulation & their classifications - Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

2. **Constrained Optimization Techniques**  

   Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming

3. **Advanced Optimization Techniques**  

   Multi stage optimization – dynamic programming; stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques; Neural network & Fuzzy logic principles in optimization.

4. **Static Applications**  


5. **Dynamic Applications**  

   Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

   **Total** 45

**References:**

Objective

Study about the design methodologies for manufacture and assembly, value engineering techniques and analysis of product development

1. Design for Manufacture


2. Form Design of Castings and Weldments

   Redesign of castings based on parting line considerations - Minimizing core requirements - Redesigning a cast members using weldments-factors influencing form design-Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials-on from design - form design of welded members, forgings and castings.

3. Design for Assembly

   Assembly processes-Handling and insertion process-Manual, automatic and robotic assembly-Cost of Assembly-Number of Parts-DFA guidelines

4. Value Engineering


5. Product Development Economics

   Elements of Economics analysis-Quantitative and qualitative analysis-Economic Analysis process-Estimating magnitude and time of future cash inflows and out flows-Sensitivity analysis-Project trade-offs-Trade-offs rules-Limitation of quantitative analysis-Influence of qualitative factors on project success

   Total 45 hr

Text book:


References:

2. Charles E. Ebeling, Reliability and Maintainability Engineering, , TMH, 2000
1. **Elements of Solid Mechanics**

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – Airy’s function – field equation for stress intensity factor.

2. **Stationary Crack under Static Loading**


3. **Energy balance and crack growth**


4. **Fatigue crack growth curve**

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values.- leak before break analysis.

5. **Applications of Fracture Mechanics**

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods

**Total 45**

**References:**

1. **Introduction**
   General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits -Datum features - Tolerance stacks.

2. **Factors Influencing Form Design**
   Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

3. **Component Design - Machining Consideration**

4. **Component Design – Casting Consideration**
   Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

5. **Design for the Environment**

Total 45
REFERENCES:
1. Surface Interaction and Friction

Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact

2. Wear and Surface Treatment


3. Lubricants and Lubrication Regimes


4. Theory of Hydrodynamic and Hydrostatic Lubrication

Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing- Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

5. High Pressure contacts and Elasto hydrodynamic Lubrication

Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives

Total 45
References:

UNIT – I Elasticity


UNIT – II Shear Center and Unsymmetrical Bending

Location of shear center for various thin sections - shear flows. Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section.

UNIT – III Curved Flexible Members and Stresses in Flat Plates

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions

UNIT – IV Torsion of Non-Circular Sections

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.

UNIT – V Stresses in Rotary Sections and Contact stresses

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications.

TOTAL:45

REFERENCES:

OBJECTIVE

i) To understand the fundamentals of composite material strength and its mechanical behavior

ii) Understanding the analysis of fiber reinforced Laminate design for different Combinations of plies with different orientations of the fiber.

iii) Thermo-mechanical behavior and study of residual stresses in Laminates during processing.

iv) Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

1. Lamina Constitutive Relations


2. Flat Plate Laminate Constitutive Relations


3. Lamina Strength Analysis


4. Analysis of Laminated Flat Plates


5. Effect of Thermal Properties

TEXT BOOK:


REFERENCES:

1. **Basic Concepts of Acoustics**

Scope of Acoustics – Sound pressure – Sound intensity – Sound power level

2. **Characteristics of Sound**

One dimensional wave equation – Solution of 1D wave equation – Velocity in gaseous medium – Velocity of plane progressive sound wave through a thin solid rod – Velocity of plane wave in a bulk of solid – Transverse wave propagation along a string stretched under tension – Wave equation in two dimension.

3. **Transmission Phenomena**

Changes in media – Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence – Standing wave pattern – Transmission through three media.

4. **Introduction to the assessment and measurement of sound**


5. **Basics of Noise Control**

Noise Control at source, path, receiver – Noise control by acoustical treatment – Machinery noise – Types of machinery involved – Determination of sound power and sound power level – Noise reduction procedures – Acoustic enclosures.

**REFERENCES:**

1. Introduction to Tool design


2. Design of cutting Tools


3. Design of Jigs and Fixtures


4. Design of Press Tool Dies


5. Tool Design for CNC machine tools


TOTAL: 45
REFERENCES:

1. PRODUCTIVITY

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle Productivity Measurement at International, National and Organisation level - Productivity measurement models

2. SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) – Methodology and application to manufacturing and service sector.

3. ORGANISATIONAL TRANSFORMATION

Elements of Organisational Transformation and Reengineering-Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines, LMI CIP Model – DSMC Q & PMP model.

4. RE-ENGINEERING PROCESS IMPROVEMENT MODELS

PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model.

5. RE-ENGINEERING TOOLS AND IMPLEMENTATION

Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem – Cases.

Total : 45

REFERENCES

1. **Introduction and Robot Kinematics**  

2. **Robot Drives and Control**  

3. **Robot Sensors**  

4. **Robot Cell Design and Application**  

5. **Robot Programming, Artificial Intelligence and Expert Systems**  

**TEXT BOOK:**

**REFERENCES:**
1. **FUNDAMENTALS OF HEAT EXCHANGER**


2. **FLOW AND STRESS ANALYSIS**


3. **DESIGN ASPECTS**


4. **COMPACT AND PLATE HEAT EXCHANGERS**


5. **CONDENSERS & COOLING TOWERS**

   Design of surface and evaporative condensers – cooling tower – performance characteristics.

**TOTAL PERIODS: 45**

**REFERENCES**

1. Introduction


2. Liquid based and solid based rapid prototyping systems


3. Powder based rapid prototyping systems:


4. Reverse Engineering and CAD Modeling


5. Rapid Tooling

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries.

TEXT BOOK:


REFERENCE:

UNIT – I Materials Handling Equipment
Types, selection and applications

UNIT – II Design of Hoists
Design of hoisting elements: Welded and roller chains - Hemp and wire ropes -
Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling
attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets
- Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone
types.

UNIT – III Drives of Hoisting Gear
Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and
monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor
ratings.

UNIT – IV Conveyors
Types - description - design and applications of Belt conveyors, apron conveyors
and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT – V Elevators
Bucket elevators: design - loading and bucket arrangements - Cage elevators -
shaft way, guides, counter weights, hoisting machine, safety devices - Design of
fork lift trucks.

TOTAL:45

TEXT BOOKS
2. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and

REFERENCES
   1 & 2, Suma Publishers, Bangalore, 1983
1. Theory of Plasticity

Theory of plastic deformation - Engineering stress and strain relationship – Stress tensor - Strain tensor - Yield criteria’s - Plastic stress strain relationship – Plastic work - Equilibrium conditions - Incremental plastic strain

2. Constitutive relationships and Instability

Uniaxial tension test - Mechanical properties - Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress

3. Analysis of metal forming problems

Slab analysis - Slip line method, upper bound solutions, statistically admissible stress field, numerical methods, contact problems, effect of friction, thermo elastic Elasto plasticity, elasto visco plasticity - Thermo mechanical coupling – Analysis of forging, rolling, extrusion and wire drawing processes - Experimental techniques of the evaluation of metal forming

4. Analysis of Sheet metal Forming


5. Advances in metal Forming

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotropic pressing, high speed extrusion, rubber pad forming, micro blanking – Superplastic forming - Overview of Powder Metal techniques - Powder rolling - Tooling and process parameters

References:
OBJECTIVE:

After undergoing this course, the students would be in a position to understand the behaviour of these commonly occurring structural elements in engineering design and would have developed the capability to design and analyse them in their normal design practice.

1. General Introduction

Review of equations of elasticity- kinematics, compatibility equations, stress measures- equations of motions- constitutive relations- transformation of stresses, strains and stiffness-energy principles and variational methods in elasticity- virtual work-external and internal virtual work- variational operator- functionals- Euler Lagrange equations- energy principles- Hamilton’s principle- principle of minimum total potential- applications

2. Classical Theory of Plates

Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

3. Buckling Analysis of Rectangular Plates

Buckling of simply supported plates under compressive forces- governing equations- the Navier solution- biaxial compression of a plate- uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy’s solution- buckling of plates with various boundary conditions- general formulation- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

4. Vibration of Plates

Governing equations for natural flexural vibrations of rectangular plates- natural vibrations of plates simply supported on all edges- vibration of plates with two parallel sides simply supported- Levy’s solution- vibration of plates with different boundary conditions- Rayleigh-Ritz method- Natural vibration of plates with general boundary conditions- transient analysis of rectangular plates- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

5. Analysis of Thin Elastic Shells of Revolution

Classification of shell surfaces- geometric properties of shells of revolution- general strain displacement relations for shells of revolution- stress resultants- equations of motion of thin shells- analytical solution for thin cylindrical shells- membrane theory- flexure under axisymmetric loads- shells with double curvature- geometric considerations- equations of equilibrium- bending of spherical shells- vibration of
cylindrical shells- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)

Total: 45 periods

Reference:
4. Wilhelm Flügge, stresses in shells, Springer - Verlag
7. Dr.N.Subramanian, Principles of Space Structures, Wheeler Publishing Co. 1999

ED 9162 DESIGN OF PRESSURE VESSELS AND PIPING L T P C
3 0 0 3

1. Introduction

2. Stresses in Pressure Vessels

3. Design Of Vessels

4. Buckling And Fracture Analysis In Vessels
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.
5. Piping


Text Books


References


CI9122 MECHATRONICS IN MANUFACTURING SYSTEMS L T P C

3 0 0 3

OBJECTIVE

This syllabus is formed to create knowledge in Mechatronic systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives a framework of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

1. INTRODUCTION


2. SENSORS AND TRANSDUCERS


3. ACTUATORS


4. PROGRAMMABLE LOGIC CONTROLLERS

Introduction - Basic structure - Input and output processing - Programming - Mnemonics-
Timers, counters and internal relays - Data handling - Selection of PLC.

5. DESIGN AND MECHATRONICS CASE STUDIES

Designing - Possible design solutions-Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Conveyor based material handling system - PC based CNC drilling machine - Engine Management system - Automatic car park barrier - Data acquisition Case studies.

Total: 45

TEXT BOOK


REFERENCES

1. **Overview**  

2. **Theoretical Basis**  

3. **Mobility Measurement Techniques**  

4. **Modal Parameter Extraction Methods**  

5. **Derivation of Mathematical Models**  

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**References:**

1. Oil Hydraulic Systems and Hydraulic Actuators

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

2. Control and Regulation Elements

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

3. Hydraulic Circuits


4. Pneumatic Systems and Circuits

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

5. Installation, Maintenance and Special circuits

Pneumatic equipments- selection of components - design calculations – application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

References:

1. **Forces and Strain Measurement**


2. **Vibration Measurements**


3. **Acoustics and Wind Flow Measures**


4. **Distress Measurements**


5. **Non Destructive Testing Methods**


Total 45

References:

1. INTRODUCTION

Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems analysis of manufacturing operations.

2. GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING


3. COMPUTER AIDED PLANNING AND CONTROL

Production planning and control-cost planning and control-inventory management-Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology- automated data collection system.

4. COMPUTER MONITORING

Types of production monitoring systems-structure model of manufacturing process-process control & strategies- direct digital control-supervisory computer control-computer in QC - contact inspection methods non-contact inspection method - computer-aided testing - integration of CAQC with CAD/CAM.

5. INTEGRATED MANUFACTURING SYSTEM

Definition - application - features - types of manufacturing systems-machine tools-materials handling system- computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS - variable mission manufacturing system - CAD/CAM system - human labor in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

References:
1. Introduction to maintenance Systems

Introduction to repair and Maintenance - Maintenance as business - Maintenance systems such as reactive, preventive, predictive or proactive systems - Human resources management in Maintenance management - Maintainability - Inherent and overall availability. - Mean time between failures, mean time to repairs and mean down time, Testability and supportability - "Design for Maintenance" - Poor maintainability aspects - Design for reliability.

2. Condition Based Maintenance

Condition based monitoring of equipment and systems - Condition monitoring techniques such as a) Vibration analysis, b) Ultrasonic detection techniques, c) Thermography, d) Oil and lubricant analysis, e) Motor condition monitoring (MCM) - Shaft alignments through laser - Vibration instruments - Outline on Thermography

3. Maintenance Techniques such as Reliability Centred Maintenance(RCM), Total Productive Maintenance(TPM) & CMMS

Reliability centred Maintenance-Failure Mode and Effect Analysis-Root cause Analysis-logic tree analysis-Criticality matrix - Total Productive Maintenance, Overall Equipment Effectiveness-Lean manufacturing- TPM and TPO- Relationship between OEE and world-class Maintenance- Ladder of Maintenance improvement- Computerized Maintenance management system in a business scenario- data acquisition for effective management of CMMS.

4. Asset Planning and Scheduling of Activities in Maintenance

Asset and spare part management, - Conventional spare Parts management techniques such as Economic Order Quantity, two bin systems - Latest trends in monitoring through bar codes, mobile computer and wireless data transmissions -. Different aspects of planning and scheduling of Maintenance, such as shutdowns- Critical aspects of both routine and shut down Maintenance -, bar charts - PERT network during shut down - Man power Training and utilization of skilled manpower - Sequencing of activities.

5. Safety and other aspects of Maintenance Functions


Total: 45
Text Book:


Reference Books:


ED 9169 BEARING DESIGN AND ROTOR DYNAMICS L T P C
3 0 0 3

1. Classification and selection of Bearings

Selection criteria-Dry and Boundary Lubrication Bearings-Hydrodynamic and Hydrostatic bearings- Electro Magnetic bearings-Dry bearings-Rolling Element bearings- Bearings for Precision Applications-Foil Bearings-Special bearings- Selection of plain Bearing materials –Metallic and Non metallic bearings

2. Design of Fluid Film Bearings


3. Selection and Design of Rolling bearings

Contact Stresses in Rolling bearings- Centrifugal stresses-Elasto hydrodynamic lubrication- Fatigue life calculations- Bearing operating temperature- Lubrication-Selection of lubricants- Internal clearance – Shaft and housing fit- -Mounting arrangements-Materials for rolling bearings- Manufacturing methods- Ceramic bearings-Rolling bearing cages-bearing seals selection

4. Dynamics of Hydrodynamic bearings

Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads , alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions
5. Rotor Dynamics

Rotor vibration and Rotor critical speeds- support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings

Total 45

References:


PD 9151 MICRO ELECTRO MECHANICAL SYSTEMS L T P C 3 0 0 3

1. Introduction 8

Introduction, Materials-substrates, Additive materials. Fabrication techniques-Deposition, Lithography, etching, Surface micro machining, Thick film screen-printing and electroplating

2. Mechanical Sensor packaging 8

Introduction, Standard IC packages-ceramic, plastic and metal packages. Packaging process-Electrical interconnects, Methods of die attachment, sealing techniques. MEMS mechanical sensor packaging

3. Mechanical Transduction Techniques 9

Piezo resistivity, Piezoelectricity, Capacitive Techniques, Optical techniques, Resonant techniques. Actuation techniques, Smart Sensors. MEMS Simulation and Design tools- Behavioral modeling simulation tools and Finite element simulation tools.

4. Pressure sensors 12

Introduction. Techniques for sensing. Physics of pressure sensing-Pressure sensor specifications. Dynamic pressure sensing. Pressure sensor types. MEMS technology pressure sensors-Micro machined silicon diaphragms,
5. Force, Torque and Inertial sensors


Text Book:


Reference:

5. Innovation
Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving -
the essential factors – Innovator’s solution – creating and sustaining successful growth –
Disruptive Innovation model – Segmentive Models – New market disruption -
Commoditization and DE-commoditization – Managing the Strategy Development Process –
The Role of Senior Executive in Leading New Growth – Passing the Baton

Total 45

Reference:-


2. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999


PD 9153 REVERSE ENGINEERING

1. Introduction
Scope and tasks of RE - Domain analysis- process of duplicating

2. Tools for RE
Functionality- dimensional- developing technical data - digitizing techniques -
construction of surface model - solid-part material- characteristics evaluation -software
and application- prototyping - verification

3. Concepts
History of Reverse Engineering – Preserving and preparation for the four stage process –
Evaluation and Verification- Technical Data Generation, Data Verification, Project Implementation

4. Data Management
Data reverse engineering – Three data Reverse engineering strategies – Definition –
organization data issues - Software application – Finding reusable software components –
Recycling real-time embedded software – Design experiments to evaluate a Reverse Engineering tool – Rule based detection for reverse Engineering user interfaces –
Reverse Engineering of assembly programs: A model based approach and its logical basics

46
5. Integration

Cognitive approach to program understated – Integrating formal and structured methods in reverse engineering – Integrating reverse engineering, reuse and specification tool environments to reverse engineering —coordinate measurement – feature capturing – surface and solid members

Total: 45

Reference:

The management task, logistics organisation, the logistics information systems-topology of SC application- MRP, ERP, Warehouse management system, product data management- cases.

Total = 45

REFERENCES:

PD 9154 ENTERPRISE RESOURCE PLANNING

1. Enterprise Resource Planning:

2. Technology and Architecture:

3. ERP System Packages:
SAP, People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organisational and social issues.


5. ERP Procurement Issues

Total = 45

References:

IC 9162                  COMPUTATIONAL FLUID DYNAMICS
L   T    P    C
3    0    0    3

1. Governing Differential Equation and Finite Difference Method
   Classification, Initial and Boundary conditions – Initial and Boundary Value problems
   – Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

2. Conduction Heat Transfer
   Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

3. Incompressible Fluid Flow

4. Convection Heat Transfer and FEM

5. Turbulence Models
   Algebraic Models – One equation model, K – є Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

Total = 45 hrs.

References


