DEPARTMENT OF
MECHANICAL ENGINEERING

Scheme of Instruction and Syllabus
of
M.E. (Mechanical)

Specialization:

AUTOMATION & ROBOTICS

Full time / Part time
(2015-16)

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007, Telangana, INDIA
### Scheme of Instruction & Examination
M.E. (Mechanical Engineering) 4 Semesters (Full Time)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Duration (Hrs)</th>
<th>Max. Marks</th>
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#### Semester - I
1. Core 3 -- 3 70 30 3
2. Core 3 -- 3 70 30 3
3. Core / Elective 3 -- 3 70 30 3
4. Core / Elective 3 -- 3 70 30 3
5. Elective 3 -- 3 70 30 3
6. Elective 3 -- 3 70 30 3
7. Laboratory - I -- 3 3 -- 50 2
8. Seminar - I -- 3 3 -- 50 2
**Total** 18 6 24 420 280 22

#### Semester - II
1. Core 3 -- 3 70 30 3
2. Core 3 -- 3 70 30 3
3. Core / Elective 3 -- 3 70 30 3
4. Core / Elective 3 -- 3 70 30 3
5. Elective 3 -- 3 70 30 3
6. Elective 3 -- 3 70 30 3
7. Laboratory - II -- 3 3 -- 50 2
8. Seminar - II -- 3 3 -- 50 2
**Total** 18 6 24 420 280 22

#### Semester - III
1. Project + Seminar* -- 4 4 -- 100** 8

#### Semester - IV
1. Dissertation -- 6 6 200 - 16

Note: Six core subjects, six elective subjects, two laboratory courses and two seminars should normally be completed by the end of semester II.

* One project seminar presentation.
** 50 marks to be awarded by guide and 50 marks to be awarded by viva-voice committee comprising Guide and two internal senior faculty members (subject experts)
**Scheme of Instruction & Examination**
M.E. (Mechanical Engineering) 6 Semesters (Part Time)

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Note: Six core subjects, six elective subjects, two laboratory courses and two seminars should normally be completed by the end of semester IV.

* Project seminar presentation on the topic of Dissertation only

** 50 marks to be awarded by guide and 50 marks to be awarded by viva-voice committee comprising Guide and two internal senior faculty members (subject experts)
# M. E. Mechanical Engineering (AUTOMATION & ROBOTICS)

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CIE : Continuous Internal Evaluation    SEE : Semester End Examination
ME2301

AUTOMATION

**Instructions:** 3 periods/week  
**Duration of university Examination:** 3 hours  
**Credits:** 3  
**SEE:** 70 Marks  
**CIE:** 30 Marks

**UNIT – I**

**Introduction:** Definition of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in-process.

**UNIT – II**


**UNIT – III**


**UNIT – IV**


**UNIT – V**


**Suggested Reading:**
CONTROL OF DYNAMIC SYSTEMS

Instructions: 3 periods/week Duration of university Examination: 3 hours
Credits: 3 SEE: 70 Marks CIE: 30 Marks

Objectives:
The goal of the course is to introduce students to the fundamentals of feedback control system theory and analytical design methods, and to apply the methods to the design of real-world systems.

- To introduce the concepts of control systems and develop the ability of formulating mathematical models and designing feedback control systems.
- To provide students with the necessary tools to analyze feedback (linear) controls systems
- an ability to analyze, design, simulate, and experimentally validate linear and non linear control systems while taking into account practical limitations of operations.
- an understanding of negative and positive feedback systems and their application to circuit analysis and control system design
- an understanding of frequency compensation and its application to linear and nonlinear control system design

UNIT-I
Mathematical Modeling of physical systems, 1st, 2nd order and higher order systems, transient, steady state analysis, steady state errors, Performance Indices.

UNIT-II
Poles, zeros, zero and pole placements, Routh’s criteria, Root locus Technique, Bode plots, Nyquist criterion, Compensation circuits.

UNIT-III
State space method, state transition matrix, canonical forms, Diagonalisation, solutions of homogeneous and non homogenous equations, zero and pole placement using state space techniques, controllability and observability, state controllability matrix, state observability matrix.

UNIT-IV

UNIT-V
Stability Analysis Concept of stability, Stability in the sense of Lyapunov and absolute stability, autonomous systems, the invariance principle, linear systems and linearization, non autonomous systems, linear time varying systems and linearization.

Suggested Reading:
3 Anand Kumar, "Control System Theory", Prentice Hall India.
The goal of the Robotics course is to familiarize the students with the concepts and techniques in robot manipulator control, enough to evaluate, chose, and incorporate robots in engineering systems.

**Objectives:**
- To develop the student’s knowledge in various robot structures and their workspace.
- To develop student’s skills in performing spatial transformations associated with rigid body motions.
- To develop student’s skills in perform kinematics analysis of robot systems.
- To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
- To provide the student with some knowledge and analysis skills associated with trajectory planning.
- To provide the student with some knowledge and skills associated with robot control

**UNIT-I**
Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

**UNIT-II**
Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics.

**UNIT-III**
Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks.

**UNIT-IV**
Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangian and Newton-Euler formulations of RR and RP type planar robots, Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, Computed torque control, force control, hybrid control.

**UNIT-V**
Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder. Robot vision: image processing fundamentals
for robotic applications, image acquisition and preprocessing. Segmentation and region
characterization object recognition by image matching and based on features

**Suggested Readings:**

3. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence,
ME2304

ADVANCED KINEMATICS

Instructions 3 periods/week

Credits 3

Duration of university Examination: 3 hours

SEE: 70 Marks

CIE: 30 Marks

Objectives

- This course builds on the basic understanding of topics learnt in the fundamental courses in kinematics and dynamics.
- principles of kinematic synthesis, analysis and dynamics to planer mechanisms
- Provides an in-depth understanding of selected advanced topics in the area of three dimensional kinematics, Robotics and flexible body dynamics.
- This course is intended to aid students in their research as well as in the application of the methods to mechanical systems in practice.

UNIT-I

Kinematic Analysis of plane mechanism: Analytical method of kinematic analysis of four bar mechanism. Acceleration analysis of complex mechanisms by auxiliary point method, good man’s indirect method.

UNIT-II

Kinematic synthesis of linkages: Number synthesis, associated linkage or equivalent linkage concept, dimensional synthesis by analytical and graphical methods.

UNIT-III

Kinematic analysis of four link RGGR spatial mechanism, D-H parameters, Transformations matrix method for position velocity and acceleration analysis of special mechanisms.

UNIT-IV

Cams: Analysis of follower motions, analytical cam design.

UNIT-V

Kinematic analysis of two-degree freedom of Robot arm.

Suggested Reading:
FLUID POWER SYSTEMS

Instructions  3 periods/week  Duration of university Examination: 3 hours
Credits  3  SEE: 70 Marks  CIE: 30 Marks

Objectives
- The course will develop the students’ knowledge and understanding of hydraulic and pneumatic devices and systems.
- The students should be able to understand the principles of operation and the design details of hydraulic pumps, motors, valves, actuators, and systems.
- The student should be able to analyze both the steady-state and the dynamic performance of individual hydraulic components and systems.
- The student should also be able to relate the theory with the practical applications of these principles.

UNIT - I
Advantages and Disadvantages of Fluid control, Types of Hydraulic Fluids, physical, chemical and thermal properties of hydraulic fluids, selection of hydraulic fluid, fluid flow fundamentals. Hydraulic Pumps and Motors: Basic Types and constructions, ideal pump and motor analysis, Performance curves and parameters.

UNIT - II
Hydraulic Control Valves- Valve configurations, general valve analysis, critical center, open center, three way spool valve analysis and Flapper valve analysis, pressure control valves, single and two stage pressure control valves, flow control valves, introduction to electro hydraulic valves.

UNIT - III
Hydraulic Power Elements: Valve controlled motor, valve controlled piston, three way valve controlled piston, pump controlled motor, pressure transients in power elements.

UNIT - IV

UNIT - V
Control of pressure and speed in Hydraulic and Pneumatic Systems, Fluidics:proportional amplifier, bistable amplifier, vortex amplifier, turbulence amplifier, impact modulator, Boolean algebra, fluid logics, manipulation of logic expressions, special circuits and sequential circuits.

Suggested Reading:
2 D McCloy & H R Martin, "The control of fluid power" Longman publications.1980
5 John Pippenger & Tyler Hicks, "Industrial Hydraulics", 3rd edition McGraw Hill, 1979
ME2306

COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS

Instructions: 3 periods/week
Credits: 3

Duration of university Examination: 3 hours

SEE: 70 Marks
CIE: 30 Marks

Objectives:

- To develop students knowledge and understanding of Bending of Plates.
- To understand the basics of designing pressure vessels against internal and external pressure loads. To understand the effect of thermal stress on pressure vessel
- To understand the phenomenon of buckling in pressure vessels and usage of various methods available to prevent buckling of pressure vessels.
- To understand the importance of numerical methods in solving multi degree freedom dynamic analysis problems.
- To understand various numerical methods available for solving eigen values problems

UNIT-I
Stresses in flat plates: Introduction, Bending of plate in one direction, Bending of plate in two perpendicular directions, Thermal stresses in plates, Bending of circular plates of constant thickness, Bending of uniformly loaded plates of constant thickness.

UNIT-II
Design of pressure Vessels: Introduction and constructional features of pressure vessels, stresses in pressure vessels, shrink fit stresses in built up cylinders, autofrettage of thick cylinders, thermal stresses and their significance. Stress concentration at a variable thickness, thickness transition in a cylindrical vessel, about a circular hole, elliptical openings, reinforcement design

UNIT-III
Buckling 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.

UNIT-IV
Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence. Subspace iteration and Lanczo’s method, Component mode synthesis, Eigen value problems applied to stepped beams and bars.

UNIT-V

Suggested Reading:

With effect from 2015 - 16

ME2307

**MICRO-CONTROLLERS AND ITS APPLICATIONS**

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**UNIT-I**

Binary data representation: decimal system, binary system, octal system, hexadecimal system, binary coded decimal system, decimal conversion, decimal to Hexadecimal, binary addition and subtraction, binary multiplication and division, binary coded decimal addition, signed numbers, twos complement arithmetic, hexadecimal arithmetic, digital logic gates, MCS51 Micro controller – difference between micro controller and microprocessor, criteria for choosing a microcontroller, internal architecture of MCS51 microcontroller and its family.

**UNIT-II**

8051 assembly language programming: instruction set-arithmetic, logical, data transfer branching and Flag manipulation Instructions, addressing modes

**UNIT-III**

8051 timer/counter, serial communication programming, interrupts structure, interrupt programming, usage of C programming to 8051 family.

**UNIT-IV**

Real word interfacing: Analog to Digital converter, Digital to Analog converter, Mechanical switches, keypads, LEDs, seven segment display, LCDs, keyboard, DC motor, stepper motor, PWM, External Memory Interface.

**UNIT-V**

Microcontroller Applications: C programming of Podium timer, microcontroller based menu card, chimney sentinel, counting cars, anonymous voting, efficient lighting using microcontroller, I2C interface with serial EPROM, reading a PWM waveform using microcontroller, 8051 based pick and place robot.

**Suggested Reading:**
1 Mazidi, The 8051 micro controller and embedded system, Pearson education, 2002
2 Han-way Huang, Using the MCS-51 microcontroller, Oxford University Press, 2009.
5 Kenneth Hintz and Daniel Tabak, Microcontrollers architecture, Implementation and programming, TMH, 2005
ME2401

FINITE ELEMENT TECHNIQUES

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Objectives:

- To understand the theory and application of the finite element method for analyzing structural systems.
- To learn Approximation theory for structural problems as the basis for finite element methods.
- To learn formulations for a variety of elements in one, two, and three dimensions.
- To understand modeling and analysis of structures using planar, solid, and plate elements.

UNIT-I

UNIT-II
Analysis of trusses and frames: Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element.

UNIT-III
Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmmetric solids subjected of axisymmetric loading with triangular elements. Convergence requirements and geometric isotropy.

UNIT-IV

UNIT-V

Suggested Reading:

ME2402

COMPUTER AIDED MODELLING & DESIGN

Instructions  3 periods/week Duration of university Examination: 3 hours
Credits 3 SEE: 70 Marks CIE: 30 Marks

UNIT-I

UNIT-II
Wire frame modeling: Curves: Curve representation. Analytic curves – lines, Circles, Ellipse, Conis. Synthetic curves – Cubic, Bezier, B-Spline, NURBS.

UNIT-III

UNIT-IV
Solid Modeling Techniques: Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration, Boundary Representation (B-rep) & Constructive Solid Geometry (CSG).

UNIT-V

Suggested Reading:
ME2308

OPTIMISATION TECHNIQUES

**Instructions** 3 periods/week  
**Credits** 3  
**Duration of university Examination:** 3 hours  
**SEE:** 70 Marks  
**CIE:** 30 Marks

**UNIT – I**
**Simulation:** Introduction, Types of Simulation, Simulation Models, Monte Carlo Simulation, Random Number, Pseudo Random Number, Mid-Square Method of generating Random Numbers, Application & Limitation, Application of Simulation to Inventory Control and Queuing Problem

**UNIT – II**


**UNIT – IV Dynamic Programming:** Introduction- Bellman’s principle of optimality-Application of dynamic programming-Linear programming problem-Capital budgeting problem

**UNIT – V Classical Optimization:** Introduction; Unconstrained problems of maxima and minima, constrained problems of maxima and minima; Constraints in the form of equations – Lagrangian method; Constraints in the form of inequalities -Kuhn-tucker conditions.

**Suggested Reading:**
ME2309

VIBRATION ANALYSIS AND CONDITION MONITORING

Instructions  3 periods/week
Duration of university Examination: 3 hours
CREDITS  3
SEE: 70 Marks
CIE: 30 Marks

Objectives
- Fully understand importance of vibrations in mechanical design of machine parts that operate under vibratory conditions.
- Able to write differential equation of motion of vibratory system and understand free and forced modes of vibration
- Able to obtain linear vibratory models of dynamic systems of varying complexity (SDOF, MDOF)
- Able to understand the various condition monitoring techniques available in the literature.
- Able to understand the various devices available to record, interpret and understand the vibration data.

UNIT-I
Causes and effects of vibration. Vibrations of Single Degree of freedom systems. Free, Damped and Forced vibrations

UNIT-II
Two Degree of freedom systems. Bending vibrations of two degree of freedom systems, Steady state and transient characteristics of vibration, vibration absorber and vibration isolation.

UNIT-III

UNIT-IV

UNIT-V
Contaminant analysis, SOAP and other contaminant monitoring techniques. Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit & position analysis.

Suggested Readings:
2. V.P.Singh, Mechanical Vibrations, Dhanpat Rai Publications, 2015
ME2310

UNDER ACTUATED ROBOTICS

Instructions  3 periods/week  Duration of university Examination: 3 hours
Credits  3  SEE: 70 Marks  CIE: 30 Marks

UNIT-I
Fully v/s under actuated systems, non linear dynamics of the simple pendulum, Acrobot and cart-pole controllability, partial feedback linearization(PFL), energy shaping

UNIT-II
Simple walking models- rimless wheels, compass gait, kneed compass gait, feedback control for simple walking models. Simple running models-spring loaded inverted pendulum (SLIP), Raibert hoppers, swimming and flapping flight.

UNIT-III
Function approximation and system identification, model systems with uncertainty, state distribution dynamics and state estimation

UNIT-IV
Introduction to optimal control, double integrator and pendulum examples, dynamic programming and value integration, grid world, quadratic regulator (Hamilton –Jacobi-Bellman sufficiency), min-time control (pontryagin), open loop optimal control, direct and indirect methods., trajectory stabilization, iterative linear quadratic regulator(ILQR).

UNIT-V
Motion planning: Dijkstra’s algorithm, A-star algorithm, randomized motion planning, rapidly exploring randomized trees, and probabilistic road maps, feedback motion planning-planning with funnels, linear quadratic regulator (LQR) trees,

Suggested Reading:
3 Fantoni, Isabelle and Rogelio Lozano, Non linear control for under actuated mechanical systems, Newyork, NY, Springer verlag, 2002
NEURAL NETWORKS AND FUZZY LOGIC

Instructions 3 periods/week
Credits 3

Duration of university Examination: 3 hours
SEE: 70 Marks
CIE: 30 Marks

UNIT-I


UNIT-II

Adaptive fuzzy systems: Neural and Fuzzy intelligence, Fuzziness as multivalent, fuzziness in probabilistic world, randomness verses ambiguity.

UNIT-III


UNIT-IV

Introduction to Neural networks: Knowledge base information processing, general view of knowledge based algorithm, neural information processing, Hybrid intelligence, and artificial neurons.

UNIT-V


Suggested Reading:

ME2312

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Instructions: 3 periods/week
Duration of university Examination: 3 hours
Credits: 3
SEE: 70 Marks
CIE: 30 Marks

UNIT-I


UNIT-II

Computer Vision: Perception, early processing, representation and recognition of scenes, Guzman’s algorithms of spurring objects in a scene, Waltz algorithm.

UNIT-III

Neural Language understanding problems, syntactic analysis, semantic analysis, augmented transition networks.

UNIT-IV

Knowledge representation (Logic): Representing facts in logic predicate logic, resolution, unification, question answering, mathematical theorem proving. Knowledge representation (Structured): Declarative representation, Semantic nets, procedural representation.

UNIT-V Learning: Learning as induction, failure drive learning, learning by teaching, learning through examples (Winston’s program) skill acquisition.

Suggested Reading:

ME2313

ADVANCED SOLID MECHANICS

Instructions 3 periods/week
Credits 3

Duration of university Examination: 3 hours
SEE: 70 Marks
CIE: 30 Marks

UNIT-I
Bending of Beams: Introduction, straight beams and Asymmetrical bending, Euler –Bernoulli hypothesis, shear center, shear stresses in thin walled open sections, bending of curved beams, deflection of thick curved bars.

UNIT-II
Bending of Plates: Behaviour of Flat plates, bending of a plate in one direction, bending of a plate in two perpendicular directions, thermal stresses in plates, bending of circular plates of constant thickness, bending of uniformly loaded plates of constant thickness.

UNIT-III
Asymmetric Bodies: Introduction, Thick-walled cylinder subjected to internal and external pressures, stresses in composite tubes-shrink fit, rotating disks of uniform thickness, disks of variable thickness, rotating shafts and cylinders.

UNIT-IV
Thermal Stresses: Introduction, thermoelastic stress–strain relations, equations of equilibrium, strain-displacement relations, thin circular disk, normal stresses in straight beam due to thermal loading, stresses in curved beams due to thermal loading.

UNIT-V
Elastic Stability: Euler’s Buckling load, beam column equations, beam column with concentrated load, continuous lateral loads, beam-Column with end couple, General treatment of column stability problems.

Suggested Readings:
ME2107

MECHANICS OF COMPOSITE MATERIALS

Instructions 3 periods/week
Credits 3

Duration of university Examination: 3 hours
SEE: 70 Marks
CIE: 30 Marks

UNIT-I


UNIT-II

Micromechanics of Composites: Mechanical properties-Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties-Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

UNIT-III

Macromechanics of Composites: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

UNIT-IV

Strength, fracture, fatigue and design: Tensile and compressive strength of unidirectional fibre composites,

Fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composites. Effect of variability of fibre strength.

Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

UNIT-V


Suggested Reading:

COMPUTER INTEGRATED MANUFACTURING

Instructions: 3 periods/week

Duration of university Examination: 3 hours

Credits: 3

SEE: 70 Marks

CIE: 30 Marks

Objectives:

1. To understand the need for CIM, evolution of CIM, fundamentals of CIM and the Concept of Concurrent Engineering.

2. To know the role of database management of CIM and understand various types of CIM technologies and systems like DFMA, CAPP, MRP, Cellular Manufacturing, FMS etc.

3. To understand the fundamental networking concepts that help in integrating all the important components of an enterprise and discuss the different types of CIM models developed by various industries. stand the new trends in manufacturing systems.

UNIT – I: Introduction to CIM


UNIT – II: CIM database and database management systems

Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

UNIT – III: CIM Technology and Systems


UNIT – IV: Enterprise Wide Integration in CIM and CIM Models

Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP,

CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

UNIT – V: Future Trends in Manufacturing Systems

Suggested Reading:
3. P.Radhakrishnan, S.Subramanyam: CAD/CAM/CIM, New Age International
4. Alavudeen, Venkateshwaran: Computer Integrated Manufacturing, Printice-Hall India
ME2110

EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS

Instructions 3 periods/week Duration of university Examination: 3 hours
Credits 3 SEE: 70 Marks CIE: 30 Marks

Objectives:
- To understand the working principle of instruments used for cutting forces measurement and temperature measurement.
- To have knowledge of various precision measuring instruments for metallurgical studies.
- To understand the basic concept of experiment design for collection of data
- To learn the data analysis, optimization of experimental methods for better data.

Unit - I

Unit - II

Unit - III

Unit - IV
Experiment design & data analysis: Statistical methods, Randomized block design, Latin and orthogonal squares, factorial design. Replication and randomization. Data Analysis: Deterministic and random data, uncertainty analysis, tests for significance: Chi -square, student’s t-test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.

Unit - V

Suggested Reading:
4. Box and Jenkins; Time Series analysis, Forecasting and control, Holden Day, Sanfrancisco.
ME2111

PRODUCT DESIGN AND PROCESS PLANNING

Instructions  3 periods/week  Duration of university Examination: 3 hours
Credits  3  SEE: 70 Marks  CIE: 30 Marks

Objectives:

- To learn the essential factors with innovative ideas to develop successive right product.
- To know the product reliability, copyrights, value Engineering in product design and cost estimation of product.
- To understand the various machining processes, improving tolerances methods, selection of materials and their importance.
- To understand the modern approaches, ergonomics considerations in product design, integration of design, manufacturing and production control.

Unit - I


Unit - II


Unit - III


Unit - IV


Unit - V

Role of computer in product design and management of manufacturing, creation of manufacturing database, Computer Integrated Manufacturing, communication network, production flow analysis, Group Technology, Computer Aided product design and process planning. Integrating product design, manufacture and production control.

Suggested Reading:

ADDITIVE MANUFACTURING TECHNOLOGIES AND APPLICATIONS

Instructions: 3 periods/week
Duration of university Examination: 3 hours
Credits: 3
SEE: 70 Marks
CIE: 30 Marks

Objectives:
- To understand the fundamentals for additive manufacturing and how it is different and discuss about various types of liquid based, solid based and powder based AM technologies.
- To understand the various types of Pre-processing, processing, post-processing errors in AM. Also to know the various types of data formats and software’s used in AM.
- To know the various applications of AM in design analysis, aerospace, automotive, biomedical and other fields

UNIT – I


UNIT – II


UNIT – III


UNIT – IV


**AM Software’s:** Need for AM software, Features of various AM software’s like Magics, Mimics, Solid View, View Expert, 3D View, Velocity 2, Rhino, STL View 3 Data Expert and 3D doctor, SurgiGuide, 3-matic, Simplant, MeshLab.

UNIT – V


**Suggested Reading:**


ME2211

Rotor Dynamics

Instructions: 3 periods/week

Duration of university Examination: 3 hours

Credits: 3

SEE: 70 Marks

CIE: 30 Marks

Unit-I


Unit-II


Unit-III

Vibrations of multi rotor systems – Matrix method, Influence coefficient methods, Transfer matrix analysis and Holzers method.

Unit-IV

Torsional vibrations in rotating machinery – Equivalent discrete system, transient response, branched system.

Unit-V


Suggested Reading:


ME2216

NUMERICAL METHODS

Instructions 3 periods/week
Credits 3

Duration of university Examination: 3 hours

SEE: 70 Marks  CIE: 30 Marks

UNIT-I

Solving linear sets of equations Gauss Elimination, LV Decomposition, Matrix Inversion, Scalar Tridiagonal Matrix, Thomas Algorithm, Gauss Seidel Method, Secant Method

UNIT-II


UNIT-III

Interpolation & Polynomial Approximation Least Squares Method, Lagrange Interpolation, Hermite Interpolation, Cubic Spline Interpolation, Chebeshev Polynomials & Series

UNIT-IV

Numerical Differentiation & Integration Numerical Differentiation, Richardson's Extrapolation, Definite & Indefinite Integrals, Simpson's Rule, Trapezoid Rule, Gaussian Quadrature

UNIT-V


Suggested Reading:

# ENGINEERING RESEARCH METHODOLOGY

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### Credits
- 3

### SEE: 70 Marks
### CIE: 30 Marks

### Objectives:
- To learn the research types, methodology and formulation.
- To know the sources of literature, survey, review and quality journals.
- To understand the research design for collection of research data.
- To understand the research data analysis, writing of research report and grant proposal.

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

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

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

### Unit - III

### Unit - IV
**Data Collection:** Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. **Sample Design:** Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software.

**Data Analysis:** Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student’s t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

### Unit - V

### Suggested Reading:
1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
ME2331

AUTOMATION AND ROBOTICS LABORATORY

Instruction 3 periods/week  CIE  50 Marks
CREDITS 2

Objectives:
- To expose students to Mathematical tools like Matlab
- To expose students to modeling of Fluid power elements using H,P simulators.
- To explain the importance and usage of Microcontrollers.
- To expose students to softwares like Flexsim software for plant layout optimization

List of Experiments

I- MATLAB
1. Basic syntax and command-line exercises, Basic array exercises, Relational and logical operations
2. Control of flow: if-blocks, Loop constructs: for and while
3. Basic 2D & 3D Plots
4. Solving ordinary differential equations
5. Curve fitting and interpolation
6. Data Analysis and statistics
7. Solving non-linear algebraic equations
8. Introduction to optimization methods like GA, Fuzzy, Neural & PSO
9. Introduction to SIMULINK
10. Modeling of problems related to kinematics and dynamics of robot using MATLAB

II- SIMULATION SOFTWARE
11. Hydraulic equipment simulation using H-Simulator
12. Pneumatic equipment simulation using P-Simulator
13. PLC simulator

III- 8051 Microcontroller
14. LCD interfacing with 8051 MC
15. Interfacing of PMW with DC motor using 8051 MC interface
16. ADC and DAC interfacing with 8051 MC
17. Temperature control using 8051 MC interface
18. Traffic Light control using 8051 MC interface
19. Servo motor Interfacing with 8051 MC

IV. FLEXSIM SOFTWARE
20. Flexsim basics and how to building basic models in Flexsim
21. Addition of model logic and managing data
22. Managing entities and time tables
23. Modeling of Randomness
24. Simulation of Production flow lines
ME2332

COMPUTATION LABORATORY

Instruction 3 periods/week  CIE  50 Marks
CREDITS 2

Objectives:
- To expose students to structural analysis like Ansys, Abaqus
- To expose students to Kinematic and dynamic analysis like MSC Adams
- To provide students with the necessary tools to analyze practical systems for both static and dynamic analysis.
- An ability to analyze, design, simulate, and experimentally validate systems while taking into account practical limitations of operations.

List of Experiments: using Abaqus Software & Ansys software
1. Introduction to Finite Element Analysis Software.
2. Static analysis of a corner bracket.
3. Determination of Beam stresses and Deflection & bending analysis of Tee shaped beam.
5. Analysis of cylindrical shell under pressure.
6. Solidification of a casting.
7. Transient Heat transfer analysis in an infinite slab & cylinder.
8. Vibration analysis of a Simply supported & cantilever beams.
9. Coupled structural/thermal analysis.
10. Drop test of a container (Explicit Dynamics).

List of Experiments: using Msc Adams Software
11. Kinematic analysis of Single Link Pendulum
12. Impact test of a falling stone body
13. Kinematic and dynamic analysis of a 4 bar mechanism
14. Kinematic and dynamic analysis of a slider crank mechanism
15. Contact analysis of a Journal bearing

Usage of analysis software’s like Ansys, Abaqus & Msc Adams