UNIVERSITY OF PUNE

Structure and Syllabus

FOR

M.E. Mechanical Engineering
(COMPUTER AIDED DESIGN, MANUFACTURE & ENGINEERING)
2013-Course

UNDER FACULTY OF ENGINEERING

EFFECTIVE FROM July 2013
### SEMESTER I

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Elective I**: Common to All M.E. Mechanical Programmes
### SEMESTER III

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**Lab Practice I & II:**

The laboratory work will be based on completion of assignments confined to the courses of that semester.

**SEMINAR:**

The student shall deliver the seminar on a topic approved by authorities.

- **Seminar I:** shall be on state of the art topic of student’s own choice approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned Guide and head of the department/institute.

- **Seminar II:** shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected by him/her approved by authority. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned Guide and head of the department/institute.

- **Seminar III:** shall be extension of seminar II. The student shall submit the seminar report in standard format, duly certified for satisfactory completion of the work by the concerned Guide and head of the department/institute.
PROJECT WORK:
The project work shall be based on the knowledge acquired by the student during the coursework and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Project Work Stage – I

Project work Stage – I is the integral part of the project Work. In this, the student shall complete the partial work of the Project that will consist of problem statement, literature review, project overview, scheme of implementation (UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. The candidate shall deliver a presentation as a part of the progress report of Project work Stage-I, on the advancement in Technology pertaining to the selected dissertation topic.

The student shall submit the progress report of Project work Stage-I in standard format duly certified for satisfactory completion of the work by the concerned guide and head of the department/Institute.

Project Work Stage - II

In Project Work Stage – II, the student shall complete the balance part of the Project that will consist of fabrication of set up required for the project, conducting experiments and taking results, analysis & validation of results and conclusions.

The student shall prepare the final report of Project work in standard format duly certified for satisfactory completion of the work by the concerned guide and head of the department/Institute.

Note: Institute must submit the list of candidates, guide and project details (title, area, problem definition, and abstract - clearly indicating objectives and scope, sponsorship details, if any) to the university within month of commencement of third semester. The guide must be approved/qualified teacher of the institute. A guide can guide at the most 8 students per year.
Semester – I
Advanced Mathematics [507201]

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1. **Inner Product Spaces, Orthogonality**
   Inner products, Cauchy-Schwartz inequality, Orthogonal projections, Gram-Schmidt orthogonalization, Matrix representation of inner product, Least square solutions

2. **Complex Analysis**
   Complex variables, Complex differentiation, Harmonic functions, conformal mapping, Complex Integration, Cauchy’s integral formulae and Calculus of residues

3. **Transforms**
   Concept of transforms, Fourier transforms, Applications to partial differential equations, Discrete Fourier transform, Laplace transforms and its inverse, Laplace transform of special functions: Unit step, Unit impulse, Periodic and Error. Applications to initial value problem and wave equation using transform techniques.

4. **Differential Equation**

5. **Numerical Analysis**
   Finite difference analysis, Explicit and Implicit finite difference scheme, Stability of finite difference method, Applications of finite difference analysis in boundary value problems, one dimensional diffusion equation, Wave equation, Laplace equation.

6. **Calculus of Variation**
   Introduction, Functional, Euler’s equation, Isoperimetric Problem, Functional involving higher order derivative, Approximate solution of boundary value problem, Rayleigh –Ritz method , Galerkin’s method, Lagrange’s principal.

**Reference Books**
1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India
3. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Springer international edition
1. **Theory of Elasticity**
   State of stress at a point, stress components on an arbitrary plane, principal stresses, plane stress, differential equations of equilibrium, boundary conditions. State of strain at a point, plane strain, compatibility conditions, generalized Hooke’s Law, relations between elastic constants, displacement equations of equilibrium. Elasticity problems in two dimension and three Dimensions, Airy’s Stress Function In Rectangular & Polar Coordinates.

2. **Theories of Failure**
   Maximum principal stress theory, maximum shear stress theory, maximum elastic strain theory, octahedral shearing stress theory, distortion energy theory, Mohr’s theory, significance of theory of failure.

3. **Energy Methods**
   Elastic strain energy, strain energy due to axial force, shear force, torsion, bending moment, Castigliano’s theorems, theory of virtual work and energy, Raleigh–Ritz method and Galerkin’s method.

4. **Design For Fatigue, Brittle Fracture And Creep**
   Introduction, Fatigue strength, factors affecting fatigue behaviour, Influence of super imposed static stress, Cumulative fatigue damage, fatigue under complex stresses, Fatigue strength after over stresses, True stress and true strength. Design for brittle fracture. Mechanism of creep of material at high temperature, Exponential creep law, hyperbolic sine creep law, stress relaxation, bending etc

5. **Composite Materials**
   Composite materials and structures, classical lamination theory, elastic stress analysis of composite material, Fatigue strength improvement techniques, stresses, stress concentration around cut outs in composite laminates, stability of composite laminate plates and shells, Hybrid materials, applications

6. **Design Of Mechanical Components**
   a) **Gear Design**: - Involute gears, tooth thickness, interference, undercutting, rack shift etc. Profile modification, S and So spur, helical gears etc.
   b) **Spring Design**: - Vibration and surging of helical springs, helical springs for maximum space efficiency, analysis of Belleville springs, ring spring, volute spring & rubber springs. Design for spring suspension.

**Reference Books**
1. CAD Tools
Definition of CAD Tools, Types of system, CAD/CAM system evaluation Criteria, Graphics standards, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.

**Wire frame modeling** - Types of mathematical representation of curves, wire frame models, wire frame entities, parametric representation of synthetic curves - Hermite cubic splines, Bezier curves, B-Splines, rational curves - NURBS.

2. Surface Modeling
Mathematical representation of surfaces, Surface model, Surface entities, surface representation, Parametric representation of surfaces, plane surface, ruled surface, surface of revolution, Tabulated surface.

3. Parametric Representation Of Synthetic Surfaces
Hermite Bicubic surface, Bezier surface, B-Spline surface, COONs surface, Blending surface, Sculptured surface, Surface manipulation - Displaying, Segmentation, Trimming, Intersection, Transformations - 2D and 3D, Orthogonal and Perspective transformations.

4. Solid Modeling
Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods, Design Applications: Mechanical tolerances, Mass property calculations, CAD database structure.

**CAD/CAM Data Exchange**: Evaluation of data exchange formats, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

5. Advanced Modeling Concepts:

6. Collaborative Engineering:

Reference Books:
2. P. N. Rao, **CAD/CAM Tata McGraw Hill**.

Software Documentation, tutorials, manuals of following software
1. UG/NX
2. Solid Works
3. CATIA
4. Autodesk Inventor Professional
5. AutoCAD
6. Open CASCADE
7. ANSYS Design Modeller
8. Pro/E
Semester – I  
Research Methodology [502404]

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1. **Research Problem**
   Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem

2. **Basic Instrumentation**
   Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.

3. **Applied Statistics**
   Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis, Probable errors in the research, Error analysis

4. **Modeling And Prediction of Performance**
   Setting up a computing model to predict performance of experimental system, Multi-scale modeling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

5. **Developing A Research Proposal**
   Format of research proposal, Individual research proposal, Institutional proposal, Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only, Other faculty members may attend and give suggestions relevant to topic of research.

**Reference Books:**
2. Dr. C. R. Kothari, *Research Methodology: Methods and Trends*
5. Dr. S.D. Sharma & Kedar Nath Ram *Operational Research*, Nath & Co.
6. Pressman, *Software Engineering*
University of Pune

Semester – I
Elective – I [502405]

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**Modules of 2 Credits (Select any Two)**

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<td>ME2I – M6</td>
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**Modules of 1 Credit (Select any One)**

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**Note:** For e.g., ME2I-M1 indicates ME – Common to all M.E. Mechanical Course, 2 – 2 Credits, I – Elective I, M1 – Module 1

**ME2I – M1 Energy Audit and Management**
Definition, Energy audit - need, Types of energy audit, Energy management (audit) approach - understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments


**ME2I – M2 Financial Management**


**ME2I – M3 Financial Costing**
Significance, Traditional absorption costing, Marginal costing, Contract costing, Activity based costing, Process costing


**ME2I – M4 Project Management**


**ME2I – M5 Energy Efficient Technologies in Electrical Systems**


**ME2I – M6 Operation Management**
Introduction, Importance, Operating systems models, key decisions, Planning and controlling, Strategic approach, Processes and systems, supply chain or network approach, Technology and knowledge management, Quality Management, Operations - Challenges, Opportunities, Excellence, risk management and sustainability, Case studies

**Reference Books:**

**ME2I – M7 Engineering Economics**
Fundamentals, Markets and Government in a Modern economy, Basic Elements of Supply and Demand, Demand and Consumer Behavior, Analysis of Perfectly Competitive Markets, Unemployment, Inflation and Economic policy

**Reference Books:** 1. Economics, Samuelson Nordhaus, Tata McGraw Hill

**ME2I – M8 Technology Forecasting**

**ME2I – M9 Technology Transfer**
Definition, Source of Technology Transfer [TT], Model of TT with Public and Private Enterprises, Success and Failure Factors in Technology Transfer. The concepts of Invention and Innovation, Definition and classifications of Research and Development, New Product Development, Challenges in Commercializing Research Results.


**ME2I – M10 Human Rights**

Primary Information with reference to Engineering Industry

**Ref. Books:** 1)Study material on UNESCO,UNICEF web site, 2)HUMAN RIGHTS IN INDIA A MAPPING, Usha Ramanathan, 3)Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing , 2005 .This book is an introductory text on international humanitarian law (the laws of war) that provides the basics of law, including excerpts from some of the leading treaty texts. Perfect for a short course in the law -- one to five weeks, 4) Freedom of Information by Toby Mendel - UNESCO , 2008

**ME11 – M11 V Environmental Pollution and Control**
Pollution and Environmental Ethics, Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards Environmental impact and economic aspects, Emission standards and regulations for Automobiles.

**Reference Books:** 1. Environmental Pollution and Control, J. Jeffrey Peirce, P Aarne Vesilind, Ruth Weiner, Butterworth-Heinemann
2. Environmental Pollution Control Engineering, C.S. Rao, New Age International

**ME11 – M12 Intellectual Property Rights**
Patentable and non-patentable inventions, statutory exceptions, Persons entitled to apply for patents.

Semester – I
Lab Practice – I [502406]

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Lab. work or Assignments have to be carried out at respective labs as mentioned in the syllabus of respective subjects excluding Research Methodology and Elective. It is to be submitted as term work at the end of semester after continuous assessment of each by respective teacher. Assessment of term work has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System. (Refer University web site)

Geometric Modelling & Analysis
Solid modelling, assembly modelling, drafting assignments using software like UNIGRAPHICS, Solid Works, CATIA, Pro/Engineer, I-DEAS, Autodesk Inventor, etc and study of the various facilities in these software’s.

Finite Element Analysis Assignments using software’s like ANSYS, Hyper Mesh Ls-Dyna, Abacus etc.

List of Assignments
1. Surface Modelling of Mechanical Components.
2. Solid Modeling of Mechanical Components.
3. Assembly modelling of Mechanical Components.
4. Finite Element Analysis of Mechanical Components.
5. Finite Element Analysis of Mechanical Systems.
Semester - II

Computer Integrated Manufacturing [502407]

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1. **Concept Of CIM**
   Introduction to CIM, Types of Manufacturing, CIM hardware and software, Elements of CIM, Product development through CIM Design Activities in a networked environment, networking in a manufacturing company, hardware elements of networking.

2. **CIM Database**
   Introduction, Database requirements of CIM, Database management, Database Models, EDM, Product Data Management (PDM), Advantage of PDM, Collaboration Engineering.

3. **Work Cell & Flexible Manufacturing System**
   Manufacturing cell, Group Technology, Cellular Manufacturing, DNC system and transfer of program from PC to machine. Introduction to FMS, Manufacturing integration model, flexible manufacturing strategy, Components of Flexible Manufacturing-Pallets and fixtures, machining centers, inspection equipment, material handling stations, storage system, In-process storage, manually operated stations, allied operation centers

4. **Integrative Manufacturing Planning And Control**
   Role of integrative manufacturing in CAD/CAM integration, Overview of production control - Forecasting, Master production schedule, Capacity planning, M.R.P., Order release, Shop-floor control, Quality assurance, Planning and control systems, Cellular manufacturing, JIT manufacturing philosophy.

5. **Web Based Manufacturing**
   Integrating process with web, Process management and control through web, Applications of web based manufacturing, casting, machining, forming & forging.

6. **Future Trends In Manufacturing Systems**

**Reference Books:**

5. Scolz B. Reiter *C.I.M Interfaces* Chapman & Hall 1992
Semester - II
Industrial Product Design & Product Lifecycle Management  [502408]

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1. **Product Development**
   Quality function deployment-quality project approach and the problem solving process. Design creativity-innovations in design alternatives. Concurrent engineering, industrial design principles. Product development versus design, types of design and redesign, modern production development process, reverse engineering and redesign product development process, examples of product development process, scoping product development – S-curve, new product development.

2. **Understanding Customer Needs & Generating Concepts**
   Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality. GENERATING CONCEPTS: Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory, DFMA, design for robustness.

3. **Product Tear Down and Experimentation**
   Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios.

4. **Introduction to Product Life Cycle Management**
   Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement., Threads of PLM-computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM, comparison of PLM to Engineering resource planning (ERP). PLM characteristics -singularity, cohesion, traceability, reflectiveness.

5. **Product Life Cycle Environment**

6. **Product Data Management**
   Benefits and Terminology, CIM Data, PDM functions, definition and architectures of PDM systems, Engineering data, engineering workflow and PDM acquisition and implementation, Resolving Data Issues, product data interchange, present market constraints, collaborative product development, Internet and developments in client server computing, portal integration. Components of a typical PDM setup - hardware and document management – creation and viewing of documents - creating parts-version - control of parts and documents, configuration management for product structure, change management and associated activities.

**Reference Books.**
Semester – II
Automated Manufacturing System Modelling [502409]

<table>
<thead>
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1. **Introduction**

2. **Automated Manufacturing Systems**

3. **Markov Chain Models**

4. **Queuing Models**
   Queues, Notation and Examples, The M/M/1 Queue, The M/M/m Queue, Batch Arrival Queuing Systems, Queues with General Distributions, Queues with Breakdowns, Analysis of a Flexible Machine Centre, Queuing Networks, Open Queuing Networks; Closed Queuing

5. **Petri Net Models**

**Reference Books:**
University of Pune

Semester – II
Elective – II [502410]

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<tr>
<th>CODE</th>
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Modules of 2 Credits

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<td>CAD2II – M1</td>
<td>Isoparametric Elements And Formulation of Plane Elasticity Problems</td>
<td>CAD2II – M3</td>
<td>Nonlinear Problems – Geometric, Material And Contact Problems</td>
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<tr>
<td>CAD2II – M4</td>
<td>Dynamic Problems – Eigen Value and Time Dependent Problems</td>
<td>CAD2II – M5</td>
<td>Finite Difference Solutions</td>
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<td>CAD2II – M6</td>
<td>Finite Volume Methods</td>
<td>CAD2II – M8</td>
<td>Advanced Materials</td>
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<td>CAD2II – M9</td>
<td>Alloys</td>
<td>CAD2II – M10</td>
<td>Ceramics</td>
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<td>CAD2II – M11</td>
<td>Composites</td>
<td>CAD2II – M13</td>
<td>Data Models</td>
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<td>CAD2II – M15</td>
<td>Distributed Database</td>
<td>CAD2II – M16</td>
<td>Web Languages</td>
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<td>CAD2II – M17</td>
<td>J2ee Technologies:</td>
<td>CAD2II – M18</td>
<td>Ejb3, Ajax</td>
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<tr>
<td>CAD2II – M19</td>
<td>Tools For Customization</td>
<td>CAD2II – M23</td>
<td>Automated Solid Modeling Using Customization</td>
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Modules of 1 Credit

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<td>CAD1II – M2</td>
<td>Plate Bending Problems – Plate And Shell Elements</td>
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<td>CAD1II – M12</td>
<td>Relational Database Design</td>
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<td>CAD1II – M20</td>
<td>Computer-Based System Engineering</td>
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<tr>
<td>CAD1II – M22</td>
<td>Solid Modelling Algorithms</td>
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CAD2II – M1: Isoparametric Elements and Formulation of Plane Elasticity Problems
Introduction, shape functions – linear & quadratic, displacement function – criteria for the choice of the displacement function, polynomial displacement functions, displacement function in terms of nodal parameters, strain-nodal parameter relationship, stress-strain relationship, element stiffness matrix, convergence of isoparametric elements, numerical integration – Trapezoidal rule, Simpson’s 1/3 rule, Newton-Cotes Formula, Gauss Quadrature formula, Guass Quadrature in two and three dimensions.

Introduction, thin and thick plates – Kirchhoff theory, Mindlin plate element, triangular and rectangular, conforming and nonconforming elements, degenerated shell elements, reduced and selective integration, shear locking and hour glass phenomenon.

CAD2II – M3: Nonlinear Problems – Geometric, Material and Contact Problems
Introduction to non-linear analysis, formulation for geometrical, material and contact nonlinear problems, Nonlinear equation solving procedure - direct iteration, Newton-Raphson method, modified Newton-Raphson method, incremental techniques.
CAD2II – M4: Dynamic Problems – Eigen Value and Time Dependent Problems

Formulation of dynamic problems, consistent and lumped mass matrices Solution of Eigen value problems – transformation methods, Jacobi method, Vector Iteration methods, subspace iteration method Forced vibration – steady state and transient vibration analysis, modelling of damping, the mode superposition scheme, direct integration methods – implicit and explicit numerical integration.

Reference Books:

CAD2II – M5: Finite Difference Solutions


CAD2II – M6: Finite Volume Methods

Introduction to finite volume method, finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows. Use of staggered grids simple algorithm.

CAD2II – M7: Turbulence Modeling

Turbulence energy equation- one-equation model, the k-ω model, the k-ε model

Reference Books:

CAD2II – M8: Advanced Materials

HSLA steels, tool and die materials, alloy cast irons, stainless steels, PH and maraging steels, materials for low temperature applications, refractory metals and super alloys, Hadfield steels, ball bearing steels and bearing metals.

CAD2II – M9: Alloys

Automobile alloys and aerospace alloys, Inter metallics, Ni and Ti Aluminides - Smart materials, shape memory alloys -Metallic glass - Quasi crystal and nano Crystalline materials.
**CAD2II – M10: Ceramics**
Ceramic crystal structures – Binary ceramic structures: Rock salt, Fluorite, Rutile and Silica structures. Ternary ceramic structures. Introduction to phase equilibria in ceramics, Phase equilibrium diagrams and composition calculations. Thermal, Electrical, magnetic and optical behavior of ceramics, Mechanical behavior of ceramics, Engineering ceramics and their applications, (Glass and Glass-ceramics, Aluminum oxide, Silicon nitride, Zirconia and zirconia-Toughned Aluminum, Sailons)

**CAD2II – M11: Composites**

**Reference Books:**

**CAD2II – M12: Relational Database Design**
Relational model and relational database design: Structure of relational database, former query languages, commercial query languages. Modifying the database views. Pitfalls in relational database design and normalization.

**CAD2II – M13: Data Models**
Network data model and hierarchical data model: data structure diagram, the DBTCCODASYL. Model data retrieval Update and set processing facility, three structure diagram, data retrieval and update facility, virtual records.

**CAD2II – M14: File & System Structure**

**CAD2II – M15: Distributed Database**
Distributed database, security and integrity: Design, transparency and autonomy, query processing, recovery, concurrency control, deadlock handling and coordinator selection. Security and integrity, near database application.

**Reference Books:**

**CAD2II – M16: Web Languages**
CAD2II – M17: J2EE Technologies
JSP- What is JSP, JSP architecture, Session in JSP, Cookies and use of cookies. Servlet- Introduction to Servlet technology, web container, Methods of Servlet, Lifecycle of a servlet, advantages of servlet, HTTP session listener and filters in servlet.

CAD2II – M18: EJB3, AJAX
Introduction to Application server, Features of enterprise beans, benefits of EJB, Annotations, Introduction to POJO, stateless and stateful session beans.
Ajax- Introduction to framework, rule of ajax in enhancing user experience, ajax examples. Distributed Computing Concepts of Client-Server Architecture (2-Tier, 4-Tier, n-Tier).

CAD2II – M19: Tools for Customization
Object Oriented Programming (OOP), OLE interfaces in CAD/CAM software; Use of General programming interfaces like VB, VBS, VC++, Open GL programming and System dependent programming interfaces like Visual LISP (AutoCAD), GRIP (Unigraphics), Pro-Programming (Pro/Engineer)

CAD2II – M20: Computer-Based System Engineering
System Engineering process, Software product development life cycle, software processes, software development project management, software prototyping.

Reference Books:
1. Ian Summerville, Software Engineering, Pearson Education.
4. George Omura, Advanced AutoCAD.
5. Shami Tickoo, Customizing AutoCAD, Thomson learning

CAD2II – M21: Rapid Development
Core issues in rapid development, rapid development languages, lifecycle planning and customer oriented development.

Reference Books:
1. Steve McConnell, Rapid development, Microsoft Press.

CAD2II – M22: Solid Modelling Algorithms
Euler operations, basic solid modelling algorithms

CAD2II – M23: Automated Solid Modeling Using Customization:
Creating 2D, 3D and solid entities through API, Editing 2D, 3D and solid entities through API, Design and development of user interfaces - icons, menus, dialog boxes, Integrating databases with CAD; creating BOM or part lists, Automated Assembly modelling through customization, Automated drafting and dimensioning using customization, Creating Automated Animations using API and animation software.

Reference Books:
1. Martti Mantilya, Solid Modelling, Computer Science Press.
Lab. work or Assignments have to be carried out at respective labs as mentioned in the syllabus of respective subjects excluding Elective. It is to be submitted as term work at the end of semester after continuous assessment of each by respective teacher. Assessment of term work has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System. (Refer University web site)

**SIMULATION & OPTIMIZATION**

04- 06 Assignment on real life problems of manufacturing systems and manufacturing processes to be simulated using simulation software’s as ARENA, FORGE, FASTFORM ADVANCED, PAMSTAMP, SIMUFACT FORMING etc. Assignments on optimization using any process/product optimization software.

**Assignments:**

3. Assignment of Finite Element Simulation of Drawing/Forming.
4. Assignment on Tool Path Simulation of Turning/Milling.
5. Assignment on Process Optimization.
Seminar – I, II and III [502412, 602416, 602418]

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Assessment of Seminar has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System.

INSTRUCTIONS FOR SEMINAR I/II/III REPORT WRITING

It is important that the procedures listed below be carefully followed by all the students of M.E. (Mechanical Engineering).

1. Prepare 3 COPIES of your manuscript.
2. Limit your project report to preferably
   a) 15-20 manuscript pages Seminar I
   b) 20-25 manuscript pages Seminar II
   c) 25-30 manuscript pages Seminar III
3. The footer
   For Computer Aided Design, Manufacture & Engineering
   Institute Name, Mechanical (CADME) Bookman Old Style 10 pt. and centrally aligned.
4. Page number at second line of footer, Bookman Old Style 10 Pt, centrally aligned
5. Print the manuscript using
   a) Letter quality computer printing.
   b) The main part of manuscript should be Bookman Old Style 12 pt. and justified.
   c) Use 1.5 line spacing.
   d) Entire report shall be one chapter. No chapters for Seminar I, II, and III.
   e) Seminar I shall not have last section as Conclusions, it will be summary only.
6. Use the paper size 8.5” × 11” or A4 (210 × 197 mm). Please follow the margins given below.

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</table>
7. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.

8. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.

9. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear.
   a) Illustrations should not be more than two per page. One could be ideal
   b) Figure No. and Title at bottom with 12 pt
   c) Legends below the title in 10 pt
   d) Leave proper margin in all sides
   e) Illustrations as far as possible should not be xeroxed.

11. Photographs if any should of glossy prints

12. Please use SI system of units. If students would like to add the equivalent in inch-pound (British) units, they must be stated in parenthesis after the SI units. In case the final result comes out in any other units (say due to empirical formula etc.) covert the unit to SI unit.

13. Please number the pages on the front side, centrally below the footer

14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author

15. Symbols and notations if any should be included in nomenclature section only

16. Following will be the order of report
   i. Cover page and Front page as per specimen on separate sheet
   ii. Certificate from institute as per specimen on separate sheet
   iii. Acknowledgement
   iv. List of Figures
   v. List of Tables
   vi. Nomenclature
   vii. Contents
   viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word “Abstract” should be bold, Bookman Old Style, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract.
   ix. Section : Introduction
   x. References

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, .... and for subheadings 1.1, 1.2, .... etc and section subheadings 2.1.1, 2.1.2, .... etc.
18. **References** should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If **figures** and **tables** are taken from any reference then indicate source of it. Please follow the following procedure for references.

**Reference Books**

**Papers from Journal or Transactions**

**Papers from Conference Proceedings**

**Reports, Handbooks etc.**

ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

**Patent**

Patent no, Country (in parenthesis), date of application, title, year.

**Internet**

www.(Site) [Give full length URL]
Format for front page and Certificate

A Seminar I / II / III on (TNR, 16pt, centrally aligned)

Title (TNR, 27pt, Bold, Centrally Aligned, Title Case)

By (TNR, 16pt, Centrally Aligned)

Mr. Student’s Name (TNR, 16pt, Centrally Aligned)

Guide (TNR, 16pt, Centrally Aligned)

Guide’s Name (TNR, 16pt, Centrally Aligned)

Institute Logo

Department of Mechanical Engineering

Name of the Institute

[2011-12](TNR, 22pt, Title Case Centrally Aligned)
This is to certify that Mr. Lele M.M., has successfully completed the seminar-I/II/III entitled “Performance analysis of……..” under my supervision, in the partial fulfilment of Master of Engineering - Mechanical Engineering (Computer Aided Design, Manufacture & Engineering) of University of Pune.

Date :

Place :

Guide’s Name
Guide

Head
Department and
Institute Name

External Examiner

Seal

Principal,
Institute Name
Semester - III
Simulation Modelling [602413]

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1. Introduction To Simulation

2. Random Number Generation And Testing
   Techniques for generating random numbers – mid square method – mid product method - constant multiplier technique - additive congruential method - linear congruential method – combined linear congruential generators – feedback shift register generators - tests for random numbers – frequency test - the Kolmogorov-Smirnov test, the chi-square test. Independence test – runs up and runs down, runs above and below the mean, autocorrelation.

3. Random Variate Generation

4. Stages In Model Building

5. Manufacturing Systems Modelling

6. Introduction To Simulation Packages And Exercises
   Model building using SIMULATION PACKAGES.

Text/Reference Books:
1. **Introduction To Optimization**
   Introduction to optimization, formulation of optimization problem, Classification of optimization problems, Optimum design of components like pins, beams, columns, shafts, spur gears, pressure vessels, etc.

2. **Linear Programming**
   Linear programming, simplex method and duality in linear programming, sensitivity or post-optimality analysis, Karmarkar’s method

3. **One Dimensional Optimization**
   One dimensional minimization, optimality criterion, minimum bracketing methods like exhaustive search method, bounding phase method; optimum seeking methods like interval halving, golden section search, successive quadratic estimation, Newton Raphson, bisection, secant, cubic search method

4. **Multi-Dimensional Optimization**
   Multivariable unconstrained optimization, optimality criteria, direct search methods Powell’s conjugate direction method; gradient search methods like Cauchy’s method, Newton’s method, conjugate gradient method and variable metric method.

5. **Constraint Based Optimization Methods**
   Constrained Optimization, Optimality conditions, Optimization methods like penalty function method, method of multipliers, variable elimination method, complex search method, random search method, cutting plane method, feasible direction method, generalized reduced gradient method

6. **Evolutionary Optimization**
   Introduction, working & Advantages of Genetic Algorithm, Simulated Annealing, Particle Swarm Optimization

**Text Books:**

**Reference Books:**
### Modules of 2 Credits

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<td>CAD2III – M2</td>
<td>Abrasive Processes</td>
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<td>Unconventional Machining Processes</td>
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<td>CAD2III – M6</td>
<td>Liquid-Based Rapid Prototyping Systems</td>
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<td>CAD2III – M7</td>
<td>Solid - Based Rapid Prototyping Systems</td>
<td>CAD2III – M8</td>
<td>Powder Based Rapid Prototyping Systems</td>
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<td>CAD2III – M11</td>
<td>Material Handling Systems</td>
<td>CAD2III – M12</td>
<td>Robot Kinematics</td>
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<td>CAD2III – M13</td>
<td>Robot Force Analysis</td>
<td>CAD2III – M14</td>
<td>Robot Sensors and Controllers</td>
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<tr>
<td>CAD2III – M16</td>
<td>Plastic Deformation In Metals:</td>
<td>CAD2III – M18</td>
<td>Sheet Metal Forming</td>
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<td>CAD2III – M20</td>
<td>Kanban System</td>
<td>CAD2III – M30</td>
<td>Design of Experiments and Analysis Of Variance</td>
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### Modules of 1 Credit

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<td>CAD1III – M15</td>
<td>Robot Programming</td>
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<td>CAD1III – M19</td>
<td>Just In Time Production System</td>
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<tr>
<td>CAD1III – M22</td>
<td>Design For Assorted Technical Requirements/ Processes</td>
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<tr>
<td>CAD1III – M24</td>
<td>Design For Reliability, Quality</td>
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<td>CAD1III – M26</td>
<td>Modules In ERP</td>
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<td>CAD1III – M28</td>
<td>Benchmarking The Supply Chain</td>
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**CAD2III – M1: Metal Cutting and Mechanics Of Metal Cutting**

Introduction to metal removal processes, Chip formation, forces acting on cutting tool and their measurement, Chip thickness, Theory of Ernest and Merchant, theory of Lee and Shafer, Tool wear and tool life, surface finish, thermal aspects, friction in metal cutting and testing of machine tools.

**CAD2III – M2: Abrasive Processes**

Introduction, Grinding wheel-designation and selection, grinding process, grinding process parameters, creep feed grinding, honing, lapping and other finishing processes.
CAD2III – M3: Forming Processes

CAD2III – M4: Unconventional Machining Processes
Need for unconventional processes, Range of non conventional machining processes USM, WJM, AJM, chemical machining, Electrochemical machining, Electrolytic grinding, EDM, LBM, EBM, Plasma arc cutting.

CAD2III – M5: High Speed Machining
Introduction to high speed machining, economics of high speed machining, brief historical perspective, material properties at high strain rates, influence of increasing speed on chip formation, stainless steel, aerospace aluminium and titanium and recommendations.

Reference/Text Books:
4. D. A. Stephenson and J. S. Agapiou, Metal Cutting Theory and Practice, CRC Press
10. D. A. Stephenson and J. S. Agapiou, Metal Cutting Theory and Practice, CRC Press

CAD2III – M6: Liquid-Based Rapid Prototyping Systems

CAD2III – M7: Solid-Based Rapid Prototyping Systems

CAD2III – M8: Powder Based Rapid Prototyping Systems
CAD1III – M9: Rapid Prototyping Data Formats

CAD1III – M10: Rp Applications

REFERENCE/TEXT BOOKS:
1. Amitabha Ghosh, Rapid Prototyping

CAD2III – M11: Material Handling Systems
Material Transport Systems - Industrial trucks, automated guided vehicle systems (AGVS), vehicle guidance technology, vehicle management and safety, monorails and other rail guided vehicles, conveyor systems, types of conveyors, conveyor operations and features, cranes and hoists, analysis of material transfer systems, charting techniques in material handling, analysis of vehicle-based systems, conveyor analysis

CAD2III – M12: Robot Kinematics
Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks, sensor based motion planning: The Bug Algorithm, The Tangent Bug Algorithm, The Incremental Voronoi Graph.

CAD2III – M13: Robot Force Analysis
Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangean and Newton-Euler formulations of RR and RP type planar robots, Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, force feedback, hybrid control

CAD2III – M14: Robot 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 pre-processing. Segmentation and region characterization object recognition by image matching and based on features

CAD1III – M15: Robot Programming
Robot languages: AL, AML, RAIL, RPL, VAL, demonstration of points in space: Continuous path (CP), Via points (VP), Programmed points (PP).
Reference/Text Books:
CAD2III – M16: Plastic Deformation in Metals
The flow curve, true stress, true strain, yielding criteria for ductile metals, plastic stress – strain relations, strain hardening coefficient, normal anisotropy coefficient, formability evaluations, drawability tester, high strength, low alloy steels developed for formability: HSLA steels, Dual phase steels, DQAK steels, CHR-X steels, two-dimensional plastic, flow – slip line field theory, Mechanics of metal working, Temperature in metal working, strain rate effects, metallurgical structures, Friction and lubrication, lubricants for hot and cold working, Deformation zone geometry, workability and residual stresses.

CAD1III – M17: Forming Equipment

CAD2III – M18: Sheet Metal Forming

Reference/Text Books:

CAD1III – M19: Just In Time Production System
JIT Logic - Pull system, Japanese approach to production elimination of waste, JIT implementation requirements, JIT application for job shops

CAD2III – M20: Kanban System
Kanban rules supplier Kanban and sequence schedule used by supplier, Monthly information & daily information, later replenish system by Kanban sequenced withdrawal P system by sequence schedule table - problems & counter measures in applying Kanban system to subcontractors - Supplier Kanban circulation in the paternal manufacturer - structure of supplier Kanban sorting office.

Reference/Text Books:

CAD1III – M21: Design For Manufacturing, Assembly And Disassembly
Principles, approaches, Product and component, DFMA. The R & D Experience, Evaluations for DFMA.

CAD1III – M22: Design For Assorted Technical Requirements/ Processes
Material storage and distribution, Dimensional control, Heat treatment, Coating, Casting, Plastic processes.

CAD1III – M23: Design For Life Cycle
Approaches to product development, Inspect ability, Serviceability.

CAD1III – M24: Design For Reliability, Quality
Approaches, QFD, Evaluations and Procedures. Design for Quality. Design for Recycling

Reference/Text Books:
2. Corrado Poli, Design for Manufacturing: A Structured Approach, Butterworth Heinemann

**CADIII – M25: Introduction to ERP**
Introduction, Evolution of ERP, Reasons for growth of ERP, Advantages / disadvantages of ERP, Evaluation of ERP, Various

**CADIII – M26: Modules in ERP**

Reference/Text Books:
1. V.K. Garg & N.K. Venkitakrishnan, *ERP Ware: ERP Implementation framework*

**CADIII – M27: Introduction to Digital Manufacturing**

Reference/Text Books:

**CADIII – M28: Benchmarking the Supply Chain**

**CADIII – M29: Managing the Supply Chain**

Reference/Text Books:

**CADII – M30: Design of Experiments and Analysis of Variance**
Experimental designs – full factorial, partial factorial, Taguchi’s orthogonal array method, completely randomized block, Latin square design (only problems). ANOVA-One way and two way classifications, Multi way ANOVA.

Reference/Text Books:
Assessment of Project stage-I has to be carried out as per R-1.4 and R-1.5 of PG Rules and Regulations of Credit System.

INSTRUCTIONS FOR DISSERTATION WRITING

It is important that the procedures listed below be carefully followed by all the students of M.E. (Mechanical Engineering).

1. Prepare 3 COPIES of your manuscript.
2. Limit your Dissertation report to 80 – 120 pages (preferably)
4. Page number as second line of footer, Bookman Old Style, 10 Pt, centrally aligned
5. Print the manuscript using
   a) Letter quality computer printing.
   b) The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
   c) Use 1.5 line spacing.
   d) Entire report shall be of 5- 7 chapters. i.e.

Abstract (half page)

i. Introduction (2-3 pages) (TNR – 14 Bold)
   1.1 Problem statement, Need (TNR – 12)
   1.2 Objectives
   1.3 Scope
   1.4 Methodology

ii. Literature Review (20-30 pages)
    Discuss the work done so far by researchers on the domain area and their significant conclusions. No derivations are expected.

iii. This chapter shall be based on your own contribution in simulation (Analytical/ Numerical) (15- 20 pages)
iv. This chapter shall be based on either a) experimental work OR b) Finite Element / CFD Analysis (15-20 pages)

v. Concluding Remarks and Scope for the Future Work (2-3 pages)

ANNEXURE (if any)

(Put all mathematical derivations, Simulation program as Annexure)

References

1. Use the paper size \(8.5'' \times 11''\) or A4 (210 × 197 mm). Please follow the margins given below.

<table>
<thead>
<tr>
<th>Margin Location</th>
<th>Paper 8.5'' × 11''</th>
<th>Paper A4 (210 × 197 mm)</th>
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</tr>
</tbody>
</table>

2. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.

3. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.

4. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).

5. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.

   a) Illustrations should not be more than two per page. One could be ideal
   b) Figure No. and Title at bottom with 12 pt
   c) Legends below the title in 10 pt
   d) Leave proper margin in all sides
   e) Illustrations as far as possible should not be xeroxed.

6. Photographs if any should of glossy prints

7. Please use SI system of units only.

8. Please number the pages on the front side, centrally below the footer.

9. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author

10. Symbols and notations if any should be included in nomenclature section only

11. Following will be the order of report

   i. Cover page and Front page as per specimen on separate sheet
   ii. Certificate from institute as per specimen on separate sheet
   iii. Acknowledgements
   iv. List of Figures
   v. List of Tables
   vi. Nomenclature
vii. Contents

viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word “Abstract” should be bold, Times New Roman, 12 pt and should be typed at the centre. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract.

ix. Section : Introduction

x. References

12. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, …. and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.

13. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it. Please follow the following procedure for references

Reference Books

Papers from Journal or Transactions

Papers from Conference Proceedings

Reports, Handbooks etc.
ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent
Patent no, Country (in parenthesis), date of application, title, year.

Internet
www.(Site) [Give full length URL]
Name of the Institute

Institute

Logo

CERTIFICATE

This is to certify that Mr. Lele M.M., has successfully completed the Project Stage-I entitled “Performance analysis of……..” under my supervision, in the partial fulfilment of Master of Engineering - Mechanical Engineering (Computer Aided Design, Manufacture & Engineering) of University of Pune.

Date :

Place :

Guide’s Name
Guide

____________________
Head
Department and
Institute Name

____________________
External Examiner
Seal
Principal,
Institute Name
Title (TNR, 27pt, Bold, Centrally Aligned, Title Case)

By (TNR, 16pt, Centrally Aligned)

Mr. Student’s Name (TNR, 16pt, Centrally Aligned)

Guide

Guide’s Name (TNR, 16pt, Centrally Aligned)

Institute

Logo

Department of Mechanical Engineering

Name of the Institute

[2011-12](TNR, 22pt, Title Case Centrally Aligned)
CERTIFICATE

This is to certify that Mr. Lele M.M., has successfully completed the Dissertation entitled “Performance analysis of…….” under my supervision, in the partial fulfilment of Master of Engineering - Mechanical Engineering (Computer Aided Design, Manufacture & Engineering) of University of Pune.

Date :

Place :

Guide’s Name
Guide

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Head
Department and
Institute Name

External Examiner Seal

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Principal,
Institute Name