Revised Syllabus Structure of M.E. Mechanical (Product Design & Development)

WITH EFFECT FROM THE ACADEMIC YEAR JUNE/JULY 2012-2013

M.E. MECHANICAL (PRODUCT DESIGN & DEVELOPMENT) SEMESTER : I

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**ELECTIVE – I**

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<tr>
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<td>Material Handling Equipment Design</td>
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**ELECTIVE – II**

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<td>Computational Fluid Dynamics</td>
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M.E. MECHANICAL (PRODUCT DESIGN & DEVELOPMENT) SEMESTER : II

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**ELECTIVE – IV**

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### M.E. MECHANICAL (PRODUCT DESIGN & DEVELOPMENT) SEMESTER: III

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### M.E. MECHANICAL (PRODUCT DESIGN & DEVELOPMENT) SEMESTER: IV

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* For Seminar-I & II, work load will be for two students.

** Open Elective –
Students can take any subject from other discipline being conducting in the same institute and with consent of their guide.

*** For Dissertation Phase-I and Dissertation Phase-II, work load will be for one student.
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I
1. APPLIED MACHINE DESIGN

Teaching Scheme: Examination Scheme:
Lecture: 3 Hrs/week Theory Paper: 100 Marks
Tutorial: 1 Hr/week Term Work: 25 Marks


3. INTRODUCTION TO SOLID MECHANICS: Stress, Strain in 2-d and 3-d, relation between stress and strain, theories of failure. (8)

4. MATERIAL SELECTION PROCESSING AND DESIGN – Material selection Process - Economics - Cost Vs Performance - Weighted property Index - Value Analysis - Role of Processing and Design - Classification of Manufacturing Process - Design for Manufacture - Design for Assembly - Design for castings, Forging, Metal Forming, Machining and Welding - Residual stresses - Fatigue, Fracture and Failure. (8)


TERM WORK: Minimum six assignments based on the above topics

TEXT BOOKS:
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I

2. COMPUTER AIDED DESIGN & SIMULATION

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 50 Marks
Pract/Oral: 25 Marks


2. **DESIGN CONSIDERATIONS:** Functional and production design-form design-influence of basic design, mechanical loading and material on form design - form design of gray castings, malleable iron castings, aluminium castings, pressure die castings, plastic mouldings, welded fabrications, forging and manufacture by machining methods. Influence of space, size, weight, etc., on form design, aesthetic and ergonomic considerations.  

3. **TOLERANCE AND ANALYSIS:** Dimensioning and tolerancing a product-functional production and inspection datum-tolerance analysis.  

4. **INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS:** Output primitives (points, lines, curves Etc.,) , 2-D transformation (Translation, scaling, rotators) windowing , view ports clipping transformation. Visual Realism: Hidden - Line - Surface - solid removal algorithms shading - coloring. Introduction to parametric and variational geometry based on softwares and their principles creation of prismatic and lofted parts using these packages.  

5. **SOLID MODELING:** Introduction to solid modeling concepts, sketching and constraining the geometry generating primitive shapes by using part modeling workbench, creation of surfaces-types and applications of various types of surfaces, Assembly of parts, tolerance analysis mass property calculations.  

6. **FINITE ELEMENT ANALYSIS:** Historical background - Weighted residual methods - Basic concept of FEM - Variational formulation of B.V.P. - Ritz method - Finite element modelling - Element Equation - Linear and quadratic shape functions - Bar ,Beam ,Elements - Application to heat transfer.  

7. **FINITE ELEMENT ANALYSIS OF 2D PROBLEM:** Basic boundary value problems in 2 Dimensions - Triangular, quadrilateral, higher order elements - Poissons and Laplaces Equation - Weak formulation - Element Matrices and vectors - Application to solid mechanics, Heat transfer, Fluid Mechanics.  


**TERM WORK:**

1. Preparation of solid models for minimum two assemblies of any industrial products using solid modeling software like CATIA, Solid works, UGS etc.
2. Solution of two problems in statics for using FEA software like Ansys, Hypermesh, Nastran etc.
3. Simulation of any mechanical system using simulation software
4. Writing interactive programs to solve design problems and production of drawings using any languages like Auto LISP/C/FORTRAN etc.
5. Two assignments on generation of surfaces using modelling software like CATIA.

References:

M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I
3. DESIGN OF EXPERIMENTS AND RESEARCH METHODOLOGY

Teaching Scheme:  
Lecture: 3 Hrs/week  
Tutorial: 1 Hr/week

Examination Scheme:  
Theory Paper: 100 Marks  
Term Work: 25 Marks

1. **Introduction:** Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsoring agent’s requirements, Ethical, Training, Cooperation and Legal aspects. (5)

2. **Research Design:** Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques, Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research. (5)


5. **Experimentation:** Objective, Strategies, Factorial Experimental Design, Applications of Experimental Design, Basic Principles – Replication, Randomization and Blocking, Guidelines for designing experiments; Laboratory Experiments, Methods of manipulating Variables, Errors in Experiments, Steps in Design of Experiments, Basis. (6)


7. **Analysis:** Analysis of Variance and Co-variance, Hypothesis Testing – Parametric and Non-Parametric Tests, Uni-variate and Bi-variate analysis (3)

8. **Report Writing:** Pre-writing Considerations, Principles of Thesis Writing, Formats of Report Writing & Publication in Research Journals, Oral Presentations (Briefing) (3)
TERM WORK:

1. Collection and review of literature on a specific topic related to design or manufacturing engineering.
2. Assignment on data collection processing, analysis, interpretation, inferences and conclusions for an engineering problem.
3. Assignment on design of experiments using Taguchi technique.
5. Presentation of any one above using MS power-point or similar.

Reference Books:

M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I

4. ELECTIVE – I

1. ADVANCED MATERIAL & PROCESSING

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

SECTION – I


5. Selection of Materials: Motivation for selection, cost basis and service requirements- selection for mechanical properties, strength, toughness, fatigue and creep. Selection for surface durability, corrosion and wear resistance. Relationship between materials selection and processing. Case studies in material selection with reference to aero, auto, Marine, machinery and nuclear applications. (3)

SECTION – II


2. Rapid prototyping: Product development cycle & importance of prototyping. Types of prototypes, principles and advantages and different types of generative manufacturing processes, viz. stereolithography, FDM, SLS etc. Factors concerning to RP: consideration for adaptations, advantages, accuracy, economic considerations. (5)

advantages, limitations and applications of ultrasonic machining, laser beam machining and electrochemical machining. (5)

4. **Special processes and electronic fabrication:** Principles, salient features, advantages & applications of abrasive floor machining, magnetic abrasive finishing, wire EDM, electrochemical grinding, honing, lapping & super finishing. Principles, elements, process, advantages, applications & surface preparation etc. of physical vapor deposition, chemical vapor deposition, electro less coating & thermal metal spraying. (5)

**TERM WORK:** Minimum six exercises to be performed based on above topics.

**REFERENCE BOOKS:**

1) “HMT Handbook” – Production Technology (TMH)
2) “Non-traditional machining processes”, Willer, SME publications.
3) “Advanced Manufacturing Processes”, G.F.Benidict, Marcel Dekker Publisher
5) “Design & Manufacturing of Composite Structures”, Geoff Eckold (Jaico Publishing House)
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I
4. ELECTIVE – I
2. INDUSTRIAL AUTOMATION

Teaching Scheme:  
Lecture: 3 Hrs/week  
Practical: 2 Hrs/week  

Examination Scheme:  
Theory Paper: 100 Marks  
Term Work: 25 Marks

SECTION – I

1. Overview of Automation: (5)  
   Types of automation, significance and importance, evaluation of automation, components of automation in various automation types.

2. Application of PLC in Manufacturing: (5)  
   PLC Hardware components, Monory organization, use of PLC for various industrial applications, layout of PLC interfacing.

3. Sensors interfacing for PLC: (4)  
   Sensors used for various applications in industry. Types and classification of sensors, features, construction and working.

4. Basics of PLC Programming: (8)  
   Ladder Systems used in ladder logic, writing ladder for given condition, guidelines for ladder writing. Basic instructions of ladder programming like Relay type, instructions, logical instructions, program control instructions.  
   Data Manipulation.  
   Data comparison instructions, data compilation instructions, data conversion instruction, data transfer instructions. Concept of file handling in PLC.

SECTION – II

5. Timers and Counters: (8)  
   Introduction to Timers, types of timers, timer instructions. Introduction to counters, types of counters, counter instructions.

6. Networking PLC: (3)  
   Introduction, Levels of industrial control, types of Networking, Network communications, PLC and internet cell control by PLC Network.

7. Controlling Robot with PLC: (3)  
   Introduction, Basic two-axis control with PLC, sequence control, industrial three-axis control with PLC.

8. SCADA (Supervisory Control And Data Acquisition) and PLC Interfacing: (4)  
   Concept, Methodology, types by which supervisory control can be effected, merits and disadvantages.

TERM WORK:
Maximum Six assignments based on above topics giving understanding of practical exposure and working experience.

REFERENCES:
3. “Desirable facility on equivalent make PLC with supporting programming software and interfacing sensor” by Allen Bradley.
6. Introduction to 8085 – Gaonkar
7. Process control and instrumentation – Johnson C.D.
9. Programmable Logic Controller – FESTO Pneumatics, - Bangalore
10. PLC Textbook and related literature by FESTO.
11. Various PLC manufacturers catalogue
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I
4. ELECTIVE – I
3. SYSTEM DESIGN

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

1. **Engineering Process & System Approach:** Introduction. General model of engineering system, elements of system identification of engineering functions, characteristics of engineering system, Problem formulation, identification & analysis of need, problem scope & constraints. (10)

2. **System theories and modeling:** System analysis, various approaches to system design, need for modeling, various modeling concepts- linear graph, mathematical modeling. (10)

3. **System Evaluation:** Feasibility assessment, time value of money financial analysis, selection between alternatives (4)

4. **Optimization:** Theory of optimization, calculus methods of optimization for two or more variables. (5)

5. **Design Analysis:** Decision models, scientific approach to decision process, quantitative methods in decision making. (4)

6. **System Simulation:** Simulation models, Queuing theory, monte carlo method, (4)

7. Application of system approach to mechanical systems. (3)

**TERM WORK:**
Design and analysis of any mechanical system, using system approach & simulating the same, using suitable software.

**Reference Books:**
1. Mechanical System Design – Siddiqui, Manoj Kumar Singh; New Age International
2. Machine Design By Dieter
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I

4. ELECTIVE – I

4. MATERIAL HANDLING EQUIPMENT DESIGN

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

1. Elements of Material Handling System:
   Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout, physical facilities and other organizational functions; Classification of Material Handling Equipments.

2. Selection of Material Handling Equipments:
   Factors affecting for selection; Material Handling Equation; Choices of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.

3. Design of Mechanical Handling Equipments:
   [A] Design of Hoists –
   Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms.
   [B] Design of Cranes –
   Hand-propelled and electrically driven E.O.T. overheat Traveling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary cranes with fixed radius; fixed post and overhead traveling cranes; Stability of stationary rotary and traveling rotary cranes.

4. Design of load lifting attachments:
   Load chains and types of ropes used in Material Handling System; Forged, Standard and Ramshorn Hooks; Crane Grabs and Clamps; Grab Buckets; Electromagnet; Design consideration for conveyor belts; Application of attachments.

5. Study of systems and Equipments used for Material Storage:
   Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks etc.

6. Material Handling / Warehouse Automation and Safety considerations:
   [A] Storage and warehouse planning and design; computerized warehouse planning; Need, Factors and Indicators for consideration in warehouse automation; which function, When and How to automate; Levels and Means of Mechanizations.
   [B] Safety and design; Safety regulations and discipline.
TERM WORK:

- Following assignments comprise the laboratory practice:-
  1. Design and development on Material Handling Equipments applicable to various process industries such as Sugar Industry, Power plants, Automobile manufacturing, Harbor, Foundries etc.
  2. Report based on visits to industries manufacturing or using various Material Handling Equipments.

REFERENCE BOOKS
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I
5. ELECTIVE – II

1. DYNAMIC ANALYSIS & TESTING METHODOLOGY

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks


2. **TWO DEGREE FREEDOM SYSTEM**: Free vibration of spring-coupled system - Mass coupled system - Bending variation of two degree freedom system - Forced vibration - Vibration Absorber - Vibration isolation. (2)


4. **VIBRATION OF CONTINUOUS SYSTEMS**: Systems governed by wave equations - Vibration of strings - Vibration of rods - Euler 's equation for beams - Effect of Rotary inertia and shear deformation - Vibration of plates. (4)


7. **Eigen values & Eigenvectors**, Examples, Modal matrix Diagonalization and Jordan Form, Homogeneous Solutions State transition matrix Particular solution, Stability of state equations, transfer functions- definition, amplitude and phase, poles and zeros, Impedances and Admittances, Elements in series and in parallel, One-port and two-port elements, Relating impedance to transfer function, Frequency response functions: definition, Relation to transfer functions, first and second order systems, bode and nequist plot, Fourier transforms- definition, Relation to transfer functions, First order systems ,applications. (6)

8. **VALIDATION OF ANALYTICAL MODELS**: Preliminary check, correlation of analytical model with experimental model, model updating- fundamentals (3)
9. **ENGINEERING APPLICATIONS**: Structural applications-Design of simple truss members. Design applications-Design of simple axial, Transverse loaded members for minimum cost, maximum weight-Design of shafts and Torsionally loaded members-Design of Springs, Dynamic applications-Optimum design of single, two degree of freedom systems, Vibration absorbers. Application in Mechanisms- optimum design of Simple linkage mechanisms (5)


**TERM WORK:**

1. Two assignments on measurement of dynamic test data of machine elements
2. One assignment on experimental modal analysis of machine element.
3. Two assignments on dynamic analysis using FEA software like Nastran, Hyperworks etc.
4. One Assignment on model data correlation for any one model used in sr. no. 1 and 2

**References:**


**Web References:**

2. [http://www.auburn.edu/isvd/](http://www.auburn.edu/isvd/)
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I
5. ELECTIVE – II
2. REVERSE ENGINEERING

Teaching Scheme: Examination Scheme:
Lecture: 3 Hrs/week Theory Paper: 100 Marks
Practical: 2 Hrs/week Term Work: 25 Marks

1. Introduction
   Scope and tasks of RE - Domain analysis- process of duplicating (5)
2. Tools for
   Functionality- dimensional- developing technical data - digitizing techniques -
   construction of surface model - solid-part material- characteristics evaluation -software
   and application- prototyping - verification (8)
3. Concepts
   History of Reverse Engineering – Preserving and preparation for the four stage process –
   Evaluation and Verification- Technical Data Generation, Data Verification, Project
   Implementation (9)
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 (9)
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 (9)

TERM WORK:
Minimum Six assignments based on above topics, which also include at least one case study.

REFERENCE:
6. Co-ordinate Measurment and reverse engineering, Donald R. Honsa, ISBN 1555897,
   American Gear Manufacturers Association
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I

5. ELECTIVE – II

3. COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

1. Introduction: (10)
   CFD as the third dimension of fluid mechanics. Numerical Discretization methods such as Finite Difference, FEM and FVM. Why FVM as preferred method in CFD. (25%)

2. Basic Equations of Fluid Dynamics: (6)

   Upwinding and central difference schemes. Stability condition in terms of Courant number. (25%)

   Characteristic form of eqns. Flux difference splitting. Application to 2-D flows such as flow through a nozzle. (20%)

5. Numerical methods for Incompressible flows: (6)
   The continuity eqn divergence constraint. Poisson eqn. for pressure. Schemes such as SIMPLE due to Patankar and Spalding. (15%)

TERM WORK:
Practical exercises (6 to 8) using Software packages like ANSYS, ICEM HEXA, FLUENT, CFX, COSMOS or equivalent on the following topics like –
1. Convection equation in one dimension.
2. Diffusion equation in one dimension.
3. One dimensional flow through a nozzle.
4. Flow over a cylinder and backward facing step.

Reference Books:
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I

5. ELECTIVE – II

4. DESIGN OPTIMIZATION

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Examination Scheme:</th>
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<tbody>
<tr>
<td>Lecture: 3 Hrs/week</td>
<td>Theory Paper: 100 Marks</td>
</tr>
<tr>
<td>Practical: 2 Hrs/week</td>
<td>Term Work: 25 Marks</td>
</tr>
</tbody>
</table>


5. Genetic Algorithm, Simulated Annealing, Artificial Neural Networks (3)

6. Theory of Constraints: Introduction to TOC, Optimized Production Technology (OPT), Nine principles of OPT, Five Focusing Steps (The 5FS) of TOC, Capacity Constrained Resources and the Time Buffer, Modeling the Time Buffer, Modeling Return-On-Investment (ROI) in TOC, Comparison of TOC and Local Optimization Approaches. (5)

TERM WORK: Minimum six exercises based on the above syllabus.

REFERENCE BOOKS:
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – I
6. SEMINAR – I

Teaching Scheme:
Practical: 1 Hr/week

Examination Scheme:
Term Work: 25 Marks

- Seminar–I should be based on the literature survey on any topic relevant to ‘Product Design & Development’. It may be leading to selection of a suitable topic of dissertation.

- Each student has to prepare a write-up of about 25 pages. The report typed on A4 sized sheets and bound in the necessary format should be submitted after approved by the guide and endorsement of the Head of Department.

- The student has to deliver a seminar talk in front of the teachers of the department and his classmates.

- The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.
1. **MANUFACTURING SYSTEM DESIGN**

   **Teaching Scheme:**
   - Lecture: 3 Hrs/week
   - Practical: 2 Hrs/week

   **Examination Scheme:**
   - Theory Paper: 100 Marks
   - Term Work: 25 Marks
   - Pract/Oral: 25 Marks

1. **Design of Sheet Metal Blanking and Piercing Dies** – (7)
   Introduction, Fundamentals of die cutting operations, General Press information types, cutting action in punch and die operations, types of die construction, die clearances, sheet metal material handling and feeding devices.

2. **Fundamentals of die design** – (7)
   Introduction, Press work materials and selection criteria, Blanking and piercing die construction, pilots, strippers and pressure pads, short run tooling for piercing, strip layout and design, calculations for sheet optimization.

3. **Bending, Forming and drawing die design** – (7)
   Introduction of bending, forming dies, Bending and forming die design, Calculation of various parameters as per ASTME, effect of various process parameters during drawing, Drawing force and related parameter calculation as per ASTME, blank size calculations.

4. **Development of non metallic components using injection moulding** – (7)
   Introduction, types of dies, die design considerations, calculation of important parameters, material properties of injection moulding materials.

5. **Design of Fixtures for Fabrication, Assembly and Inspection** – (7)
   Introduction, significance of fixtures in fabrication, Assembly and inspection, Types and classification, Materials used for above applications, design considerations, calculation of clamping force, various approaches used in design of fixtures for above applications.

6. **Gauge and Gauge Design** – (5)
   Introduction, requirement of a gauge, Types of gauges, Gauge tolerances, Selection of material for gauges, indicating gauges and automatic gauges, design of simple gauges like snap gauge, plug gauge and thread gauge.
   - CMM – Construction, working, features, software interface, elaboration of capabilities for various measurement requirement.
   - Use of CMM in reverse engineering, generation of drawing details from the existing component.
TERM WORK:

Minimum six assignments based on any of the following topics –
1. Blanking & Piercing die design.
2. Bending, forming, drawing die design.
3. Die design for injection moulded components.
4. Fixtures for Assembly, fabrication, inspection.
5. Use of CMM for component measurement and reverse engineering.
6. Use of softwares like Mould flow / Mouldex for suitable applications.

REFERENCE BOOKS:

2. Jigs & Fixtures- Kempster ,ELBS.
## M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II
### 2. CREATIVITY, INNOVATION & NEW PRODUCT DEVELOPMENT

<table>
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### 1. Introduction (8)
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brainstorming - different techniques.

### 2. Project Selection and Evaluation (8)
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques).

### 3. New Product Development (7)

### 4. New Product Planning (7)
Design of prototype - testing - quality standards - marketing research - introducing new products.


### 6. Understanding Customer Needs, Establishing Product Function (2)

### 7. Product Teardown and Experimentation, Benchmarking and Establishing Engineering Specifications, Product Architecture (4)

### TERM WORK:

### References:
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II

3. PRODUCT LIFE CYCLE MANAGEMENT

Teaching Scheme: 
Lecture: 3 Hrs/week  
Tutorial: 1 Hr/week

Examination Scheme: 
Theory Paper: 100 Marks  
Term Work: 25 Marks

1. **INTRODUCTION**: Background, Overview, Need, Benefits, Concept of Product Life Cycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement. (5)

2. **PRODUCT LIFE CYCLE ENVIRONMENT**: Product Data and Product Workflow, Company’s PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM. (4)


4. **PRODUCT MODELLING**: Product Modeling - Definition of concepts - Fundamental issues - Role of Process chains and product models -Types of product models - model standardization efforts-types of process chains - Industrial demands. (5)


6. **PRODUCT DATA MANAGEMENT (PDM) TECHNOLOGY**: Product Data Management – An Introduction to Concepts, Benefits and Terminology, CIM Data. PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition and implementation. (5)

7. **RECENT ADVANCES**: Intelligent Information Systems - Knowledge based product and process models - Applications of soft computing in product development process - Advanced database design for integrated manufacturing. (4)

Term Work :
(Minimum Six Assignments)

It shall consist of hands-on case assignments on suitable PLM software and other assignments based on the syllabus.
References:


3. Strain Analysis Methods: Three element rectangular strain rosette, correction, stress gauges, over-deterministic methods for strain analysis, residual stress determination Applications: Application of strain gauges for measurement of load, temperature, pressure, vibration, stress and strain etc. Strategy


6. Optical methods for Determining Fracture Parameters- Irwins methods, application. of moiré and isopachic fringe pattern to determine stress intensity factor, mixed mode intensity factors Strategy


TERM WORK:
1. Determination of strain by attaching strain gauges to minimum two stressed members subjected to tension, bending, torsion or combined.
2. Use of Strain rosette for principal strain determination by mohr circle method
3. Model preparation for 2-d and 2-d photoelasticity analysis.
4. Determination of Stresses in 2-D elements
5. Determination of Stresses in 3-D elements
6. Study of coating techniques for stress and strain determination

References:
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II
4. ELECTIVE – III
2. RELIABILITY ENGINEERING

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

A) Quality Engineering

2. Steps in Robust Design, Quality Characteristics and Objective Functions, Control Factors and their Levels, Noise Factors and Testing Conditions, Planning and Conducting the Experiment (2)
3. Response Surface Methodology – First-order and Second-order Models (8)

B) Reliability Engineering:

1. The Reliability Function, Failure Rate, Hazard Rate, Bath-tub Curve, Relationship between Various Reliability Characteristics (3)
2. Component Reliability, Mean-time-to-failure, Time-dependent Hazard Models – Constant-hazard, Linear-hazard, Nonlinear-hazard and Gamma Models (3)
4. Maintained Systems, Classification of Maintenance Activities: Breakdown, Preventive and Predictive Maintenance, Condition Monitoring, Maintainability and Availability, Reliability-centered Maintenance (4)

TERM WORK:

Minimum Six assignments on related topics, which should include at least one case study.

REFERENCE BOOKS:


Pre-requisites for Quality and Reliability Engineering

Experimental design fundamentals, Guidelines for designing experiments, Concepts of replication, blocking and randomization, Statistical techniques in experimentation, Sampling and sampling distributions, Confidence intervals, Inferences about means and variances Experiments with single factor, Analysis of variance, Fixed effect model – Parameter estimation, Model adequacy checking, Residual plots, Comparing treatment means, Designing and testing contrasts Factorial design, Two-factor factorial design, The 22 design and 23 design – Parameter estimation, Model adequacy checking

Probability – Concept, Definitions, Rules of probability, Bayesian theorem Continuous distributions – Normal, Lognormal, Exponential, Gamma, Chi-squared, and Weibull distribution Discrete distributions – Binomial, Poisson, and Negative binomial distribution
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II
4. ELECTIVE – III
3. INDUSTRIAL ROBOTICS & EXPERT SYSTEMS

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

1. **Introduction and Robot Kinematics** (9)

2. **Robot Drives and Control** (8)

3. **Robot** (8)

4. **Robot Cell Design and Application** (8)

5. **Robot Programming, Artificial Intelligence and Expert Systems** (7)

**TERM WORK**: Minimum Six assignments on related topics.


**References:**
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II
4. ELECTIVE – III
4. OPEN ELECTIVE

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

Students can take any subject from other discipline being conducting in the same institute and with consent of their guide.
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II
5. ELECTIVE – IV
1. RAPID PROTOTYPING

Teaching Scheme:
Lecture: 3 Hrs/week
Tutorial: 1 Hr/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

Chapter 1: Introduction to RP, Technology Description, Definition to RP, Overview of RP, Benefits and Application. (5)


Chapter 3: Classes of RP systems: 3D Printers, Enterprise Prototyping centers, Direct digital tooling, Direct digital manufacturing, system classification, Stereo lithography, SL with photo polymerization, SL with liquid thermal polymerization, Selective Laser Sintering, Fused deposition modeling, Laminated object manufacturing, Laser powder forming. (9)

Chapter 4: Prototype properties: Material, color, dimensional accuracy, stability, surface finish, machine-ability, environmental resistance, operational properties (6)


TERM WORK:
1. Two Assignments on 3SD modeling & STL File generation of industrial components.
2. Study of RP Processes and their parameters
3. Study of 3D printing & its applications
4. Use of Rapid tooling for injection molds
5. Use of RP for reverse engineering

REFERENCES:
5. Rapid & Virtual Prototyping & applications, C. E. Bocking, AEW Rennie, Wiley Eastern

WEBSITES
2. http://home.utah.edu/
3. http://www.me.psu.edu
4. http://itri.loyola.edu/rp/02
5. http://www.udri.udayton.edu/
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II
5. ELECTIVE – IV
2. ENGINEERING OPTIMIZATION IN DESIGN

Teaching Scheme:
Lecture: 3 Hrs/week
Tutorial : 1 Hr/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

1. **Unconstrained Optimization Techniques** (9)
   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** (9)
   Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming

3. **Advanced Optimization Techniques** (9)
   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** (7)

5. **Dynamic Applications** (6)
   Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

TERM WORK :
Minimum Six assignments on related topics, which should include at least one case study.

REFERENCES:

M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – II
5. ELECTIVE – IV
3. ARTIFICIAL INTELLIGENCE & NEURAL NETWORK

Teaching Scheme:
Lecture: 3 Hrs/week
Tutorial: 1 Hr/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

SECTION – I : ARTIFICIAL INTELLIGENCE

1. Concept of A.I., Approaches, Foundations of A.I., Underlying assumptions (1)
2. Problem Formulation: Problem solving agents, Components of problem definition, defining the problem as state space approach, Problem characteristics, Production System, searching for solutions, Forward and backward reasoning, means end analysis, Graphs and trees, measuring problem solving performance (3)
3. Search Strategies: a) Uninformed (blind) search- breadth first, depth first, and their variations, avoiding repeated states; b) Informed (heuristic) search- heuristic function, Generate and test, Best first search, A* search, Local search algorithms- Hill climbing, Simulated annealing, Branch and bound and Local beam search, (4)
4. Knowledge Representation: Simple rational knowledge, Inheritable knowledge, Inferential knowledge, Procedural knowledge, the Frame problem, Propositional logic-Syntax and semantics, well formed formulas (WFF), conversion to clausal form, using FOPL, inference rules, unification, non-deductive inference methods, resolution, forward and backward chaining, the knowledge engineering process, Handling uncertain knowledge, probability propositions, atomic events, unconditional (prior) and conditional (posterior), priority Bayes’ rule and its use, Bayesian network, its semantics and inference. (4)
5. Learning: Forms of learning, inductive learning, decision tree learning, ensemble learning, Pattern recognition- Introduction, recognition, and classification process, learning classification patterns. (2)
6. Knowledge based systems: Expert systems, components, characteristic features of expert systems, rule based system architecture, representing & using domain knowledge, expert system shell, explaining the reasoning and knowledge acquisition, applications. (3)
7. A.I. in Robotics: State space search, path selection, AND-OR graphs, means end analysis in a robotic problem, robot problem solving as a production system, robot learning and task planning, symbolic spatial relationship, obstacle avoidance, graph planning. (3)
8. Machine Vision: Functions, imaging devices, lighting, A-D conversion, quantization, encoding image storage, image data reduction, segmentation techniques, feature extraction, object recognition, training the vision system, applications. (2)

SECTION – II : ARTIFICIAL NEURAL NETWORK

1. Significance, Basic building blocks. (2)
2. Types of ANN – and their representation. (2)
3. Learning Modes and Algorithms. (4)
4. Applications of ANN to various engineering and industrial problems. (3)
5. Implementation methodology to solve problems, by using softwares like MatLab on equivalent. (5)
6. Desirable facilities. MatLab latest version with ANN Tool box and equivalent Supporting softwares preferably like Prolog, LISP, C++. (2)

TERM WORK: Minimum six exercises based on above, consisting of case studies.

BOOKS:
3. Dan W. Patterson (1999), “Introduction to Artificial Intelligence and Expert Systems” (7th Indian Reprint) (EEE) (Prentice Hall of India)
7. Conference Proceedings and current journals for case studies and applications.
9. A.N.N. by Yadnanarayana, Prentice Hall of India Publication
10. A.N.N. by Zurda J.M.
11. A.N.N. and MatLab by Sivanandan.
5. ELECTIVE – IV

4. TOTAL QUALITY MANAGEMENT & SIX SIGMA

Teaching Scheme:
Lecture : 3 Hrs/week
Tutorial : 1 Hr/week

Examination Scheme:
Theory Paper: 100 Marks
Term Work: 25 Marks

SECTION – I

1. **Overview of TQM:**
   Concept and definition, Fundamentals, TQM Verses Management relationship, Elements of TQM, approaches to TQM, TQM models, Zero defect concept.

2. **Contributions of Quality Gurus:**
   Deming’s approach, Jurans quality trilogy, Crossby and quality improvement, Ishikawas company wide quality control, Fegenbaum theory of TQC.

   **Revolution In Management Thinking:** Customer focus, problem solving QC tools, Continuous improvement (Kaizen), Customer satisfaction, Kanos model, Customer retention.

4. **Quality Circles:**
   Total Employee Involvement (TEI), Employee empowerment, Employee suggestion scheme.

   **Creating Quality Culture:** Requisite changes to implement Quality culture, developing TQM culture,

6. **Total Quality in Service Sector.**

SECTION – II

7. **Introduction to Six Sigma :**
   Concept, Approach and Orientation of Six Sigma.

8. **Strategy for Six Sigma :**
   Planning for Six Sigma, Prerequisites, Project Management, Performance Reporting.

9. **Implementation of Six Sigma :**
   Organizing Six Sigma, Team Leaders tools, corporate initiative.

10. **Design for Six Sigma:**

TERM WORK :
Minimum Eight (08) assignments on above topics preferably with case study.
Reference Books:

2. Implementing Total Quality-Joe Culle
4. Amitava Mitra, “Fundamentals of Quality Control and Improvement”, Pearson Education
6. SEMINAR – II

Teaching Scheme:
Practical: 1 Hr/week

Examination Scheme:
Term Work: 50 Marks

- Seminar–II should be based on the literature survey on any topic relevant to CAD/CAM/CAE. It may be leading to selection of a suitable topic of dissertation. The report shall contain some contribution by the candidate in the form of experimental results, deductions, compilation and inferences etc.

- Each student has to prepare a write-up of about 25 pages. The report typed on A4 sized sheets and bound in the necessary format should be submitted after approved by the guide and endorsement of the Head of Department.

- The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – III
1. MINI PROJECT

Examination Scheme:
Term Work: 50 Marks

A Mini Project based on the subjects studied during Semester-I and Semester-II, shall be undertaken and completed by the candidate during vacation after Semester-II.

The report of this project shall be submitted in the prescribed format at the beginning of Semester III. It will be approved by the guide and endorsed by the Head of Department. It will be assessed for term work during Semester III, by the evaluation committee(*) appointed by the Head of the Department.
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – III

2. DISSERTATION PHASE-I

Teaching Scheme:
Practical: 5 Hrs/week

Examination Scheme:
Term Work: 50 Marks
Oral: 50 Marks

It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations / experimental design etc. A report of the work shall be submitted at the end of Semester III after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work, by the evaluation committee(*) appointed by the Head of the Department, for appropriateness, sufficiency of contents and offer suggestions if any.
M.E. (PRODUCT DESIGN & DEVELOPMENT) Sem – IV
1. DISSERTATION PHASE-II

Teaching Scheme:
Practical: 5 Hrs/week

Examination Scheme:
Term Work: 200 Marks
Oral : 100 Marks

The candidate shall submit the detailed report as per the synopsis approved by the university, of the dissertation work in the prescribed format after approval by the Guide and endorsement by the Head of the Department. It will be assessed for term work by the evaluation committee(*) appointed by the Head of the Department, for completion of the proposed work.

(*) Note: The evaluation committee shall consist of the Guide, one senior expert faculty member and the Head of the Department or his/her representative.