## VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
### SCHEME OF TEACHING AND EXAMINATION FOR
### M.TECH.-PRODUCT DESIGN & MANUFACTURING (MPD)

#### I Semester

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Teaching hours/week</th>
<th>Duration of Exam in Hours</th>
<th>Marks for Total Marks</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>14 MPD 11</td>
<td>Product Design &amp; Development</td>
<td>4 2 3</td>
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<td>50 100 150</td>
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<td>14 MPD 12</td>
<td>Product Life Cycle Management</td>
<td>4 2 3</td>
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<td>14 MPD 13</td>
<td>Advanced Materials Technology</td>
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<td>14 MPD 14</td>
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<td>14 MPD 15x</td>
<td>Elective - I</td>
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<td>14MPD16</td>
<td>Lab Component</td>
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<td><strong>300 550 850</strong></td>
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#### Elective – I

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<tbody>
<tr>
<td>14 MPD 151</td>
<td>Applied Probability and Statistics</td>
</tr>
<tr>
<td>14 MPD 152</td>
<td>Simulation and Modeling of Manufacturing Systems</td>
</tr>
<tr>
<td>14 MPD 153</td>
<td>Computer Applications in Design</td>
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<tr>
<td>14 MPD 154</td>
<td>Quality by Design</td>
</tr>
<tr>
<td>14MPD 155</td>
<td>Modern Trends in Management</td>
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### Subject Code | Name of the Subject | Teaching hours/week | Duration of Exam in Hours | Marks for Total Marks | CREDITS |
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<tbody>
<tr>
<td>14 MPD 21</td>
<td>Industrial Design &amp; Ergonomics</td>
<td>4 Lecture, 2 Practical / Field Work / Assignment / Tutorials</td>
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<td>14 MPD 26</td>
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<td>14 MPD 27</td>
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<td><strong>Project Phase-I (6 week Duration)</strong></td>
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<td>-- Lecture, -- Practical / Field Work / Assignment / Tutorials</td>
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<td>-- I.A., -- Exam</td>
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<tr>
<td><strong>Total</strong></td>
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<td>20 Lecture, 13 Practical / Field Work / Assignment / Tutorials</td>
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**Elective – II**

<table>
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<th>Sub. Code</th>
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<tr>
<td>14 MPD 251</td>
<td>Quality and Reliability Engineering</td>
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<tr>
<td>14 MPD 252</td>
<td>Virtual Design and Manufacturing</td>
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<tr>
<td>14 MPD 253</td>
<td>Lean Manufacturing Systems</td>
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<tr>
<td>14 MPD 254</td>
<td>Non-Traditional Machining Processes</td>
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<tr>
<td>14 MPD 255</td>
<td>Financial Management</td>
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**) Between the II Semester and III Semester, after availing a vocation of 2 weeks.**
### III Semester: INTERNSHIP

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Subject</th>
<th>No. of Hrs./Week</th>
<th>Duration of the Exam in Hours</th>
<th>Marks for Total Marks</th>
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<tr>
<td>14MPD31</td>
<td>Seminar / Presentation on Internship (After 8 weeks from the date of commencement)</td>
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<tr>
<td>14MPD32</td>
<td>Report on Internship</td>
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<td>-</td>
<td>75</td>
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<td>14MPD33</td>
<td>Evaluation and Viva-voce</td>
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### IV Semester

**Subject Code** | **Subject** | **No. of Hrs./Week** | **Duration of Exam in Hours** | **Marks for Total Marks** | **CREDITS**
--- | --- | --- | --- | --- | ---
**Lecture** | **Field Work / Assignment / Tutorials** | **I.A.** | **Exam** | **Credits**

| 14MPD41 | Advanced Manufacturing Practices | 4 | -- | 3 | 50 | 100 | 150 | 4 |
| 14MPD42 | Elective-III | 4 | - | 3 | 50 | 100 | 150 | 4 |
| 14MPD43 | Evaluation of Project Phase-II | - | - | - | 25 | - | 25 | 1 |
| 14MPD44 | Evaluation of Project Phase-III | - | - | - | 25 | - | 25 | 1 |
| 14MPD45 | Evaluation of Project Work and Viva-voce | - | - | 3 | - | 100+100 | 200 | 18 |

**Total** | **12** | **07** | **09** | **150** | **400** | **550** | **28** |

**Grand Total (I to IV Sem.) : 2400 Marks; 94 Credits**

### Elective – III

<table>
<thead>
<tr>
<th>Sub. Code</th>
<th>Name of the Subject</th>
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<tbody>
<tr>
<td>14 MPD 421</td>
<td>Optimization Techniques for Decision Making</td>
</tr>
<tr>
<td>14 MPD 422</td>
<td>Product Planning and Marketing</td>
</tr>
<tr>
<td>14 MPD 423</td>
<td>Agile Manufacturing</td>
</tr>
<tr>
<td>14 MPD 424</td>
<td>Product Analysis and Cost Optimization</td>
</tr>
<tr>
<td>14 MPD 425</td>
<td>Robust Design</td>
</tr>
</tbody>
</table>
Note:

1) Project Phase – I: 6 weeks duration shall be carried out between II and III Semesters. Candidates in consultation with the guides shall carry out literature survey / visit to Industries to finalise the topic of dissertation.

2) Project Phase – II: 16 weeks duration. 3 days for project work in a week during III Semester. Evaluation shall be taken during the first two weeks of the IV Semester. Total Marks shall be 25.


Mark of Evaluation of Project:

- The I.A. Marks of Project Phase – II & III shall be sent to the University along with Project Work report at the end of the Semester.

4) During the final viva, students have to submit all the reports.

5) The Project Valuation and Viva-Voce will be conducted by a committee consisting of the following:

   a) Head of the Department (Chairman)
   b) Guide
   c) Two Examiners appointed by the university. (out of two external examiners at least one should be present).
I SEMESTER
PRODUCT DESIGN AND DEVELOPMENT

Subject Code : 14MPD11   IA Marks : 50
No. of Lecture Hours/Week : 04   Exam Hours : 03
Total No. of Lecture Hours : 52   Exam Marks : 100

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

Development Processes and Organizations: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications.

Concept Generation: The activity of concept generation clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process.

Concept Selection: Overview of methodology, concept screening, and concept scoring.

Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

INDUSTRIAL DESIGN: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design.

Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes.

Product Development Economics: Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Managing Projects: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

TEXT BOOK:

REFERENCE BOOKS:

PRODUCT LIFE CYCLE MANAGEMENT

Subject Code : 14MPD12
No. of Lecture Hours/Week : 04
Total No. of Lecture Hours : 52

IA Marks : 50
Exam Hours : 03
Exam Marks : 100

Product life cycle management – Need for PLM, Components of PLM, Product Data and Product workflow, Drivers for Change,

The PLM Strategy, Developing a PLM Strategy, A Five-step Process


Change Management for PLM, Configuration management, cost of design changes, schemes for concurrent engineering,

Design for manufacturing and assembly, robust design, failure mode and effect-analysis

Modeling, Current concepts, part design, sketching, use of datum’s construction features, free ovulation, patterning, copying, and modifying features, reference standards for datum specification, Standards for Engineering data exchange

Tolerance mass property calculations, rapid prototyping and tooling, finite modeling and analysis, general procedure, analysis techniques,

Finite element modeling. Applicability of FEM, Static analysis, thermal analysis, dynamic analysis.

REFERENCE BOOKS:

ADVANCED MATERIALS TECHNOLOGY

<table>
<thead>
<tr>
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<tr>
<td>14MPD13</td>
<td>50</td>
<td>04</td>
<td>03</td>
<td>52</td>
<td>100</td>
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</tbody>
</table>

Introduction to composite materials
Definition, Classification, Types of matrices & reinforcements, characteristics & selection, Fiber composites, laminated composites, particulate composites, prepregs, sandwich construction.

Micro mechanical analysis of a lamina
Introduction, Evaluation of the four elastic moduli – Rule of mixture, ultimate strengths of unidirectional lamina.

Macro mechanics of a lamina:
Hooke’s law for different types of materials, number of elastic constants, Two – dimensional relationship of compliance & stiffness matrix. Hooke’s law for two dimensional angle lamina, engineering constants – angle lamina, Invariants, Theories of failure.

Macro Mechanical analysis of laminate:
Introduction, code, Kirchoff hypothesis – CLT, A, B, & D matrices, Engineering constants, Special cases of laminates, Failure criterion.

Manufacturing:
Layup and curing – open and closed mould processing – Hand lay –up techniques – Bag moulding and filament winding. Pultrusion, pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance – Introduction, material qualification, types of defects, NDT methods.

Application developments - aircrafts, missiles, space hardware, automobile, electrical and electronics, marine, recreational and sports equipment-future potential of composites.

Metal matrix composites: Reinforcement materials, types, Characteristics & selection, base metals- selection, applications.

Text Books:
Reference Books:

FINITE ELEMENT METHODS

Subject Code : 14MPD14  
IA Marks : 50

No. of Lecture Hours/Week : 04  
Exam Hours : 03

Total No. of Lecture Hours : 52  
Exam Marks : 100

Introduction: Equations of equilibrium, stress-strain relations for 2-D and 3-D, Potential energy and equilibrium, Boundary conditions, Von Misses Stresses

FEM for 1-D Problems: General procedure for FEA, Raleigh Ritz method, Galerkin Approach, shape functions, stiffness matrix, load vectors, temperature effects, Applications of boundary conditions using elimination, penalty and multi-constraint approaches, Application problems – 1-D bar element, Trusses and beams

FEM for 2-D Problems: Shape functions, stiffness matrix, strain matrix, load vectors for CST Elements and application problems

FEM for Axisymmetric Problems: Axisymmetric formulation, triangular elements, PE approach, Body force term, application problems

FEM for Scalar Field Problems: 1-D Steady state heat transfer, torsion, potential flow and fluid flow in ducts and application problems

Dynamic Analysis: Equations of motion for dynamic problems --consistent and lumped mass matrices --formulation of element mass matrices free vibration and forced vibration problems formulation.

REFERENCE BOOKS:

**Introduction to statistics:** Statistical Thinking, Collecting data, Statistical Modeling Framework, measure of central tendency and variance, Importance of Data summary and Display, Tabular and Graphical display.

**Discrete Random Variables and Probability distribution:** Discrete Random variables, Probability distributions and Probability mass functions, Cumulative distribution functions, Mean and Variance of a discrete random variable, discrete uniform distribution, Binominal distribution, Hyper Geometric distribution, Poisson distribution, Applications.

**Continuous Random Variables and Probability Distributions:** Continuous random variables, Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, uniform distribution, Normal distribution, Normal approximation to Binominal and Poisson distribution, Exponential distribution.

**Testing of Hypothesis:** Estimation theory, Hypothesis testing, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Inference on a population proportion, Testing for Goodness of Fit, Inference for a difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the Variances of two normal populations, Inference on two population proportions.

**Simple Linear Regressions and Correlation:** Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Transformations to a straight line, Correlation.

Multiple linear regressions model, least square estimation of parameters, Matrix approach to multiple linear regression, properties of least square estimators and estimation of variance.

Introduction to DOE: Completely Randomised Block Design (CBD) and Randomised Block Design (RBD)

**REFERENCE BOOKS:**

**SIMULATION AND MODELING OF MANUFACTURING SYSTEMS**

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**Principles of Computer Modelling And Simulation:** Monte Carlo simulation. Nature of computer-modeling and simulation. Limitations of simulation, areas of applications.

**System and Environment:** Components of a system - discrete and continuous systems, Models of a system - a variety of modeling approaches.

**Discrete Event Simulation:** Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem.

**Statistical Models in Simulation:** Discrete distributions, continuous distributions.

**Random Number Generation:** Techniques for generating random numbers- Mid square method - the mod product method - Constant multiplier technique - Additive congruential method - Linear congruential method - Tests for random numbers - The Kolmogorov-Smirnov test - the Chi-square test.

**Random Variable Generation:** Inversion transforms technique - exponential distribution, uniform distribution, weibul distribution, continuous distribution, generating approximate normal variates - Erlang distribution.

**Empirical Discrete Distribution:** Discrete uniform - distribution poisson distribution - geometric distribution - acceptance - rejection technique for Poisson distribution gamma distribution.

**Design and Evaluation Of Simulation Experiments:** variance reduction techniques - antithetic variables, variables- verification and validation of simulation models.

**Simulation Software:** Selection of simulation software, simulation packages.

**REFERENCE BOOKS :**


Tutorials, Computational exercises involving Geometric Modeling of components and their assemblies

Text Book:
2. CAD/CAM/CIM - Radhakrishnan P. et al. - New Age International - 2008
Reference Books:

QUALITY BY DESIGN

Subject Code : 14MPD154
IA Marks : 50
No. of Lecture Hours/Week : 04
Exam Hours : 03
Total No. of Lecture Hours : 52
Exam Marks : 100

Reliability design, Critical parameter management; Value engineering, Failure-analysis (FMEA). Prototype building and testing, Pre-production model and testing, Taguchi method, Statistical process control, product development cycle.

TEXT BOOKS:


REFERENCE BOOKS:

3. Management for quality improvement, productivity press.
MODERN TRENDS IN MANAGEMENT

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**Implementing a Program for continuous Improvement**: Japanese concept of continuous Improvement. (KAIZEN mean continuous Improvement), Innovation concept of Improvement, Need for continuous improvement, Steps in implementing continuous improvement.

**Quality Circles**: Definition of quality circles, Quality circles as a tool for problem solving, Q.C. as a group oriented KAIZEN.

**Kanban System**: Definition of KANBAN, Difference between PULL & PUSH Systems of Material Control, KANBAN as a Push System, KANBAN as JIT concept.

**Concurrent Engineering**: Definition of Concurrent Engineering. Design for Manufacturing and Assembly (DFMA), Concurrent Engineering, Team, Advantages of concurrent Engineering.

**REFERENCE BOOKS**:

Laboratory Exercises
14 MPD 16

1. Static (Structural) Analysis of 1-D problems
2. Static (Structural) Analysis of plane stress and Plane Strain problems
3. Structural Analysis of Trusses
4. Static Analysis of Axisymmetric problems
5. Transient Heat Transfer Analysis of 1D problems
6. Transient Heat Transfer Analysis of 2D problems
7. Heat Transfer Analysis of Axisymmetric Problems
8. Dynamic Analysis of 1D problems – Free vibration Analysis
9. Non-linear Static Analysis – Typical problems in geometric and material non-linear Analysis
10. Buckling Analysis of Shell Structures
II SEMESTER

INDUSTRIAL DESIGN AND ERGONOMICS

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**Introduction:** An approach to industrial design - elements of design structure for industrial design in engineering application in modern manufacturing systems.

**Ergonomics and Industrial Design:** Introduction - general approach to the man- machine relationship - workstation design - working position.

**Control and Displays:** Shapes and sizes of various controls and displays - multiple, displays and control situations - design of major controls in automobiles, machine tools etc., design of furniture - redesign of instruments.

**Ergonomics and Production:** Ergonomics and product design - ergonomics in automated systems - expert systems for ergonomic design. Anthropometric data and its applications in ergonomic, design - limitations of anthropometric database use of computerized database. Case study.

**Visual Effects of Line and Form:** The mechanics of seeing - psychology of seeing general influences of line and form.

**Colour:** Colour and light - colour and objects - colour and the eye - colour consistency - colour terms - reactions to colour and colour continuation - colour on engineering equipments.

**Aesthetic Concepts:** Concept of unity - concept of order with variety - concept of purpose style and environment - Aesthetic expressions. Style-components of style - house style, observation style in capital goods, case study.

**Industrial Design in Practice:** General design - specifying design equipments - rating the importance of industrial design - industrial design in the design process.

**REFERENCE BOOKS:**

PRODUCT DATA MANAGEMENT

Centralized systems: Client Server Systems, Parallel Systems, Distributed Systems, Network Types, Parallel Database, Distributed Database, Security and Integrity, Standardization views

Product Data Management: Product life cycle, Complexity in Product Development, General Description of PDM

Basic functionality of PDM: Information architecture, PDM System architecture, Applications used in PDM systems. Trends in PDM


Creating Product Structures: Part centric approach, CAD centric approach, Product Structure configuration, Managing Product Structures

PDM Tools: Matrix One, TeamCenter, Windchill.Enovia, PDM resources on the Internet


Reference Books:

DESIGN FOR MANUFACTURE

Subject Code : 14MPD23 IA Marks : 50
No. of Lecture Hours/Week : 04 Exam Hours : 03
Total No. of Lecture Hours : 52 Exam Marks : 100


Engineering Design features. – Dimensioning, Tolerances, General Tolerance, Geometric Tolerances, Assembly limits, achieving larger machining tolerances. Screw threads, Ground surfaces, holes. Examples

Datum features – Functional datum, Machining sequence, manufacturing datum, changing the datum. Examples

Component design – Machining Considerations – Drills, Milling cutters, Drilling, Keyways, Dowels, Screws, Reduction in machining areas, Simplification by separation and amalgamation, work piece holding, surface grinding, Examples

Component design – Casting Considerations – Pattern, Mould, parting line, cast holes, machined holes, identifying parting line, special sand cores, designing to obviate sand cores. Examples


Geometric Tolerance – Symbols, Three datum concept of dimensioning, Straightness, concentricity, Run-out, Location Tolerance, Assembly of parts having concentric cylinders, Control of feature location by true position, Body of revolution, Roundness, Profile dimensioning, Tapers, Shaft of two diameters. Examples.

TEXT BOOKS:

Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.


Selective Laser Sintering and Fusion Deposition Modeling: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Principle of Fusion deposition modeling, Process parameter, Path generation, Applications


Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer. Genisys Xs printer HP system 5, object Quadra systems.

Rapid Tooling: Indirect Rapid tooling -Silicone rubber tooling –Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3Q keltool, etc >Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.


TEXT BOOKS:

REFERENCE BOOKS:
QUALITY AND RELIABILITY ENGINEERING

Subject Code: 14 MPD251 IA Marks: 50
No. of Lecture Hours/Week: 04 Exam Hours: 03
Total No. of Lecture Hours: 52 Exam Marks: 100

Basic Concepts: Definitions of quality and Reliability, Parameters and Characteristics, Quality control, statistical Quality Control, Reliability concepts.


Introduction to Probability Distributions: Normal, Poisson and Binomial distribution.

Control Charts: Variable Chart – X Bar chart, R-chart and Sigma chart. Attribute Chart: P – Chart, nP Chart, C-Chart and U – Chart.

Acceptance Sampling: Fundamentals of acceptance sampling, types of acceptance sampling, O.C Curve, AQL, LTPD, AOQL.

Failure Data Analysis: Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, Problems, Introduction to Failure Mode and Effect Analysis.

System Reliability: Series, parallel and mixed configuration, Block diagram concept, r-out-of-n structure solving problems using mathematical models.

Reliability Improvement and Allocation: Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Optimization, Reliability-Cost trade off, Prediction and Analysis, Problems.

Maintainability and Availability: Introduction, Formulas, Techniques available to improve maintainability and availability trade-off among reliability, maintainability and availability, Simple problems

REFERENCE BOOKS:

## VIRTUAL DESIGN AND MANUFACTURING

<table>
<thead>
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<th>14MPD252</th>
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**Review of Computer Graphics:** Review of computer graphics, 2D graphics, 2D primitives and transformations. Algorithm to digitize the graphic entities, rasterization, 3D graphics, 3D primitives and transformations, projections and viewing, algorithms for hidden line removals, lighting, Shading and ray tracing.

**VR Devices:** Input devices-track balls, 3D Mouse, data gloves, Virtual hand and trackers, output devices graph terminal, stereo glasses, head mounting devices, vision dome, caves.

**Applications:** Virtual prototyping, behavior simulation, digital mockup, walk through/flythrough. Virtual training/simulation, micro electro mechanical systems and nanotechnology.

**Virtual Modeling language:** History, Concepts, syntax, basic nodes-group, transform switch, LOD etc, geometry nodes-indexed face set, indexed line set, coordinate, coordindwx, textures etc. sensor nodes-time sensor touch sensor, sphere sensor, cylinder sensor and proximity sensor, scriping. VRML Script and JAVA Script.

**Tutorials and samples:** VRML authoring tools-3D studio MAX, cosmo World, VRML Pad (editor) VRML Viewing tools-cosmo player, auto Vue, SGI's open inventor, virtual collaborative tools-V collab.

**Practical Lab:** V Collab.

**TEXT BOOKS:**

LEAN MANUFACTURING SYSTEMS

Just in time production system. JIT Logic -Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops, Case studies

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.
The rise & fall of Mass Production Mass production, work force, organization, tools, product –logical limits of mass production, Sloan as a necessary compliment to Ford. Case study:- Rouge Production Plant.

The rise of lean production: - Birth place, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production.

Shortening of production lead times: reduction of setup times, practical procedures for reducing setup time.

Standardization of operations: Machine layout, multi function workers and job rotation. Improvement activities to reduce work force and increase worker morale -foundation for improvements.

Elements of lean production viz G M Framingharn : Toyota Takaoka Mass Production V /s lean production, diffusing lean production.

Managing lean enterprise: Finance, Career ladders, geographic spread and advantages of global enterprise.

Prospects for catching up. Simplicity in the natural state: institutional factors -life time employment -educational commodities -quality & productivity in full circle.

An action plan: Getting started - Creating an organization to channel your streams.Install business system to encourage lean thinking.The inevitable results of 5 year commitment.

REFERENCE BOOKS:


Mechanical Process: Ultrasonic Machining-Definition-Mechanism of metal elements of the process- Tool feed mechanism. theories of mechanics of causing effect of parameter applications.

Abrasive Jet Machining: Principles - parameters of the process applications-advantages and disadvantages.


Chemical Machining: Introduction-fundamental principle types of chemical machining Maskants- Etchenes- Advantages and disadvantages-applications.

Plasma arc Machining: Introduction-Plasma-Generation of Plasma and equipment Mechanism of metals removal, PAN parameters-process characteristics - type of torches applications.

Electron Beam Machining (EBM): Introduction-Equipment for production of Electron beam - Theory of electron beam machining Thermal & Non thermal types characteristics - applications.

Laser Beam Machining (LBM): Introduction-principle of generation of lasers Equipment and Machining procedure-Types of Lasers-Process characteristics-advantages and limitations-applications

Ion Beam Machining: Introduction-Mechanism of metal removal and associated equipment-process characteristics applications


REFERENCE BOOKS:

1. New technology Institution of Engineers - Bhattacharya - India
FINANCIAL MANAGEMENT

<table>
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**Introduction to Financial Management:** Objectives, functions & scope, evolution interface of Financial Management with other functional areas, environment of corporate finance.

**Indian Financial System:** Financial Markets – money market, capital market, Govt., Securities market, All India Financial Institutions DBI, IFCI, ICICI, IRBI, EXIM Bank, SFCs, SIDCs Investment Institutions – LID, GIC, VTI, mutual funds Commercial banks: NBFCs.

**Time Value of money:** Future value of a single cost flow, multiple flows and annuity, present value of a single cash flow.

**Risk & Return:** Risk & Return concepts, risk in a portfolio, context, relationship between risk & return.

**Valuation of Securities:** Concept of valuation, equity valuation Dividend: Dividend capitalization approach & ratio approach.

**Financial Statement Analysis:** Ratio analysis, time series analysis, Du pont analysis, funds flow analysis.

**Leverage:** Concept of leverage, opening leverage, financial leverage, total leverage.

**Sources of long term finance:** Equity capital & preference capital, Debenture capital, term loan & deferred credit, Govt Subsidies, Sales Tax Deferments & Exception, leasing and hire purchase.

**Cost of Capital and Capital Structure:** Cost of debentures, Term loans, Equity capital & retained earning, Weighted average cost of capital, Systems of weighing. Introduction to capital structures, factors affecting capital structure, feature of an optimal capital structure, capital structures, Capital Structure theories, tradition position, MM Position and its critique imperfections.

**Dividend Policy:** Traditional position, water model, golden model, Miller and Modugliani position, rational expectations model.

**Estimation of working capital** – Objectives of working capital (Conservative Vs Aggressive policies) static Vs Dynamic view of W.C. Factors affecting the composition of W.C., interdependence among Components of W.C., operating cycle approach to W.C.

**REFERENCE BOOKS:**

Laboratory Exercises  
14 MPD26

**General Guidelines:**
1. Students need to generate the Solid Model and Draft the required views.
2. The orthographic views and solution shall be drawn.
3. If required, various manufacturing sequences shall be shown in the model and drawing.
4. Any 3D Modeling and Drafting CAD tools are permitted.
5. Dimensions that are not defined may be assumed.
6. Results, including the calculations shall be shown along with the drawing.

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<tr>
<th>No.</th>
<th>Description</th>
<th>Suggested Books and references</th>
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<tbody>
<tr>
<td>1</td>
<td>The shaft assembly of the intermediate transmission unit shown in Fig. 1.42 is required to have an axial freedom of maximum 0.18 mm and minimum 0.06 mm when assembled in working condition. Using the nominal sizes specified for the miter bevel gear, shaft, housing, bearing bushes and spur gear, shown in Fig. 1.43, draw only the relevant components and state only the appropriate limits to achieve the required axial freedom.</td>
<td>Fig. 1.42 and Fig. 1.43 from the book “DESIGN FOR MANUFACTURE” by Harry Peck.</td>
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<tr>
<td>2</td>
<td>The partial assembly of an oil pump is shown in Fig. 1.45. A four lobe inner rotor is mounted off-set to the body bore in which a five lobe outer rotor rotates, driven by the inner rotor. Both the specified clearances are to be measured by a feeler gauge when the parts are assembled. Taking this procedure into account, and also the fact that the outer rotor can “float” radially, state the appropriate limits for the relevant dimensions which will ensure that the specified clearance limits are not exceeded. Assume zero clearance between inner rotor stem and body bore (20 mm diameter). Nominal sizes are shown in Fig. 1.46.</td>
<td>Fig. 1.45 and Fig. 1.46 from the book “DESIGN FOR MANUFACTURE” by Harry Peck.</td>
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<td>3</td>
<td>The shaft is to be manufactured from 0.4 % carbon steel to the sizes shown in Fig. 2.31. The 30 mm and the 25 mm diameter are to be ground. Prepare a production detail drawing for the shaft.</td>
<td>Fig. 2.31 from the book “DESIGN FOR MANUFACTURE” by Harry Peck.</td>
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</table>
| 4   | The slide block shown in Fig. 3.42 is to be manufactured in batches of 100.  
1. Describe a method of manufacture intended to reduce machining time to a minimum.  
2. Redraw the block showing the appropriate manufacturing dimensions. | Fig. 3.42 from the book “DESIGN FOR MANUFACTURE” by Harry Peck. |
<p>| 5   | In the fulcrum block shown in Fig. 4.39, a lever, mounted on a hinge pin, oscillates 30° each side of the vertical centre line; this lever is shown, chain dotted, in the two extremes of the position. Comment on the machining involved and show design modifications to facilitate the machining. | Fig. 4.39 from the book “DESIGN FOR MANUFACTURE” by Harry Peck. |</p>
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<td><strong>6</strong></td>
<td>Suggest a suitable operation sequence for the stub carrier shown in Fig.4.40 and redraw the component incorporating features to facilitate manufacture. The carrier is to be produced from a steel casting and the symbol ‘G’ indicates a ground surface for the 30 mm diameter f8 limits.</td>
<td>Fig.4.40 from the book “DESIGN FOR MANUFACTURE” by Harry Peck.</td>
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<tr>
<td><strong>7</strong></td>
<td>Indicate the parting line for the steel forked lever casting seen in Fig.5.27, and also the necessary sand cores. Maintaining as nearly as possible, the existing weight of the casting, offer a design modification that will alleviate the sand core requirements.</td>
<td>Fig.5.27 from the book “DESIGN FOR MANUFACTURE” by Harry Peck.</td>
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<tr>
<td><strong>8</strong></td>
<td>For the pedestal shown in Fig.5.28 indicate the probable parting line and any unnecessary sand cores, accepting that the probable parting line is the one involving the minimum sand cores. Show a design modification to reduce or eliminate the need for sand cores; maintain approximately same weight of casting in the modified design.</td>
<td>Fig.5.28 from the book “DESIGN FOR MANUFACTURE” by Harry Peck.</td>
</tr>
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</table>
JIT – Introduction – The spread of JIT Movement, some definitions of JIT, core Japanese practices of JIT, Creating continuous Flow Manufacture, Enabling JIT to occur, Basic elements of JIT, Benefits of JIT.

Just in Time Production – Primary purpose, profit through cost reduction, Elimination of over production, Quality control, Quality Assurance, Respect for Humanity, Flexible work Force, JIT Production Adapting to changing production Quantities, process layout for shortened lead Times, Standardization of operation, Automation.

Sequence and scheduling used by suppliers: Monthly and daily Information. Sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system to sub contractors.

Toyota Production System- The philosophy of TPS, Basic Frame work of TPS, Kanban, Determining the Number of Kanban in Toyota Production System.

- Kanban Number under Constant Quantity Withdrawal System.
- Constant Cycle, Non-constant Quantity Withdrawal System. Supplier Kanban and the Sequence Schedule for Use by Suppliers.
- Later Replenishment System by Kanban.
- Sequenced Withdrawal System.
- Circulation of the Supplier Kanban within Toyota.

Production Smoothing in TPS, Production Planning, Production Smoothing Adaptable to Demand Fluctuations, Sequencing Method for the Mixed Model Assembly Line to Realize Smoothed Production of Goal.

Just-in-Time Production with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain, Scrap/Quality Improvements, Motivational effects, Responsibility effects, small Group improvement Activities, withdrawal of Buffer Inventory, the total Quality Control Concept.

Total Quality Control-Introduction- Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, Goals, Habit of improvement, perfection, Basics, process control, Easy to see Quality control as facilitator, small lot sizes, Housekeeping, Less than full capacity scheduling, Daily machine checking, Techniques and Aids, Exposure of problems, Fool proof Devices, Tools of Analysis, QC Circles, TQC in Japanese-owned US Electronics plant, TQC in Japanese-owned Automotive plants.

Plant Configurations: Introduction- ultimate plant configuration, job shop Fabrication, Frame Welding, Forming Frame parts from Tubing, Dedicated production lines, overlapped production, the daily schedule, Forward Linkage by means of Kanban, physical merger of processes, Adjacency, mixed Models, Automated production Lines, Pseudo Robots, Robots, CAD and Manufacturing, Conveyors and stacker Cranes, Automatic Quality Monitoring.

REFERENCE BOOKS:


Elective - III

OPTIMISATION TECHNIQUES FOR DECISION MAKING

Subject Code : 14MPD421  IA Marks : 50
No. of Lecture Hours/Week : 04  Exam Hours : 03
Total No. of Lecture Hours : 52  Exam Marks : 100


Classical Optimization Technique: Single variable optimization, with equality constraints solution by direct substitution, solution by the method of constrained Variation. Solution by the method of Lagrange multipliers, multivariable optimization with inequality constraints Kuhn – Tucker condition.


Descent Methods: Steepest descent, conjugate gradient, variable metric method.

Non Linear Programming: (Constrained Optimization problem) Characteristic of a constrained problem.

Direct Methods: The complex method, cutting plane method, methods of Feasible directions.

Indirect Methods: Transformation technique, change variables and elimination of variables, penalty function methods- interior and exterior penalty function.

TEXT BOOKS:


REFERENCE BOOKS:

PRODUCT PLANNING AND MARKETING

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**Product strategy and planning product** - market evolution, successful product development process, characteristics of successful product development

**New Product Strategy:** Strategic response, reactive verses proactive strategies, marketing verses Research and Development, Comprehensive strategy.

**Proactive new product development process** - Sequential decision process, reasons for product failure and strategies to avoid failures, cost, time, risk and expected benefit in new product development.

**Opportunity Identification** - Market definition and entry strategy, desirable characteristics of markets, market profile analysis, methods for market definition, target group selection through market segmentation, market selection, idea generation – idea sources, method of generating ideas, idea management.

**Consumer measurement and Perceptual mapping** – Consumer measurement process, research methods, sampling, measuring instruments, attitude scaling, Consumers perceptions of new and existing products: Perceptual positioning, Perceptual maps, Analytic Methods used to produce Perceptual maps, Managerial review of maps.

**Product positioning – Preference analysis and benefits, segmentation**- Role of preference in product positioning, proactive product positioning, Analytic preference models and estimation methods, Benefit segmentation, managerial use of preference models.

**Forecasting sales potential** – Role of purchase potential in design process, models of purchase potential, models of sales formation, managerial use of purchase models.

**Launching the products and Strategy for Testing new products** – Planning and tracking launch of durable and industrial products, advertising testing and product quality testing

**TEXT BOOKS:**


2. William L. Moore & Edgar, “Product Planning and Management”, A. Pessemier
AGILE MANUFACTURING

Subject Code: 14MPD423 IA Marks: 50
No. of Lecture Hours/Week: 04 Exam Hours: 03
Total No. of Lecture Hours: 52 Exam Marks: 100

**Introduction:** what is agile Manufacturing? -Competitive environment of the future- the business case for agile manufacturing conceptual framework for agile manufacturing.

**Four Core Concepts:** strategy driven approach- integrating organization, people technology interdisciplin ary design methodology.

**Agile Manufacturing and Change Management:** The change implications, post failures in advanced manufacturing, changes on the way, traditional management accounting, paradigm, investment appraisal, product costing - performance, Measurement and control systems.

Control technological and Design paradigms - traditional problems in workplace- organizational issues -role of technology.

**Agile Manufacturing Enterprise Design:** Agile manufacturing –enterprise design -system concepts as the basic manufacturing theory-joint technical & organizational design as a model for the design of agile manufacturing enterprise,. enterprise design process -insights into design processes, what is interdisciplinary design, Main issues - simple design example.

**Skill & Knowledge Enhancing Technologies For Agile Manufacturing:** Skill and Knowledge enhancing Technologies -scheduling -technology design strategic-


**REFERENCE BOOKS:**

**Introduction:** New products, new product strategy - market definition, Idea generation introduction to the design process - forecasting sales potential - product engineering and markets - monopoly competitive.

**Manufacturing Planning:** Selection of optimum process, standardization. Break even analysis - application and area of use - problems - multi-product analysis.

**Value Analysis:** Steps in selection, analysis and implementation, Selection of cutting speed for optimum cost - problems.

**Cost Accounting:** Cost estimation - difference - types - steps involved in cost estimation.

**Types of Cost:** Cost Centres, Direct - indirect, material cost - direct indirect material cost. Overhead cost, Elements in overheads: Preparation of cost sheet, machine hour rate, apportioning methods

**Variance Analysis** – Labour variance, Material variance and Overhead variance, Activity based costing - Introduction to target costing.

**Cost Calculation:** Cost calculation for machined components, welding, casting and forged components illustrations - calculation of sales cost.

**Cost Optimization Techniques:** Analytical, Graphical and incremental methods Learning curves.

**TEXT BOOKS:**


**REFERENCE BOOKS:**

Quality by Experimental Design: Quality, western and Taguchi quality philosophy, Elements of cost, Noise factors causes of variation, Quadratic loss function and variation of quadratic loss functions. Robust Design: Steps in robust design: parameter design and tolerance design, reliability improvement through experiments, illustration through numerical examples.

Experimental Design: Classical experiments: factorial experiments, terminology, factors. Levels, Interactions, Treatment combination, randomization, 2-level experimental design for two factors and three factors. 3-level experiment designs for two factors and three factors, factor effects, factor interactions, Fractional factorial design, Saturated design, Central composite designs, Illustration through numerical examples.


Analysis and interpretation of experimental data: Measures of variability, Ranking method, column effect method and plotting method, Analysis of variance (ANOVA), in factorial experiments: YATE’s algorithm for ANOVA, Regression analysis, Mathematical models from experimental data, illustration through numerical examples.

Taguchi’s Orthogonal Arrays: Types orthogonal arrays, Selection of standard orthogonal arrays, Linear graphs and interaction assignment, dummy level technique, Compound factor method, modification of linear graphs, Column merging method, Branching design, Strategies for constructing orthogonal arrays.


Parameter Design and Tolerance Design: Parameter and tolerance design concepts, Taguchi’s inner and outer arrays, Parameter design strategy, Tolerance design strategy, Illustrations through numerical examples.

Reliability Improvement Through Robust Design: Role of S-N ratios in reliability improvement; Case study; Illustrating the reliability improvement of routing process of a printed wiring boards using robust design concepts.

TEXT BOOKS:


REFERENCE BOOKS:
