**II SEMESTER**

## INDUSTRIAL DESIGN AND ERGONOMICS

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| Subject Code | : **16 MPD21** | IA Marks | : 20 |
| No. of Lecture Hours/Week | : 04 | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 50 | Exam Marks | : 80 |

### Module 1

**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.

### Module 2

**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

**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 data- use of computerized database.

### Module 3

**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.

### Module 4

**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.

### Module 5

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

**REFERENCE BOOKS:**


1. **Industrial Design for Engineers -** Mayall W.H. - London Hiffee books Ltd. -1988.
2. **Applied Ergonomics Hand Book -** Brain Shakel (Edited) - Butterworth scientific. London -1988.
3. **Introduction to Ergonomics -** R. C. Bridger - McGraw Hill Publications - 1995.
4. **Human Factor Engineering** - Sanders & McCormick - McGraw Hill Publications – 6th edition, 2002.

## PRODUCT DATA MANAGEMENT

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|---|---|---|---|
| Subject Code | : **16MPD22** | IA Marks | : 20 |
| No. of Lecture Hours/Week | : 04 | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 50 | Exam Marks | : 80 |

### Module 1

**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

### Module 2

**Document Management Systems:** Document management and PDM, Document life cycle, Content Management, Document management and related technologies, Document management resources on the Internet

### Module 3

**Workflow Management in PDM**: Structure Management, Engineering Change Management, Release Management, Version Management, Configuration Management

### Module 4

**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

### Module 5

**PDM Implementation Case Studies**: Sun Microsystems, Inc., Mentor Graphics Corporation, Ericsson Radio Systems AB, Ericsson Mobile Communications AB, ABB Automation Technology Products, SaabTech Electronics AB

**REFERENCE Books:**


1. **Implementing and Integrating Product Data Management and Software Configuration Management** - 20 - Ivica Cmkovic Ulf Asklund - Annita Persson Dahlqvist - Archtech House Publishers.
2. **Product Data Management -** Rodger Burden - Publisher: Resource Publishing- ISBN-10: 0970035225, ISBN-13: 978-0970035226 – 2003.
3. **The AutoCAD Database Book – Accessing and Managing CAD Drawing Information** - Galgotia Publications - Third Edition.

## DESIGN FOR MANUFACTURE

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|---|---|---|---|
| Subject Code | : **16MPD23** | IA Marks | : 20 |
| No. of Lecture Hours/Week | : 04 | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 50 | Exam Marks | : 80 |

### Module 1

**Material and process selection –** Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Selection of materials.

**Engineering Design features.** – Dimensioning, Tolerances, General Tolerance, Geometric Tolerances, Assembly limits, achieving larger machining tolerances, Datum features.

### Module 2

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

### Module 3

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

### Module 4

**Design for Injection molding and Sheet metal working –** Injection molding materials, Molding cycle, Systems, molds, machine size, cycle time, Cost estimation, Insert molding, Design guidelines, Introduction to sheet metalworking, Dedicated Dies and Press working, Press selections, Design Rules.

### Module 5

**Design for Die casting and Powder metal processing –** Die casting alloys, cycle, machines, dies, finishing, Assembly techniques, Design principles, Powder metallurgy processing, stages, compaction characteristics, Tooling, Sintering, Design guidelines.

**REFERENCE BOOKS:**


1. **Product Design for Manufacture and Assembly** – Geoffrey Boothroyd - Peter Dewhurst - Winston Knight – Marcel Dekker, Inc. – Newyork - Second Revison, ISBN 0-8247-0584-X.
2. **Designing for Manufacturing** – Harry Peck - Pitman Publications – 1983.
3. **Dimensioning and Tolerancing for Quantity Production** – Merhyle F Spotts –Inc. Englewood Cliffs - New Jersey - Prentice Hall, 5th edition.

## RAPID PROTOTYPING

| | | | |
|---|---|---|---|
| Subject Code | : **16MPD24** | IA Marks | : 20 |
| No. of Lecture Hours/Week | : 04 | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 50 | Exam Marks | : 80 |

### Module 1

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

**Stereo Lithography Systems:** Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.

### Module 2

**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

### Module 3

**Solid Ground Curing:** Principle of operation, Machine details, Applications.

**Laminated Object Manufacturing:** Principle of operation, LOM materials. Process details, application.

### Module 4

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

### Module 5

**RP Process Optimization:** factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.

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**REFERENCE BOOKS:**


1. **Stereo lithography and other RP & M Technologies -** Paul F. Jacobs - SME, NY 1996.
2. **Rapid Manufacturing -** Flham D.T & Dinjoy S.S - Verlog London 2001.
3. **Rapid automated -** Lament wood - Indus press New York
4. **Wohler's Report 2000 -** Terry Wohlers - Wohler's Association -2000.

## QUALITY AND RELIABILITY ENGINEERING

| | | | |
|---|---|---|---|
| Subject Code | : **16 MPD251** | IA Marks | : 20 |
| No. of Lecture Hours/Week | : 03 | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 40 | Exam Marks | : 80 |

### Module 1

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

**Concepts in Probability and Statistics :** Events, Sample Space, Probability rules, Conditional probability, Dependent and Independent Events, Application of Probability concepts in Quality Control, Problems

### Module 2

**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.

### Module 3

**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.

### Module 4

**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.

### Module 5

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

**REFERENCE BOOKS:**


1. **Quality Planning and Analysis** - Tata McGraw - Juran, J.M and Gryna, F.M. - Hill publishing Coimpany Ltd., New Delhi, India – 1982.
2. **Maintainability and Reliability Handbook of Reliability Engineering and Management -** Editors – Ireson. W.G. and Cooms - C.F. McGraw - Hill Book Company Inc. – 1988.
3. **Concepts in Reliability Engineering**- Srinath L S - Affiliated East-West Press Private Limited, New Delhi, India. – 1985.
4. **An Introduction to Reliability and Maintainability Engineering** - TMH Charles Ebeling - Tata Mcgraw Hill – 2000.
5. **Reliability Engineering** - A K Govil - Prentice Hall – 1981.

## VIRTUAL DESIGN AND MANUFACTURING

| | | | |
|---|---|---|---|
| Subject Code | : **16MPD252** | IA Marks | : 20 |
| No. of Lecture Hours/Week | : 03 | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 40 | Exam Marks | : 80 |

### Module 1

**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.

### Module 2

**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.

### Module 3

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

### Module 4

**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.

### Module 5

**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.

**REFERENCE BOOKS:**


1. **Computer Graphics-Principles and practice -** Janes D,Foley et al., - Second edition. in C,Addision -Wesley 1997.
2. **The VRML- 2.0 Hand book -** Jed Hartman and Josie wernecke - Addision-Wesley -1997.
3. **The Annocated VRML 2.0 hand book Addision -** R Carey and G Bell -Wesley 1997.

## LEAN MANUFACTURING SYSTEMS

| | | | |
|---|---|---|---|
| Subject Code | : **16MPD253** | IA Marks | : 20 |
| No. of Lecture Hours/Week | : 03 | Exam Hours | : 03 |
| Total No. of Lecture Hours | : 40 | Exam Marks | : 80 |

### Module 1

**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

### Module 2

**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.

### Module 3

**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.

### Module 4

**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.

### Module 5

**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.

**REFERENCE BOOKS:**


1. **Productions and Operations Management** - Chasel Aquilino - Dreamtech latest edition.
2. **Toyoto Production System -An integrated approach to Just in Time** - Yasuhiro Monden - Engineering aild Management Press -Institute of Industrial Engineers Norcross Georgia - 1983.
3. **The Machine that changed the World. The Story of Lean Production -** James P Womack - Daniel T Jones - and Daniel Roos -Harper Perennial - edition published 1991.
4. **Lean Thinking -** James Womack – ISBN 0743249275 – 2003.
5. **Japanese Manufacturing Techniques. The Nine Hidden Lessons by simplicity** - Richard Schourberger - ASQC Press 1991.
6. **Quality Function Development** - James Bossert - ASQC Press 1991.

## NON-TRADITIONAL MACHINING PROCESS

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|---|---|---|---|
| Sub Code | **: 16 MPD 254** | IA Marks | : 20 |
| No. of Lecture Hrs/week | : 03 | Exam Hours | : 03 |
| Total Lecture Hrs | : 40 | Exam Marks | : 80 |

### Module 1

**Introduction**: Need for non-traditional machining processes.
**Mechanical Process**: Ultrasonic Machining-Definition-Mechanism of metal elements of the process- Tool feed mechanism. theories of mechanics of causing effect of parameter applications.

### Module 2

**Abrasive Jet Machining**: Principles - parameters of the process applications-advantages and advantages.
**Thermal Metal Removal Process**: Electric discharge machining Principle of operation – mechanism of meta removal basic EDM circuitry-spark erosion get Analysis of relaxation type of circuit material removal rate in relaxation.

### Module 3

**Electro chemical and chemical processes**: Electro chemical machining (ECM) Classification ECM process-principle of ECM Chemistry of the ECM parameters of the processes-determination of the metal removal rate - dynamics of ECM process-Hydrodynamics of ECM process-polarization-.Tool Design-advantages and disadvantages - applications. Electro Chemical Grinding-Electro Chemical holding Electrochemical deburring.

### Module 4

**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.

### Module 5

**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
2. **Production Technology** - HMT - Tata Mc Graw Hill - ISBN-10; 0070964432
3. **Modern Machining Process** - P.C Pandy & H.S. Shan - Tata McGraw Hill - ISBN: 0070965536 - Publishing Date: Feb-80
4. **Metals Hand Book** - ASM - Vol-3.
5. **Modern Manufacturing Method** - Adithan - New Age International (p) Limited - ISBN**:** 8122408176, 2007.
6. **Modern Machining Processes** - P.K. Mishra - Narosa Publishing House, New Delhi - 1997.

## FINANCIAL MANAGEMENT

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|---|---|---|---|
| Sub Code | **16 MPD 255** | IA Marks | 20 |
| No. of Lecture Hrs/week | 03 | Exam Hours | 03 |
| Total Lecture Hrs | 40 | Exam Marks | 80 |

**Module 1**

**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.

**Module 2**

**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.

**Module 3**

**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.

**Module 4**

**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 Positionand its critique imperfections.

**Module 5**

**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:**


1. **Fundamentals of Financial Management** – James C. Van Home - ISBN – 8177587862.
2. **Financial Management** – I.M. Panday – Vikas **Publishing** House Pvt - 2009.
3. **Management Accounting & Financial Management** – M.Y. Khan & P.K. Jain - Mcgraw Hill – Tata - ISBN: 0471477613.

**Laboratory Exercises**
**16 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.

| No | Description | Suggested Books and references |
|---|---|---|
| 1 | 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. | Fig.1.42 and Fig.1.43 from the book "DESIGN FOR MANUFACTURE" by Harry Peck. |
| 2 | 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.<br>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.<br>Assume zero clearance between inner rotor stem and body bore (20 mm diameter). Nominal sizes are shown in Fig.1.46. | Fig.1.45 and Fig.1.46 from the book "DESIGN FOR MANUFACTURE" by Harry Peck. |
| 3 | 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. | Fig.2.31 from the book "DESIGN FOR MANUFACTURE" by Harry Peck. |
| 4 | The slide block shown in Fig.3.42 is to be manufactured in batches of 100.<br>1. Describe a method of manufacture intended to reduce machining time to a minimum.<br>2. Redraw the block showing the appropriate manufacturing dimensions. | Fig.3.42 from the book "DESIGN FOR MANUFACTURE" by Harry Peck. |
| 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. |

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| 6 | 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. | Fig.4.40 from the book "DESIGN FOR MANUFACTURE" by Harry Peck. |
| 7 | 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. | Fig.5.27 from the book "DESIGN FOR MANUFACTURE" by Harry Peck. |
| 8 | For the pedestal shown inFig.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. | Fig.5.28 from the book "DESIGN FOR MANUFACTURE" by Harry Peck. |