VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

SCHEME OF TEACHING AND EXAMINATION FOR

M.TECH.-PRODUCT DESIGN & MANUFACTURING (MPD)

I Semester **CREDIT BASED**

Subject Code	Name of the Subject	Teaching hours/week		Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Practical / Field Work / Assignment/ Tutorials		I.A.	Exam		
14 MPD 11	Product Design & Development	4	2	3	50	100	150	4
14 MPD 12	Product Life Cycle Management	4	2	3	50	100	150	4
14 MPD 13	Advanced Materials Technology	4	2	3	50	100	150	4
14 MPD 14	Finite Element Method	4	2	3	50	100	150	4
14 MPD 15x	Elective - I	4	2	3	50	100	150	4
14MPD16	Lab Component	--	3	3	25	50	75	2
14MPD17	Seminar	--	3	--	25	--	25	1
Total		**20**	**13**	**15**	**300**	**550**	**850**	**23**

Elective – I	
Sub. Code	**Name of the Subject**
14 MPD 151	Applied Probability and Statistics
14 MPD 152	Simulation and Modeling of Manufacturing Systems
14 MPD 153	Computer Applications in Design
14 MPD 154	Quality by Design
14MPD 155	Modern Trends in Management

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II Semester **CREDIT BASED**

Subject Code	Name of the Subject	Teaching hours/week		Duration of Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Practical / Field Work / Assignment/ Tutorials		I.A.	Exam		
14 MPD 21	Industrial Design & Ergonomics	4	2	3	50	100	150	4
14 MPD 22	Product Data Management	4	2	3	50	100	150	4
14 MPD 23	Design for Manufacturing	4	2	3	50	100	150	4
14 MPD 24	Rapid Prototyping	4	2	3	50	100	150	4
14 MPD 25x	Elective-II	4	2	3	50	100	150	4
14MPD26	Lab Component		3	3	25	50	75	2
14MPD27	Seminar	--	3	--	25	--	25	1
	**Project Phase-I(6 week Duration)	--	--	--	--	--	--	--
Total		**20**	**13**	**15**	**300**	**550**	**850**	**23**

Elective – II	
Sub. Code	**Name of the Subject**
14 MPD 251	Quality and Reliability Engineering
14 MPD 252	Virtual Design and Manufacturing
14 MPD 253	Lean Manufacturing Systems
14 MPD 254	Non-Traditional Machining Processes
14 MPD 255	Financial Management

**** Between the II Semester and III Semester, after availing a vocation of 2 weeks.**

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III Semester: INTERNSHIP **CREDIT BASED**

Course Code	Subject	No. of Hrs./Week		Duration of the Exam in Hours	Marks for		Total Marks	CREDITS
		Lecture	Practical / Field Work		I.A.	Exam		
14MPD31	Seminar / Presentation on Internship (After 8 weeks from the date of commencement)	-	-	-	25	-	25	1
14MPD32	Report on Internship	-	-	-		75	75	15
14MPD33	Evaluation and Viva-voce	-	-	-	–	50	50	4
	Total	**-**	**-**	**-**	**25**	**125**	**150**	**20**

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IV Semester **CREDIT BASED**

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		
14MPD41	Advanced Manufacturing Practices	4	--	3	50	100	150	4
14MPD42X	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	
Sub. Code	**Name of the Subject**
14 MPD 421	Optimization Techniques for Decision Making
14 MPD 422	Product Planning and Marketing
14 MPD 423	Agile Manufacturing
14 MPD 424	Product Analysis and Cost Optimization
14 MPD 425	Robust Design

Note:

1) Project Phase – I : 6 weeks duration shall be carried out between II and III Semesters. Candidates in consultation with the guides shall carryout 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.
3) Project Phase – III : 24 weeks duration in IV Semester. Evaluation shall be taken up during the middle of IV Semester. At the end of the Semester Project Work Evaluation and Viva-Voce Examinations shall be conducted. Total Marks shall be 250 (Phase I Evaluation:25 Marks, Phase –II Evaluation: 25 Marks, Project Evaluation marks by Internal Examiner(guide): 50, Project Evaluation marks by External Examiner: 50, marks for external and 100 for viva-voce).

   Marks 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:

1. **Product Design and Development** - Karl.T.Ulrich, Steven D Eppinger - Irwin McGrawHill - 2000.

REFERENCE BOOKS:

1. **Product Design and Manufacturing -** A C Chitale and R C Gupta, PH1, - 3rd **Edition**, 2003.
2. **New Product Development -** Timjones. Butterworth Heinmann -Oxford. UCI -1997
3. **Product Design for Manufacture and Assembly -** Geoffery Boothroyd, Peter Dewhurst and Winston Knight - 2002

PRODUCT LIFE CYCLE MANAGEMENT

Subject Code	: **14MPD12**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	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

Strategy Identification and Selection, Strategy Elements, Implications of Strategy Elements, Policies, Strategy Analysis, Communicating the Strategy

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, pattering, 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:

1. **Product Lifecycle Management Paradigm for century Product Realization -** John Stark, Springer-Verlag, **21st**, London, 3rd printing -2006. 441 pp., ISBN: 1-85233-810-5.
2. **CAD/CAM Theory and Practice -** Zeid, Mc Graw Hill.- 1991.
3. **Computer Integrated Design and Manufacturing**, - Mark Henderson & Philip Wolfe, Bedworth Mc Graw hill inc.- 1991.
4. **Part modeling Users Guide**, Engineer - I998.

ADVANCED MATERIALS TECHNOLOGY

Subject Code	: **14MPD13**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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:

1. **Composite Materials handbook** - Mein Schwartz - Mc Graw Hill Book Company - 1984.
2. **Mechanics of composite materials -** Autar K. - Kaw CRC Press New York. – 1st edition, 1997.

Reference Books:

1. **Mechanics of composite materials -** Rober M. Joness - McGraw Hill Kogakusha Ltd. – 2008.
2. **Stress analysis of fiber Reinforced composite materials -** Michael W Hyer - McGraw Hill International -1999.
3. **Composite material science and Engineering** - Krishan K - Chawla Springer - 1999.
4. **Fibre reinforced composites -** P.C. Mallik Marcel Decker- 2nd edition, New York -1993.

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:

1. **Introduction to Finite Elements in Engineering –**Tirupathi R.- Chandrupatla Ashok D Belegundu - Prentice Hall India Pvt. Ltd., New Delhi – 3rd Edition, 2003
2. **Concepts and Applications of finite Element Analysis** - Cook R.D - Malkus D.S & Plesha M.E - John Wiley & Sons - 1989.
3. **Applied Finite Element Analysis** -Segerlind L.J - John Wiley & Sons Edition- 1984.
4. **The Finite Element Method in Engineering**, - Rao SS Pergomon Press – Oxford - 2nd Edition, 1984.
5. **Finite Element Procedures in Engineering Analysis** - Bathe K .J - Prentice Hall NewJersey - 1982.
6. **Energy and Finite Element Methods in Structural mechanics** - Shames III & Dym C L - Wiley eastern ltd – 1995.

APPLIED PROBABILITY AND STATISTICS

Subject Code	: **14MPD151**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

Introduction to statistics: Statistical Thinking, Collecting data, Statistical Modeling Frame work, 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:

1. **Applied statistics and Probability for Engineers** – Douglas C Montgomery - George C Runger - John Wiley and Sons - 2nd Edn, ISBN-0-471-17027-5.- 2000.
2. **Statistics for Management** - Richard I Levin - David S Rubin - Prentice Hall India - 6th Edn, ISBN-81-203-0893-X.- 1979.
3. **Probability and Statistics in Engineering** - William W Hines - Douglas C Montgomery - John Wiley and Sons - 2nd Edn, ISBN**:** 0471240877.
4. **Business Statistics for Management and Economics** - Daniel, Terrell - Houghton Mifflin Company - 6th Edn, ISBN-0-395-62835-0.
5. **Probability and Statistics** - Walpole & Mayer - MacMillan Publishing Company -1989.

SIMULATION AND MODELING OF MANUFACTURING SYSTEMS

Subject Code	: **14MPD152**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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 :

1. **Discrete Event System Simulation** - Jerry Banks & .John S Carson II - Prentice Hall Inc.-1984.
2. **Systems Simulation** - Gordan. G - Prentice Hall India Ltd -1991.
3. **System Simulation With Digital Computer** - Nusing Deo - Prentice Hall of India - 1979.
4. **Computer Simulation and Modeling** - Francis Neelamkovil - John Wilely & Sons -1987.
5. **Simulation Modeling with Pascal** - Rath M.Davis & Robert M O Keefe - Prentice Hall Inc. -1989.

COMPUTER APPLICATIONS IN DESIGN

Subject Code	: **14MPD153**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

Introduction to CAD/CAM/CAE Systems: Overview, Definitions of CAD. CAM and CAE, Integrating the Design and Manufacturing Processes through a Common Database-A Scenario, Using CAD/CAM/CAE Systems for Product Development-A Practical Example.

Components of CAD/CAM/CAE Systems: : Hardware Components ,Vector-Refresh (Stroke- Refresh) Graphics Devices, Raster Graphics Devices, Hardware configuration, Software Components, Windows-Based CAD Systems.

Basic Concepts of Graphics Programming: Graphics Libraries, Coordinate Systems, Window and Viewport, Output Primitives - Line, Polygon, Marker Text, Graphics Input, Display List, Transformation Matrix, Translation, Rotation, Mapping, Other Transformation Matrices, Hidden-Line and Hidden-Surface Removal, Back-Face Removal Algorithm, Depth-Sorting, or Painter.s, Algorithm, Hidden- Line Removal Algorithm, z-Buffer Method, Rendering, Shading, Ray Tracing, Graphical User Interface, X
Window System.

Geometric Modeling Systems: Wireframe Modeling Systems, Surface Modeling Systems, Solid Modeling Systems, Modeling Functions, Data Structure, Euler Operators, Boolean Operations, Calculation of Volumetric Properties, Nonmanifold Modeling Systems, Assembly Modeling Capabilities, Basic Functions of Assembly Modeling, Browsing an Assembly, Features of Concurrent Design, Use of Assembly models, Simplification of Assemblies, Web-Based Modeling.

Representation and Manipulation of Curves: Types of Curve Equations, Conic Sections, Circle or Circular Arc, Ellipse or Elliptic Arc, Hyperbola, Parabola, Hermite Curves, Bezier Curve, Differentiation of a Bezier Curve Equation, Evaluation of a Bezier Curve, B-Spline Curve, Evaluation of a B-Spline Curve, Composition of B-Spline Curves, Differentiation of a B-Spline Curve, Nonuniform Rational B-Spline (NURBS) Curve, Evaluation of a NURBS Curve, Differentiation of a NURBS Curve, Interpolation Curves, Interpolation Using a Hermite Curve, Interpolation Using a B-Spline Curve, Intersection of Curves.

Representation and Manipulation of Surfaces: Types of Surface Equations, Bilinear Surface, Coon's Patch, Bicubic Patch, Bezier Surface, Evaluation of a Bezier Surface, Differentiation of a Bezier Surface, B-Spline Surface, Evaluation of a-B-Spline Surface, Differentiation of a B-Spline Surface, NURBS Surface, Interpolation Surface, Intersection of Surfaces.

CAD and CAM Integration : Overview of the Discrete Part Production Cycle, Process Planning, Manual Approach, Variant Approach, Generative Approach, Computer-Aided Process Planning Systems, CAM-I CAPP, MIPLAN and Multi CAPP, Met CAPP, ICEM-PART, Group Technology, Classification and Coding, Existing Coding Systems, Product Data Management (PDM) Systems.

Standards for Communicating Between Systems: Exchange Methods of Product Definition Data, Initial Graphics Exchange Specification, Drawing Interchange Format, Standard for the Exchange of Product Data.

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

Text Book:

1 **Principles of CAD/CAM/CAE systems** – Kunwoo - Lee Addison Wesley -1999
2. **CAD/CAM/CIM** - Radhakrishnan P. et al. - New Age International - 2008

Reference Books:

1. **CAD/CAM – Theory & Practice -** Ibrahim Zeid - McGraw Hill - 1998
2. **Computer Integrated Design and Manufacturing -** Bedworth, Mark Henderson & Philip Wolfe - McGraw hill inc. - 1991.
3. **Part modeling Users Guide -** Pro-Engineer - 1998

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

Define customer needs - Quality Function Deployment, Concept generation as System Technique (FAST), Use brain storming and selection processes, Six Phases: Accept reduction phase. Review functional requirements, product specifications, concepts, Select candidate. Concept evaluation phase, Pugh method, and technical risks, output, Conclusions and recommendations.

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:

1. **Quality Through design –** McGraw hill -1993.
2. **Engineering Quality by Design** Marcel Dekker Inc- New York. ISBN 0-8247-8246-1

REFERENCE BOOKS:

1. **Velocity Function Deployment -** Marcel Dekker Inc-New York. First Indian Edition 2005.
2. Techniques for value analysis and Engineering, 1972.
3. Management for quality improvement, productivity press.
4. Design, addition -Wesley, wokingham, 1991.
5. **Designing For Quality -** Matar - chapman & hall. New York – 1990.
6. Indolence through quality and reliability, applied 1989.
7. **Design for excellence -** McGraw -Hill Inc, New York - 1996.

MODERN TRENDS IN MANAGEMENT

Sub Code	**: 14 MPM 155**	IA Marks	: 50
No. of Lecture Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

Just in Time ldeas: Introduction of JIT Concepts, Difference between Conventional Material Control technique and lIT, Steps in implementing JIT, J.I.T. as a management Kaizen concept, Feasibility of JIT concepts to Indian Industries.

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:

1. **Just in Time Manufacturing** - Amaldo Hernandez - PH International.
2. **Just in Time - Productivity Process** - David Hutehins - Jaco Publications.

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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

Subject Code	: **14 MPD21**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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 data- 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:

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

Subject Code	: **14MPD22**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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

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

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

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

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

Material and process selection – Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Process capabilities, Selection of materials, Primary process/ materials selection, Systematic selection of processes and materials.

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 marhining areas, Simplication 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

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.

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.
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:

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	: **14MPD24**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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.

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

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

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

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.

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

TEXT 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

REFERENCE BOOKS:

1. **Wohler's Report 2000** - Terry Wohlers - Wohler's Association -2000.

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.

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

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:

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	: **14MPD252**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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:

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	: **14MPD253**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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:

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

Sub Code	**: 14 MPD 254**	IA Marks	: 50
No. of Lecture Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks	: 100

Introduction: Need for non-traditional machining processes. Processes selection c1assification on – comparative study of different 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.

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 circuits- critical resistance parameters in Ro Circuit-Die electric fluids-Electrodes for sparl surface finish. Applications.

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.

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

High Velocity forming process: introduction - development of specific process selection-comparison of conventional and high velocity forming methods - Types of high velocity forming methods- explosion forming process-elector hydraulics forming magnetic pulse forming.

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. **High Velocity Forming of Metals** - F.M Wilson - ASTME Pretice Hall.
6. **Modern Manufacturing Method** - Adithan - New Age International (p) Limited - ISBN**:** 8122408176, 2007.
7. **Modern Machining Processes** - P.K. Mishra - Narosa Publishing House, New Delhi - 1997.

FINANCIAL MANAGEMENT

Sub Code	**14 MPD 255**	A Marks	50
No. of Lecture Hrs/week	04	Exam Hours	03
Total Lecture Hrs	52	Exam Marks	100

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 Positionand 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:

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
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.

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. 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.	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. 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.
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.

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.

IV SEMESTER

ADVANCED MANUFACTURING PRACTICES

Subject Code	: **14MPD41**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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
Adaptability 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:

1. **Toyota Production system"** – An integrated approach to just in time – by Yasuhiro Monden - Hardcover – 1993.
2. **Lean Thinking** – By James Womack.- **ISBN:** 0-7432-4927-5.

3. **The machine that changed the World – The story of Lean production –** by James P. Womack, Daniel T Jones, and Daniel Roos – Harper Perennial edition published 1991.
4. **Just in time manufacturing (manual)** – Kargoanker.

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

Introduction: Engineering application of optimization, multivariable optimization Statement of a optimization problem. Design Vector, Design constraints, objective function, classification of optimization problems.

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.

Non-linear Programming: (One Dimensional minimization method) Numerical method, Unimodal function, Unrestricted search, Exhaustive search. Dichotomous search, Fibonacci and Golden section method.

Interpolation Method: Quadratic and Cubic Nonlinear programming (Unrestricted Optimization Technique) Random search methods, Univariate method, powels method, Simplex method.

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:

1. **Optimization, "Theory and Application" -** S.S. Rao - Willey Eastern - 1984

REFERENCE BOOKS:

1. **Optimization methods for Engg. Design -** R.L Fox - Addison – Wesley – ISBN 0201020785 -1971
2. **Optimisation Theory and Practice** - GSG Beveridge and R.S. Schechter - McGraw Hill, New York – 1970.
3. **Optimisation and Probability in System Engg**.- Ram - Van Nostrand – 1974.

PRODUCT PLANNING AND MARKETING

Subject Code	: **14MPD422**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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:

1. Glen L. Urban. .John R. Hauser, "**Design and Marketing of New products"** A Prentice Hall, Englewood cliffs, New Jersey, 1993

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 interdisciplinary 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-

Design Concepts. Design & Skill of Knowledge enhancing Technologies for machine tool systems- Historical Overview, Lessons, Problems and Future Development.

REFERENCE BOOKS:

1. **Agile Manufacturing -Forging new Frontiers -** Paul T. Kidd - Addison Wesley- Publication- 1994.
2. **Agile Manufacturing -Proceeding of International Conference on Agile Manufacturing** Dr. M.P Chowdiah (Editor), TATA Mc Graw Hill Publications 1996.
3. **Concurrent Engg -** Paul T Kidd – Addison Wesley Publication -1994
4. **World Class manufacturing -** Paul T Kidd – Addition Wesley Pub - 1994

PRODUCT ANALYSIS AND COST OPTIMIZATION

Subject Code	: **14MPD424**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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:

1. **Design and Marketing of New Products** - Glen L Urban - John R Hauser- Prentice Hall. New Jersey, 1980.
2. **Production and Costing** - Narang CBS & Kumar V - Khanna Publishers- 2001.

REFERENCE BOOKS:

1. **Cost management in the New Manufacturing Age** -Yasuhiro Monden, ProductivityPress-1992.
2. **Technique for Value Analysis And Engineering** - Miles Lewrence.D - McGraw Hill, New york-1972.

ROBUST DESIGN

Subject Code	: **14MPD425**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

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 deigns for two factors and three factors, factor effects, factor interactions, Fractional factorial design, Saturated design, Central composite designs, Illustration through numerical examples**.**

Measures of Variability : Measures of variability, Concept of confidence level, Statistical distributions : normal, log normal and Weibull distributions. Hipothesis testing, Probability plots, choice of sample size illustration through numerical examples.

Analysis and interpretation of experimental data: Measures of variability, Ranking method, column effect method and ploting 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.

Signal to Noise ratio (S-N Ratios) : Evaluation of sensitivity to noise, Signal to noise ratios for static problems, Smaller – the – better types, Nominal – the – better – type, larger – the- better – type. Signal to noise ratios for dynamic problems, Illustrations through numerical examples.

Parameter Design and Tolerance Design : Parameter and tolerance design concepts, Taguchi's inner and outer arrays, Parameter design strategy, Tolerance deign 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:

1. **Quality Engineering using Robust Design -** Madhav S. Phadake: Prentice Hall, Englewood Clifts, New Jersey 07632, 1989.
2. **Design and analysis of experiments -** Douglas Montgomery: Willey India Pvt. Ltd., V Ed., 2007.
3. **Techniques for Quality Engineering -** Phillip J. Ross: Taguchi 2nd edition. McGraw Hill Int. Ed., 1996.

REFERENCE BOOKS:

1. **Quality by Experimental Design -** Thomas B. Barker - Marcel Dekker Inc ASQC Quality Press, 1985
2. **Experiments planning, analysis and parameter design optimization -** C.F. Jeff Wu, Michael Hamada - John Willey Ed., 2002.
3. **Reliability improvement by Experiments -** W.L. Condra, - Marcel Dekker Inc ASQC Quality Press, 1985