

S-25 March, 2013 AC after Circulars from Circular No.153 &amp; onwards

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**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY****CIRCULAR NO. ACAD/NP/M.E./Syllabi/189/2013**

It is hereby informed to all concerned that, on recommendations of the Faculty of Engineering and Technology, the Hon'ble Vice-Chancellor has accepted the following **"Revised Syllabi with Cumulative Grade Point Average [CGPA]"** under the Faculty of Engineering & Technology on behalf of the **Academic Council Under Section-14(7) of the Maharashtra Universities Act, 1994** as appended herewith :-

Sr. No.	Revised Syllabi
[1]	Revised Syllabus of M.E. [Computer Networking Engg.],
[2]	Revised Syllabus of M.E. [Structural Engineering],
[3]	Revised Syllabus of M.E. [Water Resources Engineering],
[4]	Revised Syllabus of M.E. [Environmental Engineering],
[5]	Revised Syllabus of M.E. [Software Engineering],
[6]	Revised Syllabus of M.E. [Computer Science],
[7]	Revised Syllabus of M.E. [Control System Engineering],
[8]	Revised Syllabus of M.E. [Heat Power],
[9]	Revised Syllabus of M.E. [Manufacturing Engineering],
[10]	Revised Syllabus of M.E. [Electronics],
[11]	Revised Syllabus of M.E. [Electronics & Telecommunication],
[12]	Revised Syllabus of M.E. [Embedded System],
[13]	Revised Syllabus of M.E. [Communication Engineering],
[14]	Revised Syllabus of M.E. [Digital Communication],
[15]	Revised Syllabus of M.E. [Biotechnology],
[16]	Revised Syllabus of M.E. [CAD/CAM],
[17]	Revised Syllabus of M.E. [Thermal],
[18]	Revised Syllabus of M.E. [Design Engineering],

This is effective from the Academic Year 2013-2014 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,  
Aurangabad-431 004.  
REF.NO. ACAD/ NP/ M.E./  
SYLLABI / 2013/14092-100  
**V.C.14[7] A-08.**  
Date:- 15-06-2013.

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**Director,**  
**Board of College and**  
**University Development.**

S-25 March, 2013 AC after Circulars from Circular No.153 &amp; onwards

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**:: 2 ::****Copy forwarded with compliments to :-**

- 1] The Principals, affiliated concerned Colleges,  
Dr. Babasaheb Ambedkar Marathwada University.
- 2] The Director, University Network & Information Centre, UNIC, with  
**a request to upload the above all syllabi on University Website**  
**[www.bamu.net].**

**Copy to :-**

- 1] The Controller of Examinations,
- 2] The Superintendent, [ Engineering Unit ],
- 3] The Programmer [Computer Unit-1] Examinations,
- 4] The Programmer [Computer Unit-2] Examinations,
- 5] The Superintendent, [ Eligibility Unit ],
- 6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,  
Dr. Babasaheb Ambedkar Marathwada University,
- 7] The Record Keeper,  
Dr. Babasaheb Ambedkar Marathwada University.

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**DR. BABASAHEB AMBEDKAR  
MARATHWADA UNIVERSITY,  
AURANGABAD.**



**Revised Syllabus of**

**M.E.**

**(CAD/CAM)**

***[ Effective from the Academic Year 2013-14 & onwards ]***

**Dr. Babasaheb Ambedkar Marathwada University, Aurangabad**  
**Proposed Syllabus Structure of M.E. (CAD/CAM)**

**Semester I**

Course code	Name of the Subject	Teaching scheme Hrs per week				Examination scheme- Marks					Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva voce	Total	
MCE 601	Advanced Machine Design	3	1		4	80	20			100	4
MCE 602	Computer Aided Design	3	1		4	80	20			100	4
MCE 603	Concurrent Product Design	3	1		4	80	20			100	4
MCE 641	Elective- I	3	1		4	80	20			100	4
MCE 642	Elective- II	3	1		4	80	20			100	4
MCE 621	Simulation Lab			4	4			50		50	2
MCE 622	Geometric Modeling Lab			2	2				50	50	1
MCE 623	Seminar – I			2	2				50	50	1
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>8</b>	<b>28</b>	<b>400</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>650</b>	<b>24</b>

**Semester II**

Course code	Name of the Subject	Teaching scheme Hrs per week				Examination scheme- Marks					Credit
		L	T	P	Total hrs	Theory	Class Test	Term Work	Viva voce	Total	
MCE 651	Computer Aided Analysis	3	1		4	80	20			100	4
MCE 652	Computer Aided Manufacturing	3	1		4	80	20			100	4
MCE 653	Advanced Manufacturing Technology	3	1		4	80	20			100	4
MCE 691	Elective- III	3	1		4	80	20			100	4
MCE 692	Elective- IV	3	1		4	80	20			100	4
MCE 671	Design and Analysis Lab			4	4			50		50	2
MCE 672	CAM and PLM Lab			2	2				50	50	1
MCE 673	Seminar – II			2	2				50	50	1
	<b>Total</b>	<b>15</b>	<b>5</b>	<b>8</b>	<b>28</b>	<b>400</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>650</b>	<b>24</b>

**Semester III**

Course code	Name of the Subject	Teaching scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MCE 731	Dissertation Phase I	--	12	12	--	50	50	100	12
	<b>Total</b>	--	<b>12</b>	<b>12</b>	--	<b>50</b>	<b>50</b>	<b>100</b>	<b>12</b>

**Semester IV**

Course code	Name of the Subject	Teaching scheme Hrs per week			Examination scheme Marks				Credit
		L	CH	Total hrs	Theory	Term work	Viva voce	Total	
MCE 781	Dissertation Phase II	--	20	20	--	100	200	300	20
	<b>Total</b>	--	<b>20</b>	<b>20</b>	--	<b>100</b>	<b>200</b>	<b>300</b>	<b>20</b>
	<b>Grand Total</b>							<b>1700</b>	<b>80</b>

<b>Elective – I</b>
MCE 641-A Lean Manufacturing
MCE 641-B Data Based Management Systems
MCE 641-C Enterprise Resource Planning
MCE 641-D System Dynamics

<b>Elective - II</b>
MCE 642 A Sheet Metal Modeling and Manufacturing
MCE 642 B Product Life Cycle Management
MCE 642 C Automated Material Handling Systems

<b>Elective – III</b>
MCE 691-A Customization of CAD/CAM software
MCE 691-B Computational Fluid Dynamics
MCE 691-C Reliability Engineering and Life Testing
MCE 691-D Project Management

<b>Elective - IV</b>
MCE 692-A Design for 'X'
MCE 692-B Robust Design of Products/Processes
MCE 692-C Digital Manufacturing

L: Lecture hours per week

T: Tutorial Hours per week

P: Practical hours per week

CH: Contact hours

$$\begin{aligned}
 \text{Total Credits} &= \text{SEM I} + \text{SEM II} + \text{SEM III} + \text{SEM IV} \\
 &= 24 + 24 + 12 + 20 \\
 &= 80
 \end{aligned}$$

## Semester I

### MCE 601 ADVANCED MACHINE DESIGN

**Teaching Scheme:**

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

**Examination Scheme:** 4 Credit

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

**Solid Mechanics:** Analysis of stress and strain, multidimensional stress-strain relationship, plane stress, plane stress, and axisymmetric analysis. Introduction to elastic stability, energy methods displacement method and force method (5 hrs.)

**Analysis of Plates:** Introduction, Love-Kirchoff's theory, stress resultants. Deflection of plates, governing equation, support conditions. Laminated composite plates, first order shear deformation theory, higher order shear deformation theory, stress-strain relationships. (5 hrs.)

**Transient analysis:** Introduction, single degree of freedom system, multi degree of freedom system, explicit schemes, and implicit schemes of solution. (5 hrs.)

**Dynamic Analysis:** Introduction, basic concepts of eigen value problems, basic properties of eigen values and eigen vectors, iterative methods, transformation methods, approximate methods, subspace iteration method. (5 hrs.)

**Fracture mechanics:** Introduction: Fracture mechanics approach to design, the energy criterion, the stress intensity approach, effect of material properties on fracture, dimensional analysis in fracture mechanics  
**Fundamental Concepts:** Stress concentration effect of flaws, the Griffith energy balance, the energy release rate, instability and the R curve, stress analysis of cracks, K as a failure criterion. (8 hrs.)

**Fracture toughness testing of metals:** General considerations, KIC testing, K-R curve testing, J testing of metals, CTOD testing. (5 hrs.)

Reference books

1. Advanced solid mechanics: L.S. Srinath, Tata McGraw Hill publishers.
2. Theory of plates and shells: Timoshenko and Goodiar, Tata McGraw Hill international.
3. Mechanics of composite materials: R.M. Jones, Wiley international
4. CAD and Design of machine elements: M.A. Rao, R. Bhatt Rao, New Age publishers.
5. Fracture mechanics, fundamentals and applications: T.L. Anderson, CRC Press, 2nd edition.

## MCE 602 COMPUTER AIDED DESIGN

### Teaching Scheme:

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

**Examination Scheme:** 4 Credit

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

Product design process: Importance of design, design process, technological innovation and the design process, Team behavior and tools; Embodiment design: Product architecture, configuration of design, parametric design, Industrial design, Human factors design, Design for X (DFX). (3 hrs.)

CAD: Introduction, Role of CAD, CAD system architecture, Hardware and software for CAD, Software modules, ICG, Graphics Software, Ground rules for design of GS, functions of GS, modeling and simulation, Solid modeling methods An overview of modeling software: like UG/NX, Solid Works, Autodesk Inventor, Professional, AutoCAD, PRO/E, CATIA: Capabilities, Modules, Coordinate systems, sketching tools, solid modeling tools, surface modeling tools, expression/parameters toolbox, data exchange tools, API and customization facilities. (5 hrs.)

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections. (4 hrs.)

CAD/CAM Data exchange and data storage: Introduction, graphics and computing standards, data exchange standards like IGES, STEP, Model storage - Data structures - Data base considerations – Object oriented representations - Organizing data for CIM applications - Design information system. (3 hrs.)

Mathematical representations of solids: Fundamentals, Solid models, Classification of methods of representations, half spaces, boundary representation, CSG, sweep representations, Octree representations, primitive instancing, cell decomposition, spatial occupancy enumeration. (4 hrs.)

Mathematical representations of curves and surfaces: Curve representation, Parametric representation of analytic and synthetic curves; Surface models, Surface representations, Parametric representation of analytic and synthetic surfaces. (4 hrs.)

Assembly modeling: Representation, mating conditions, representation schemes, generation of assembling sequences AI approaches and applications in CAD, Knowledge Based Engineering, OpenGL, Introduction to Advanced visualization topics in CAD like Modern representation schemes like FBM, PM, Feature recognition, Design by features, Tolerance modeling, System customization and design automation, Open Source CAD like Open CASCADE. (7 hrs.)

### Reference Books

1. CAD/CAM – Principle Practice and Manufacturing, Chris McMahon and Jimmie Browne, Management, Addison Wesley England, Second Edition, 2000.
2. CAD/CAM theory and Practice, Ibrahim Zeid ,Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. Engineering Design – A materials and processing approach, Dieter George, McGraw Hill Publishers, 2000
4. Mastering CAD/CAM, Ibrahim Zeid ,Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. Mathematical Elements for Computer Graphics, Rogers, D.F. and Adams, A., McGraw Hill Inc, NY, 1989
6. CAD/CAM/CIM, P.Radhakrishnan, S.Subramanian and V.Raju ,

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New Age International (P) Ltd., New Delhi.

7. CAD/CAM: Computer Aided Design and Manufacturing, Groover M.P. and Zimmers E. W.,  
Prentice Hall International, New Delhi, 1992.

8. Computer Aided Design and Manufacturing, Dr. Sadhu Singh ,Khanna Publishers, New Delhi,  
Second Edition, 2000.

Software Documentation, tutorials, manuals of following software

1. UG/NX

2. Solid Works

3. CATIA

4. Autodesk Inventor Professional

5. AutoCAD

6. Open CASCADE

7. ANSYS Design modeler

8. Pro/E



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### MCE 603 CONCURRENT PRODUCT DESIGN

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credit**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Introduction: Types of design, importance of design, design considerations, product life cycle technology life cycle, benchmarking and mass customization. Concurrent design team its elements. (3 hrs.)

Product Design Process: Steps in design, Functional requirement analysis, Axiomatic design, Product design specifications, concurrent design model. (4 hrs.)

Material And Manufacturing Process Selection In Design: Factors influencing material and process selection, approaches, tools and software used in selection. (3 hrs.)

Design For 'X': An introduction: Design for manufacturing, assembly and disassemble, an overview of

DF'X'. Design for maintainability and serviceability, design for environment, design for aesthetic, design for packaging, design for handling, design for safety, etc. (5 hrs.)

Design Cost Estimation: Need, cost indexes, categories; cost-capacity factors; design to cost and life cycle costing. Product Development Approaches: Concurrent engineering, partnership with supplier, collaborative and Internet based design. (8 hrs.)

Design Project Management: PDM, PLM and related software tools. (2 hrs.)

Introduction to VRML, modular product design, mechanical and electronic products design Concurrent and collaborative product development case studies (5 hrs.)

**Reference Books**

1. Engineering Design by Dieter George E. McGraw Hill Pub. Company, 2000.
2. Product design and development by Ulrich Karl T and Eppinger Steven D., McGraw Hill Pub. Company 1995.
3. Product Design and Manufacture by Chitale AK and Gupta RC, Prentice-Hall of India, New Delhi
4. Handbook of Product Design for Manufacturing, Bralla, James G., McGraw Hill Pub. 1986

### MCE 641-A LEAN MANUFACTURING (ELECTIVE-I)

**Teaching Scheme:**

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

**Examination Scheme:** 4 Credit

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

Just In Time Production System: JIT Logic -Pull system, Japanese approach to production elimination of waste, JIT implementation requirements, JIT application for job shops (3 hrs.)

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. (12 hrs.)

The Rise of Lean Production: Birthplace, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production. (3 hrs.)

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. Managing Lean Enterprise: Finance, Career ladders, geographic spread and advantages of global enterprise. (9 hrs.)

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. (3 hrs.)

#### Reference Books

1. "Productions and Operations Management", Chasel Aquilino
2. "Toyota Production System -An integrated approach to Just in Time", Yasuhiro Monden  
Engineering and Management Press, Institute of Industrial Engineers, Norcross Georgia.
- 3., "The Machine that changed the World. The Story of Lean Production", James P Womack, Daniel T Jones and Daniel Roos Harper Perennial edition, 1991.
4. "Lean Thinking", James Womack
5. "Japanese Manufacturing Techniques. The Nine Hidden Lessons by simplicity", Richard Schourberger
6. "Quality Function Development", ASQC Press 1991, James Bossert
7. "Straight talk on design of experiments", Launshy and Weese

## MCE 641-B DATA BASE MANAGEMENT SYSTEMS (ELECTIVE I)

### Teaching Scheme:

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

### Examination Scheme: 4 Credit

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

Introduction: Purpose of Database Systems; View of Data; Data Models; Database Languages;

Transaction Management; Storage Management; Database Administrator; Database Users; Overall System Structure. (3 hrs.)

Entity-Relationship Model: Design Issues; Mapping Constraints; Keys; Entity-Relationship Diagram; Weak Entity Sets; Extended E-R Features; Design of an E-R Database Schema; Reduction of an E-R Schema to Tables. (3 hrs.)

Relational Model: Structure of Relational Databases; The Relational Algebra; The Tuple Relational Calculus; The Domain Relational Calculus; Extended Relational Algebra Operations; Modifications of the Database; Views. (3 hrs.)

Structured Query Language (Sql): Basic Structure; Set Operations; Aggregate Functions; Null Values; Nested Sub queries; Derived Relations; Views; Modification of the Database; Joined Relations; Data-Definition Language; Other Relational Languages - Query-by-Example; Quel; Datalog; Views (3 hrs.)

Relational Database Design: Pitfalls in Relational-Database Design; Decomposition; Normalization Using Functional Dependencies; Views (3 hrs.)

Object-Oriented Database: New Database Applications; The Object-Oriented Data Model; Object-Oriented Languages; Persistent Programming Languages; Persistent C++ Systems; Object-Relational Databases; Views: Indexing and Hashing Ordered Indices; B+ - Tree Index Files; B-Tree Index Files; Static Hashing; Comparison of Ordered Indexing and Hashing; Index Definition in SQL Views. (3 hrs.)

Query: Processing Catalog Information for Cost Estimation; Measures of Query Cost; Selection Operation; Sorting; Join Operation; Transformation of Relational Expression Views (2 hrs.)

Database System Architectures: Centralized Systems; Client-Server Systems; Parallel Systems; Distributed Systems; Network Types; Parallel Databases; Distributed Databases; Security and Integrity; Standardization Views

Expert Database Systems: Expert Database Architectures; Semantic Data Models; Views (2 hrs.)

Dbms Applications: Decision-Support Systems; Data Analysis; Data Warehousing; Spatial and Geographic Databases; Multimedia Databases; Mobility and Personal Databases; Information-Retrieval Systems Distributed Information Systems; The World Wide Web Views (3 hrs.)

Database Applications: DBMS Applications in Mechanical Engineering for Product Design Databases CAD-CAM Data Management Requirements; Databases for Shop floor control and Factory information (2 hrs.)

system; Enterprise Resource Planning; Database requirements of Computer Integrated Manufacturing Views Database Project Development on PCs Steps in DPD; System requirements study; System Design; Designing Databases, menus, screens, reports and labels; Using Multiple databases and Program Generators and

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Wizards/Design Masters. Building Application Templates. Introduction to Database programming using OOP languages like Visual Basic, Introduction to Open Database Connectivity (ODBC), Views (3 hrs.)

### **Reference Books**

1. "Database System Concepts", Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill International Editions, Third Edition
2. "Expert Database Systems - A Gentle Introduction", P. Beynon-Davies, McGraw Hill International; 1991
3. "Database Management Systems", James Martin
4. "DBMS", Gordon, Davis
5. "FoxPro 2.5 Made Simple for DOS and Windows", R.K.Taxali, BPB Publications
6. "FoxPro 2.5/2.6 for Windows Programming Guide", Michael Antonowich, Galgotia Publications
7. "Database Programming With Visual Basic 5 In 21 Days", Michael Amundsen and Curtis Smith; Techmedia, Second Edition, 1997
8. "Worldwide Web - Database Developer's Guide", Mark Swank and Drew Kittel.
9. "The AutoCAD Database Book - Accessing and Managing CAD Drawing Information", Fredrick H. Jones and Lloyd Martin; Galgotia Publications, Third Edition .

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**MCE 641-C ENTERPRISE RESOURCE PLANNING (ELECTIVE I)****Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credit**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

**Introduction to ERP:** Introduction, Evolution of ERP, Reasons for growth of ERP, Advantages / disadvantages of ERP, Evaluation of ERP, Various Modules in ERP. (5 hrs.)

**Modules in ERP:** Finance and Controlling, Sales and Distribution, Materials Management, Production

Planning and Control, Quality Management, Plant Maintenance, Human Resource. (5 hrs.)

**Business Processes:** Order To Cash, Procure To Pay, Plan To Produce, Make To Stock, Make To Order and Assemble To Order, Difference in Discrete and Process industries (3 hrs.)

**Manufacturing Process Knowledge:** Auto Industry, Hi Tech, FMCG, Pharma and Chemical (2 hrs.)

**ERP Projects:** Project types, Implementation methodology, Various steps in the project Implementation, Project Preparation, Business Blueprinting, As Is – To Be Study, Gap Analysis, Realization, Final Preparation, Go Live and Support, User Training, Issues during implementation ERP and Related technologies: Business Process Re – engineering, MIS, Executive Information System, Decision Support System(8 hrs.)

**ERP Market:** ERP packages like SAP, BAAN, Oracle Apps, JD Edwards, Comparison Study, Evaluation and Selection Future Directions in ERP: Current trends in ERP, Changes in the ERP Implementations, Faster implementation methodologies, Web enabling Integration of ERP with SCM, SRM, CRM and PLM, system architecture, landscape and licensing. (7 hrs.)

**Reference Books**

1. Enterprise Resource Planning, Alexis Leon
2. ERP Ware: ERP Implementation framework, V.K. Garg & N.K. Venkitakrishnan,
3. ERP Concepts and Planning, V.K. Garg & N.K. Venkitakrishnan
4. APIC's material on ERP

### MCE 641-D SYSTEM DYNAMICS (ELECTIVE I)

**Teaching Scheme:**

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

**Examination Scheme: 4 Credit**

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

Why do so many business strategies fail? Why do so many others fail to produce lasting results? Why do many businesses suffer from periodic crises, fluctuating sales, earnings, and morale? Why do some firms grow while others stagnate? How do once-dominant firms lose their competitive edge? And how can a firm identify and design high-leverage policies, policies that are not thwarted by unanticipated side effects? Introduction and Overview: Purpose, Tools and Concepts of System Dynamics. (8 hrs.)

System Dynamics Tools Part 1: Problem Definition and Model Purpose System Dynamics Tools Part 2: Building Theory with Causal Loop Diagrams System Dynamics Tools Part 3: Mapping the Stock and Flow Structure of Systems System Dynamics Tools Part 4: Dynamics of Stocks and Flows. (7 hrs.)

System Dynamics Tools Part 5: Linking Feedback with Stock and Flow Structure (3 hrs.)

System Dynamics Tools Part 6: Linking Feedback with Stock and Flow Structure (continued) Growth Strategies Part 1: Modeling Innovation Diffusion and the Growth of New Products Growth Strategies Part 2: Network Externalities, Complementarities, and Path Dependence (7 hrs.)

The dynamics of growth: S shaped growth, path dependence, delays. Modeling, decision making, formulating nonlinear relationship, model testing, Case Studies. (5 hrs.)

**Reference Books**

1. Systems Thinking and Modeling for a Complex World, Sterman, J. Business Dynamics

Irwin/McGraw Hill

2. Strategic Management Dynamics, Kim Warren ,John Wiley & Sons, Ltd

3. Books by Jay Forrester

4. System Dynamics Review Volumes

**MCE 642-A SHEET METAL MODELLING AND MANUFACTURING  
(ELECTIVE II)**

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Sheet Metal Modeling: Sheet Metal Methods, Stages in the Process, Designing with Sheet Metal Features, Miter & Edge Flanges, Bend Angles, Adding a Tab, Flat Pattern, Cuts, Sheet Metal Parts in Drawings, Sheet Metal Forming Tools, Edge Flanges and Closed Corners, Hems, Curved Edge Flanges, Designing in Flat, Existing Rounds, Using Symmetry, Manual Relief Cut, Break Corner, Jog Feature, Lofted Bends, Sheet Metal Topics, Recognize Bends Method, Opening IGES Files, Using the Rip Feature, Adding Bends in Place of Sharp Corners, Sheet Metal Features, Making Changes, Adding a Welded Corner, Sheet Metal from Shelled Parts, Unrolling Cones and Cylinders, Process Plans. (8 hrs.)

Plastic Deformation in Metals: The flow curve, true stress, true strain, yielding criteria for ductile metals, plastic stress – strain relations, strain hardening coefficient, normal anisotropy coefficient, formability evaluations, drawability tester, high strength, low alloy steels developed for formability: HSLA steels, Dual phase steels, DQAK steels, CHR-X steels, two- dimensional plastic, flow – slip line field theory, Mechanics of metal working, Temperature in metal working, strain rate effects, metallurgical structures, Friction and lubrication, lubricants for hot and cold working, Deformation zone geometry, workability and residual stresses. (7 hrs.)

Forming Equipments: Forming Equipment - types and press construction, Principle of working of Mechanical, Hydraulic and Pneumatic press. Press control system in forging equipments, Presses for hydro forming, selection of presses. (6 hrs.)

Sheet Metal forming: Press tool operations - classification based on type of stresses, Shearing operations (blanking and piercing), and effect of clearance, Calculation of punching force, Trimming, Shaving, Nibbling and Notching operations, Drawing and Deep drawing, redrawing, limiting draw ratio, forming limit criteria draw die design. Bending, spring back in bending. Spinning, stretch forming, Embossing, Coining, Rubber forming. Defects in formed parts. Sheet Metal Forming Dies – progressive die, compound and combination die. Die Construction, Center of pressure calculation, Stock strip layout, Strip development. (9 hrs.)

**Reference Books**

1. Mechanical metallurgy, Dieter G. E. Bacon David ,McGraw Hill, ISBN-0-07-100406-8
2. Metal forming handbook, Grobh Schuler ,Springer Verlag Berlin, Heidelberg, 1998, ISBN-3-540- 61185-1
3. Tool Design, Cyril Donaldson, George H. Locain, V. C. goold ,Tata McGraw Hill, ISBN-0-07-099274-6
4. ASTME, Frank w. Wilson, Fundamentals Of Tool Design ,prentice Hall of India, New Delhi ISBN-0-87692-058-10
5. Processes and materials of manufacturing, Roy A. Lindberg ,Prentice Hall of India, New Delhi, ISBN-81-203-0663-5
6. Press tools: design and construction, Prakash H. Joshi ,Wheeler Publishing, New Delhi, ISBN-81-85814-46-5

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**MCE 642-B PRODUCT LIFECYCLE MANAGEMENT  
(ELECTIVE II)**

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credit**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Background, overview, Need, Benefits, Concept of product Lifecycle, Components of PLM, Emergence of PLM, Why PLM is important, Customer Involvement. (6 hrs.)

The Product Lifecycle Environment, Product Data and Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's PLM Vision, The PLM Strategy. (9 hrs.)

Product Lifecycle Activities, Organizational Structure, Human Resources in the Product Lifecycle, Methods, Techniques, Interfaces, Information, Standards, Vendors of PLM Systems and Components, Examples of PLM in use. (10 hrs.)

PDM basics, PDM Systems, Importance of PDM, Resolving Data Issues, A Multi-user, Multi-organization Environment, Multiple Data Definition, Justification of PDM, Reasons for implementing a PDM System. (5 hrs.)

**Reference Books**

1. Product Lifecycle Management by Antti Saaksvuori and Anselmi Immonen, Springer; 1 edition (November 5, 2003).
2. Relevant recent technical articles, research papers, key note addresses, etc.



## MCE 642-C AUTOMATED MATERIAL HANDLING SYSTEMS

### (ELECTIVE II)

**Teaching Scheme:**

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

**Examination Scheme:** 4 Credits

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

Introduction to Material Handling - Overview of material handling equipment, considerations material handling system design, the ten principles of material handling (Material Transport Systems Industrial trucks, automated guided vehicle systems (AGVS), vehicle guidance technology, vehicle management and safety, monorails and other rail guided vehicles, conveyor systems, types of conveyor conveyor operations and features, cranes and hoists, analysis of material transfer systems, charting technique in material handling, analysis of vehicle-based systems, conveyor analysis (8 hrs.)

Storage Systems - Storage system performance, storage location strategies, conventional storage methods and equipment, automated storage systems, automated storage/retrieval systems (AS/RS), types AS/RS and applications, carousel storage systems, engineering analysis of storage systems Material Handling and Storage System in FMS/CIM - Functions of the handling system, FMS layout configurations material handling equipment. (7 hrs.)

Robot Technology - Robot anatomy, need, purpose and motives for robot use in industry, elements of robotic system, need for using robots, robot physical configurations, robot motions, motion planning trajectory planning, technical features, drive systems, control systems, robot programming languages, end effectors, work cell control and interlocks, robot sensors, robot vision, ranging, laser, acoustic, tactile, general considerations in robot applications, mobile robots Robot Applications - Current, near future and future applications of robots, material transfer, machine loading, assembly and inspection, spot welding, continuous arc welding, spray coating other processing applications such as, machining, die casting, drilling, routine grinding, wire brushing, water jet cutting, laser cutting, riveting and similar operations. (15 hrs.)

### Reference Books

1. "Automation, Production Systems and Computer-Integrated Manufacturing", Mikell P. Grover, Pearson Education, New Delhi
2. "CAD/CAM/CIM" ,P. Radhakrishnan & S. Subramanyan ,Willey Eastern Limited New Delhi
3. "CAD/CAM", Mikell P. Grover and Enory W. Zimmers Jr. ,Pearson Education, New Delhi.
4. "Industrial Robotics" , Mikell P. Grover
5. "Robotis Technology and flexible Automation" Satya Rajan Deb ,Tata Mc Graw Hill Publishing Company Limited New Delhi
6. Handbook of Material Handling, Ellis Horwood limited

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**MCE 621 SIMULATION LAB****Teaching Scheme:****Practical:** 4 hrs per week**Examination Scheme:** 2 Credits**Term Work:** 50 Marks

A minimum of eight assignments based on simulation that must consist of a complete simulative experiment using various simulation packages.

**MCE 622****GEOMETRIC MODELING LAB****Teaching Scheme:****Practical:** 2 hrs per week**Examination Scheme:** 1 Credit**Viva Voce:** 50 Marks

Solid modeling, assembly modeling, drafting assignments using software like UNIGRAPHICS, Solid Work CATIA, Pro/Engineer, ANSYS, Autodesk Inventor, etc and study of the various facilities in these software.

**MCE 623 SEMINAR-I****Teaching Scheme:****Practical:** 2 hrs per week**Examination Scheme:** 1 Credit**Viva Voce:** 50 Marks

The seminar shall consist of study of a particular topic based on 4-6 research papers or case study of 1/ industries. The marks shall be awarded as the basis of performance of the individual student during his/h seminar presentation. Each student is also required to submit a report based on above study in the prescribe format. Viva Voce will be based on the work carried out by student with respect to seminar topic.

## Semester II

### MCE 651 COMPUTER AIDED ANALYSIS

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Finite Difference Method: Introduction, One dimensional and two dimensional problems, Boundary conditions, Method of solving simultaneous algebraic equations, Explicit method, Implicit method, Application of FDM to steady and unsteady heat conduction. (6 hrs.)

Finite Element Method: Introduction, Overview of FEM, Advantages and applications, recent advances in FEM, FEA software Basic principles and general procedure of FEM. Discretization, Bandwidth and minimization, Interpolation models, Pascal triangle, Convergence requirements, Shape functions, variation and weighted residual methods for derivation of element characteristic matrix and vector, Rayleigh Ritz and Galerkin approach. Assembly of finite element equations, Application of boundary conditions, Solution techniques. (9 hrs.)

Higher Order and Isoparametric Elements: Natural Coordinates, Higher Order elements in terms of Natural Coordinates and Classical Interpolation Polynomials, Isoparametric elements, 2D elements, Computation of element stiffness matrix, Gauss quadrature, Convergence criteria. (8 hrs.)

Formulation of Plate Bending Elements: Introduction to CPT, FSDT, HSDT and formulation of rectangular elements, Application to composite laminated plates. (5 hrs.)

Applications: FEA to fluid mechanics and heat transfer. (2 hrs.)

**Reference Books**

1. "Text Book Of Finite Element Analysis", P. Seshu, PHI Publishing, 2003
2. "Finite Element Procedures, K. J. Bathe PHI Publishing, 1997
3. "The Finite Element Method in Engineering" S.S. Rao, Pergamon Press.
4. "Finite Element Method", J.N. Reddy, McGraw Hill Int.
5. "Heat Transfer A Basic Approach", Ozisik M. N., McGraw Hill Int. edition 1985

## MCE 652 COMPUTER AIDED MANUFACTURING

### Teaching Scheme:

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

### Examination Scheme: 4 Credits

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

**Introduction of Automation:** Introduction, basic elements of an automated system, advanced automation functions, levels of automation (2 hrs.)

**Numerical Control:** Basic components of an NC system, classification, merits and demerits, applications, the cost of NC/CNC, dimensioning systems, axes designation, NC motion control, interpolation, part programming formats, manual part programming, NC words, macro statements, application of NC to machine tools and other applications, NC coding systems (ISO and EIA), computer assisted part programming, APT statements, programming, NC part programming using CAD/CAM, manual data input (MDI), engineering analysis of NC positioning systems, open loop and closed loop positioning systems precision in NC positioning Computer Numerical Control (CNC) and DNC: Features of CNC, the machine control unit for CNC, CNC software, direct numerical control, distributed numerical control Group Technology and Cellular Manufacturing: Introduction to GT, benefits, part families, part classification and coding, product flow analysis, cellular manufacturing, adaptation consideration in GT, quantitative analysis in cellular manufacturing. (13 hrs.)

**Flexible Manufacturing Systems -** Introduction to FMS, components, applications, benefits, FMS layout, FMS planning and implementation issues, quantitative analysis of FMS (3 hrs.)

**Computer Integrated Manufacturing (CIM):** CAD, CAD/CAM, CIM, evolution of CIM, CIM hardware and software, nature and role of the elements of CIM system, development of CIM, the IBM concept of CIM, the Siemens concept of CIM, the CIM concept of Digital equipment corporation, Esprit CIM – OSA model, the NIST – AMRF Hierarchical model (6 hrs.)

**Manufacturing support Systems:** CAPP, benefits, types, forward and backward planning, implementation considerations, process planning systems, CAQC, CMM, JIT principles, the meaning of JIT MRP-I and MRP-II. (6 hrs.)

### Reference Books

1. "Automation, Production Systems and Computer-Integrated Manufacturing", Mikell P. Grover, Pearson Education, New Delhi.
2. "CAD/CAM/CIM", P. Radhakrishnan & S. Subramanian, Wiley Eastern Limited New Delhi,
3. "CAD/CAM", Mikell P. Grover and Enory W. Zimmers Jr ,Pearson Education, New Delhi.
4. "CNC" , Hans B. Kief and J. Frederick Waters ,Glencae Macmillan / McGraw Hill
5. "CNC Technology and Programming", Steve Krar and Arthar Gill , McGraw Hill Pub. Company, New Delhi.
6. "Competitive Manufacturing Management", Nicholas John M , McGraw Hill International
7. "CAM" , P.N. Rao, N. K. Tewari et el ,Tata Mc Graw Hill Pub. New Delhi.

## MCE 653 ADVANCED MANUFACTURING TECHNOLOGY

### Teaching Scheme:

**Theory:** 3 hrs per week

**Tutorial:** 1 hrs per week

### Examination Scheme: 4 Credits

**Theory:** 80 Marks (3 hrs.)

**Class Test:** 20 Marks (1 hr)

**Introduction:** Review of basic Manufacturing concept, Manufacturing automation, Nontraditional manufacturing processes. Rapid prototyping, Economics of nontraditional and automated manufacturing Introduction to Micromachining and MEMS, Introduction to coatings and tribology (3 hrs.)

**Plastics Materials & Processes:** Different thermosetting and thermoplastic compounds, Compression molding, Transfer molding, Injection molding, Film & sheet forming, Thermo forming, Use of reinforced and laminated plastics, Applications of different processes. (5 hrs.)

**Rapid Prototyping:** Product development cycle & importance of prototyping, Types of prototypes Principles & advantages, & different types of generative manufacturing processes, viz. stereolithography FDM, SLS etc Factors concerning to RP : Consideration for adoptions, Advantages, Accuracy, Economic considerations (7 hrs.)

**Non-Conventional Machining Processes:** Introduction and need of Non-conventional machining processes, Principle, Theory of material removal, Process parameters, Advantages, limitations and applications of Ultrasonic machining, Electro discharge machining, Laser beam machining & Electro chemical machining. (6 hrs.)

**Special Processes and Electronic Fabrications:** Principles, Salient features, Advantages & application of Abrasive floor machining, Magnetic abrasive finishing, Wire EDM, Electro chemical grinding, Honing Lapping and Super finishing. (5 hrs.)

**Principle, Elements, Process, Advantages, Applications & Surface preparation etc. of Physical Vapor Deposition, Chemical Vapor Deposition, Electroless coating and Thermal metal spraying. (4 hrs.)**

### Reference Books

1. "Manufacturing Processes", B.H. Amstee, Philip F. Ostwald & Myron L. Begeman, John Wiley & Sons, eighth edition.
2. "Advanced Manufacturing processes", G.F. Benidict, Marcel Dekker Publisher
3. "Manufacturing Analysis", N. Cook.
4. "Non-traditional Machining Processes", Willer, SME Publications.
5. "Non-conventional Machining Processes", P.K. Mishra, Narosa Publication.
6. HMT Hand book - Production technology.
7. "Machining Data Hand Book"
8. "Metals Hand Book"

**MCE 691-A CUSTOMIZATION OF CAD/CAM SOFTWARE  
(ELECTIVE III)**

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

**Introduction To Customization:** Customization, Application Programming Interface (API), macros, script  
**Tools For Customization:** Object Oriented Programming (OOP), OLE interfaces in CAD/CAM software; Use  
of General programming interfaces like VB, VBS, VC++, OpenGL programming and System dependent  
programming interfaces like Visual LISP (AutoCAD), GRIP (Unigraphics), Pro-Programming (Pro/Engineer)  
(8 hrs.)

**Computer-Based System Engineering:** System Engineering process, Software product development life cycle  
software processes, software development project management, software prototyping. Rapid Development  
Core issues in rapid development, rapid development languages, lifecycle planning and customer oriented  
development. (7 hrs.)

**Solid Modeling Algorithms:** Euler operations, basic solid modeling algorithms(2 hrs.)

**Automated Solid Modeling Using Customization:** Creating 2D, 3D and solid entities through API, Editing  
2D, 3D and solid entities through API, Design and development of user interfaces - icons, menus, dialog  
boxes, Integrating databases with CAD; creating BOM or part lists, Automated Assembly modeling through  
customization, Automated drafting and dimensioning using customization, Creating Automated Animation  
using API and animation software. (13 hrs.)

**Reference Books**

1. Rapid development; Steve McConnell, Microsoft Press
2. Software Engineering; Ian Sommerville, Pearson Education
3. Computer graphics; Foley, van Dam, et al, Pearson Education
4. OpenGL Programming guide; Mason Woo, et al;
5. Advanced AutoCAD; George Omura
6. Customizing AutoCAD; Sham Tickoo, Thomson learning
7. Solid Modeling; Martti Mantilya; Computer Science Press
8. Solid Works API using VB and C++; Custom Programming Unlimited LLC
9. GRIP programming manuals for Unigraphics (Vol. 1 and 2)
10. User Function Programming manuals for Unigraphics (Vol. 1, 2, 3)

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**MCE 691-B COMPUTATIONAL FLUID DYNAMICS  
(ELECTIVE III)**

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Introduction: CFD as the third dimension of fluid mechanics. Numerical Discretization methods such as Finite Difference, FEM and FVM, Why FVM as preferred method in CFD. (5 hrs.)

Basic Equations of Fluid Dynamics: Potential flow, Nonlinear Potential flow, Inviscid flows and viscous flows, Navier Stokes Equations, Primitive variable vs. conservation form, Dimensional form vs. Non dimensional form Numerical methods for Convection - Diffusion equations: Upwinding and central difference schemes, Stability condition in terms of Courant number. (10 hrs.)

Numerical Methods for Inviscid Flows: Characteristic form of equations, Flux difference splitting, Application to 2-D flows such as flow through a nozzle. (7 hrs.)

Numerical methods for Incompressible flows: The continuity equation divergence constraint. Poisson equation for pressure, Schemes such as SIMPLE due to Patankar and Spalding (8 hrs.)

**Reference Books**

1. CFD: The Finite Volume Method, Veersteeg and Malalasekara, Prentice Hall, 1996
2. Computational Fluid Mechanics and Heat Transfer, Anderson, Tannehill and Pletcher, Hemisphere Publishers, 1984.
3. Computational Methods for Fluid dynamics: Vol 1 and 2. C A J Fletcher, Springer Verlag, 1987
4. Numerical Computation of Internal and External Flows Vol.1 and 2, C. Hirsch,
5. Turbulence Modeling for CFD, D C Wilcox, DCW Industries.

**MCE 691-C RELIABILITY ENGINEERING AND LIFE TESTING  
(ELECTIVE III)**

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Basic concepts in Reliability: Risk and Reliability, Bath tub curve, Failure Mechanism of mechanical components: causes, modes, function of mechanical elements, failure theories. (3 hrs.)

Component Reliability: Failure data analysis, reliability function, hazard rate, failure rate, and their relationship, MTTF, mean failure rate, MTBF. (3 hrs.)

System Reliability: Series, parallel, mixed configuration, r-out of-n structure, solving complex systems reliability logic diagrams (RLD). Techniques of Reliability Estimation: Fault Tree analysis, tie sets and cut sets, Boolean algebra. (4 hrs.)

System Reliability Improvement: use of better components, simplification, derating, redundancy, working environment control, maintenance, etc. Redundancy Techniques: Introduction, component vs uni redundancy, weakest link technique, mixed redundancy, standby redundancy, redundancy optimization double failure and redundancy. (5 hrs.)

Case Application of complex systems: Marine power plant, computer system, Nuclear power plant, combat aircraft, etc. (3 hrs.)

Reliability Testing: Introduction, objectives, assumption, different types of test. Life testing in practice Methodology, problems and difficulties. Economics of Reliability engineering. (4 hrs.)

Accelerated Life Cycle Testing: Intro, basic concepts, data qualification. Accelerated stress combination methods, limitations, step stress method for AST, various AST models, recent development recommended approach. Highly accelerated life testing (HALT), HASS. (5 hrs.)

Self Learning Component Through Sessionals: Case application, assignments, subject paper/project presentation etc. (3 hrs.)

**Reference Books**

1. Mechanical Reliability by Srinath LS, Affiliated East-West Press Pvt Ltd, New Delhi.
2. Reliability Engineering Third Ed. by Srinath LS, Affiliated East-West Press Pvt Ltd, New Delhi.
3. Reliability Engineering and Life Testing by V.N.A. Naikan, PHI Learning Pvt. Ltd. New Delhi.
4. Reliability Engineering by E. Balagurusamy, TMH, New Delhi



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### MCE 691-D PROJECT MANAGEMENT (ELECTIVE III)

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Introduction to PM: Projects in Contemporary Organization, Project Life Cycle. (2 hrs.)

Project Initiation: Strategic Management, Project Selection & Evaluation, Selection Criteria & Models, Risk Management, Portfolio Process, Project Proposals, Project manager: Demands on Project manager, Selecting the Project Manager, Multicultural Communication, Project Organization: Organizational Concepts in PM Selecting an Organizational Form, Project Planning: Systems integration, WBS & Responsibility Chart Interface Coordination, Conflict and Negotiation in PM: Nature of Negotiation, Conflict and Project Life Cycle. (13 hrs.)

Project Implementation: Budgeting and Cost Estimation: Estimating Project Budgets, Improving Cost Estimation Process, Scheduling: Background, Network Techniques: PERT & CPM, Risk Analysis & Crystal Ball Simulation, Resource Allocation: CPM & Crashing a Project, Resource Allocation, Resource Loading & Leveling, Constrained Resource Scheduling, Multi-project Scheduling & Resource Allocation, Goldratt's Critical Chain, Monitoring & Information System, Planning-Monitoring-Controlling Cycle: Information Needs & Reporting Process, Earned Value Analysis, Computerized PMIS, Project Control: Need for Project Control, Three Types of Control Processes, Design of Control Systems, Control of Creative Activities, Control of Change & Scope, Creep. (12 hrs.)

Project Termination: Project Auditing: System Goals & Project Audit, Audit Report, Project Audit Life Cycle Project Termination, Varieties of Project Termination, Termination Process, Final Report, A Project History (3 hrs.)

**Reference Books**

1. Project Management, P. Gopalakrishnan and V. E. Rama Moorthy, Macmillan India Ltd., New Delhi, 1993.
2. Projects: Preparation, Appraisal, Budgeting and Implementation, Prasanna Chandra, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.
3. Project Management: Principles and Techniques, B. B. Goel, Deep & Deep Publications, New Delhi, 1986.
4. UNIDO Series on Project Management.

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**MCE 692-A DESIGN FOR 'X' (ELECTIVE IV)****Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme: 4 Credits****Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Introduction: Need, evolution, fundamentals and usages of DFX. Performance characteristics and tool kits for DFX. Development and Implementation of DFX tools. (4 hrs.)

Design for Manufacturing, Assembly and Disassembly: Principles, approaches, Product and component

DFMA, The B & d Experience, Evaluations for DFMA. (5 hrs.)

Design for assorted technical requirements/processes: Material storage and distribution, Dimensional control, Heat treatment, Coating, Casting, Plastic processes like wise. (6 hrs.)

Design for Life Cycle: Approaches to product development, Inspectability, Serviceability. (5 hrs.)

Design for Reliability, Quality: Approaches, QFD, Evaluations and Procedures. (5 hrs.)

Design for competitiveness: Modularity, Technical Merit, Optimization of Product Life cycle and allied. (5 hrs.)

**Reference Books**

1. Design for X: Concurrent engineering approach, Edited by G. H. Haung, Chapman & Hall, 1996.
2. Industrial assembly, S. Y. Nof. W. E. Wihelm and H. J. Warnecke, Chapman & Hall, 1996
3. Assembly automation and product design, Geoffrey Boothroyd, Marcel Dekker, Inc,
4. Design for manufacturing: a structured approach, Corrado Poli, Butterworth Heinemann
5. Process section from Design to Manufacturing, Swift and Booker, Butterworth Heinemann
6. Design for Manufacturability Handbook, James Barilla, Mc Graw Hill
7. Design for manufacturing and concurrent engineering, David M. Anderson, CIM press, 2004

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**MCE 692-B ROBUST DESIGN OF PRODUCTS/PROCESSES  
(ELECTIVE IV)**

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Introduction to Robust Design: Robustness Strategy & its primary tools: P-Diagram, Quality Measurement, Quality Loss Function, Signal To Noise (S/N) Ratios, Orthogonal Arrays, Steps in Robust Parameter Design, Robust design and Six-Sigma for Lean Enterprises. (7 hrs.)

Introduction to Taguchi's Experiment Design: Criteria For The Use Of Experiment Design Methods; Applying Experiment Design Methods According To Situation; Problem Analysis And Empiric Parameter Reduction. Orthogonal Arrays, Graphical representation of factor combinations, Linear graphs, Variance Analysis (ANOVA), Inner-Outer arrays Design. (8 hrs.)

Parameter Design According to Taguchi: Direct product design, indirect variance analysis, Product design with characteristic values, taking cost into account, Signal-to-noise ratio according to Taguchi. Experiment Design According to Shainin: Multi-variate charts, components search, paired comparisons (7 hrs.)

Determining decisive parameters (variable search), scatter plots, randomization of experiments, B versus C test, full factorial. Response Surface Methodology (RSM): Linear experiment designs, quadratic experiment designs. (8 hrs.)

**Reference Books**

1. Optimizing Engineering Design - J. Krottmaier; McGraw Hill Ltd.
2. Taguchi Techniques for quality engineering - Philip J. Ross McGraw Hill Ltd.
3. Quality Control and Improvement- A. Mitra, Pearson Publications.
4. TQM and Taguchi Methods – Logothetis.

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**MCE 692-C DIGITAL MANUFACTURING  
(ELECTIVE IV)**

**Teaching Scheme:****Theory:** 3 hrs per week**Tutorial:** 1 hrs per week**Examination Scheme:** 4 Credits**Theory:** 80 Marks (3 hrs.)**Class Test:** 20 Marks (1 hr)

Introduction to Digital Manufacturing: A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, Digital Materials, Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing Process simulation and validation: Assembly and component manufacturing, process simulation and validation, Ergonomic/ human simulation, Robotic simulation and OLP Plant design simulation & optimisation: Station / work-cell layout design, Throughput simulation, Discrete event simulation, Optimisation of material flow and logistic. (15 hrs.)

Manufacturing process simulation solution customisation: Functionality enhancements as extensions of OOTB software solution, Reports customisation, User interface customization (5 hrs.)

Special Topics: Informatics platform for designing and deploying e-manufacturing systems, framework for integrated design of Mechatronic systems, Collaborative supplier integration for product design and development. Reconfigurable manufacturing systems design, Virtual Reality based platform for collaborative product review and customisation, Managing collaborative process planning activities through extended enterprise, rapid product development, desktop assembly factories, Information sharing in digital manufacturing based on STEP and XML. (10 hrs.)

**Reference Books**

1. Collaborative Design and Planning for Digital Manufacturing, Springer, 2009

**MCE 671****DESIGN AND ANALYSIS LAB****Teaching Scheme:****Practical:** 4 hrs per week**Examination Scheme:** 2 Credits**Term Work:** 50 Marks

Assignments on mesh generation, and discretization of domain. Solution of problems related to structural mechanics, heat transfer and fluid mechanics using standard software like NASTRAN and programming languages like FORTRAN, C, C++, etc. Viva Voce on the above study.

**MCE 672****CAM & PLM LAB****Teaching Scheme:****Practical:** 2 hrs per week**Examination Scheme:** 1 Credit**Viva Voce:** 50 Marks

CAM Lab: Practical assignments on CNC Lathe machine, CNC Mill using CAM Software, Robot programming, laser drilling, EDM Machine, and preparation of CNC table  
PLM lab: Assignments based on the syllabus of PLM. Viva Voce on the above study.

**MCE 623****SEMINAR-II****Teaching Scheme:****Practical:** 2 hrs per week**Examination Scheme:** 1 Credit**Viva Voce:** 50 Marks

The SEMINAR-II shall consist of few particulars amongst the following:

Literature review with sizable number of publications and from peer reviewed Journals. Design / Development / Synthesis related to a particular area. Implementation of existing theory for applications, pilot experiments etc. Each student is required to prepare a report and deliver a talk based on the work carried out in mini-project under the guidance of a faculty member(s). The work carried out should be preferable related to his/her dissertation topic. Viva voce will be based on the contents of the topic.

## **Semester III**

### **MCE 731 DISSERTATION PHASE – I**

**Teaching Scheme:**  
**Contact Hour:** 12 hrs per week

**Examination Scheme:** 12 Credits  
**Term Work:** 50 Marks  
**Viva-voce:** 50 Marks

It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations/ experimental design etc. A report of the work shall be submitted at the end of Semester III after approval by the Guide and endorsement of the Head of Department. It will be assessed for term work. By the evaluation committee appointed by the Head of the Department, for appropriateness, sufficiency of contents and offer suggestions if any.

Note: The evaluation committee shall consist of the Guide, one senior expert faculty member from other institute appointed by University, and the Head of Department or his/her representative.

## **Semester IV**

### **MCE 781 DISSERTATION PHASE – II**

**Teaching Scheme:**  
**Contact Hour:** 20 hrs per week

**Examination Scheme:** 20 Credits  
**Term Work:** 100 Marks  
**Viva-voce:** 200 Marks

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

Note: The evaluation committee shall consist of the Guide, one senior expert faculty member from other institute appointed by University, and the Head of Department or his/her representative.

