SHRI GURU GOBIND SINGHJI INSTITUTE OF ENGG. & TECH., NANDED

PRODUCTION ENGINEERING DEPARTMENT

M. Tech. Mechanical - CAD/CAM (2009-10)

Part - I and II

GROUP OF SUBJECTS	SUBJECT CODE	SUBJECT	TEACHING CREDITS			
			Credits	L	T	P
A	MME – A 501	Advanced Machine Design	3	3	--	--
	MME – A 502	Computer Aided Design	3	3	--	--
	MME – A 503	Concurrent Product Design	3	3	--	--
B*	MME – B 511–517	Students can register for any two from the list provided	3	3	--	--
	MME – B 511–517		3	3	--	--
C	MME – C 541	Simulation Lab.	2	--	1	2
	MME – C 542	Geometric Modeling Lab.	2	--	1	2
	MME – C 543	Seminar – I (Presentation of comprehensive sessionals for the semester – I)	1	--	--	2
	Audit course without examination	Professional Communication	--	1	--	--
		SUB-TOTAL	**20**	**16**	**02**	**06**
A	MME – A 551	Computer Aided Analysis	3	3	--	--
	MME – A 552	Computer Aided Manufacturing	3	3	--	--
	MME – A 553	Advanced Mfg. Technology	3	3	--	--
B	MME – B 561–567	Students can register for any two from the list provided	3	3	--	--
	MME – B 561–567		3	3	--	--
C	MME – C 591	Design and Analysis Lab.	2	--	1	2
	MME – C 592	CAM & PLM Lab.	2	--	1	2
	MME – C 593	Seminar – II (Presentation of comprehensive sessionals for the semester – II)	1	--	--	2
		SUB-TOTAL	**20**	**15**	**02**	**06**

L=Lecture, T= Tutorial / Seminar/Project, P=Practical.

** For the course MME – B 516, Evaluation Scheme – 1. Theory (03 Credits), Mid Term (30 Marks), End Term (70 Marks) 2. Sessionals (01 Credit) 50 Marks (Continuous evaluation)*

Tutorial(s) may consist of: *subject paper, minor project, assignments, case studies, technological state of art etc related to the subject OR the requirements as designed by the concerned subject teacher.*

Part - III and IV

Sr. No.	SUBJECT	TEACHING CREDITS			
		L	T	P	Credits
MME 601	Dissertation Part - I	--	--	10	22
	Sub Total	--	--	10	22
MME 651	Dissertation Part - II	--	--	10	22
	Sub Total	--	--	10	22

L=Lecture, T= Tutorial / Seminar/Project, P=Practical.

'B' Group Subjects: Part I

MME – B 511	Automated Material Handling Systems
MME – B 512	Data Base Management Systems
MME – B 513	Enterprise Resource Planning
MME – B 514	System Dynamics
MME – B 515	Sheet Metal Modelling and Manufacturing
MME – B 516	Reliability Engineering & Life Testing
MME – B 517	Lean Manufacturing

'B' Group Subjects: Part II

MME – B 561	Customization of CAD/CAM Software
MME – B 562	Computational Fluid Dynamics
MME – B 563	Product Lifecycle Management
MME – B 564	Project Management
MME – B 565	Design for 'X'
MME – B 566	Robust Design of Products/Processes
MME – B 567	Digital Manufacturing

Programme Structure and Credits

Credits Course work	Sem. I	Sem. II	Sem. III	Sem. IV	Total
Core Courses (A group)	09	09			18
Electives (B group	06	06			12
Lab Courses	04	04			08
Seminar/Min Project	01	01			02
Project I / II			22	22	44
Total	**20**	**20**	**22**	**22**	**84**

MME – A 501 ADVANCED MACHINE DESIGN

Solid mechanics: Analysis of stress and strain, multidimensional stress-strain relationship, plane strain, plane stress, and axisymmetric analysis. Introduction to elastic stability, energy methods, displacement method and force method

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.

Transient analysis: Introduction, single degree of freedom system, multi degree of freedom system, explicit schemes, and implicit schemes of solution.

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.

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 Grifith energy balance, the energy release rate, instability and the R curve, stress analysis of cracks, K as a failure criterion.
Fracture toughness testing of metals: General considerations, K_{IC} testing, K-R curve testing, J testing of metals, CTOD testing.

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.

MME – A 502 COMPUTER AIDED DESIGN

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)

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

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

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

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

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
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

Reference Books

1. **Chris McMahon and Jimmie Browne**, CAD/CAM – Principle Practice and Manufacturing Management, Addision Wesley England, Second Edition, 2000.
2. **Ibrahim Zeid**, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
3. **Dieter George,** Engineering Design – A materials and processing approach, McGraw Hill Publishers, 2000
4. **Ibrahim Zeid**, Matering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. **Rogers, D.F. and Adams, A**., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
6. **P.Radhakrishnan, S.Subramanayan and V.Raju**, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
7. **Groover M.P. and Zimmers E. W.**, CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
8. **Dr. Sadhu Singh**, Computer Aided Design and Manufacturing, 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

MME – A 503 CONCURRENT PRODUCT DESIGN

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

Product Design Process: Steps in design, Functional requirement analysis, Axiomatic design, Product design specifications, concurrent design model

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

Design For 'X': An introduction: Design for manufacturing, assembly and dissemble, an overview of DF'X'. Deign for maintainability and serviceability, design for environment, design for aesthetic, design for packaging, design for handling, design for safety, etc.

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

Design Project Management: PDM, PLM and related software tools.
Introduction to VRML, modular product design, mechanical and electronic products design. Concurrent and collaborative product development case studies

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

MME – B 511 AUTOMATED MATERIAL HANDLING SYSTEMS

Introduction to Material Handing - Overview of material handing equipment, considerations in material handing system design, the ten principles of material handing

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 conveyors, conveyor operations and features, cranes and hoists, analysis of material transfer systems, charting techniques in material handing, analysis of vehicle-based systems, conveyor analysis

Storage Systems - Storage system performance, storage location strategies, conventional storage methods and equipment, automated storage systems, automated storage/retrieval systems (AS/RS), types of AS/RS and applications, carousel storage systems, engineering analysis of storage systems

Material Handing and Storage System in FMS/CIM - Functions of the handing system, FMS layout configurations material handing equipment

Robot Technology - Robot anatomy, need, purpose and motives for robot use in industry, elements of a 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, routing, grinding, wire brushing, water jet cutting, laser cutting, riveting and similar operations.

Reference Books

1. **Mikell P. Grover** "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi
2. **P. Radhakrishnan & S. Subramanyan** " CAD/CAM/CIM" Willey Eastern Limited New Delhi
3. **Mikell P. Grover and Enory W. Zimmers Jr.** " CAD/CAM", Pearson Education, New Delhi.

4. **Mikell P. Grover** "Industrial Robotics"
5. **Satya Rajan Deb** "Robotis Technology and fiexible Automation" Tata Mc Graw Hill Publishing Company Limited New Delhi
6. Handbook of Material Handling, Ellis Horwood limited

MME – B 512 DATA BASE MANAGEMENT SYSTEMS

Introduction: Purpose of Database Systems; View of Data; Data Models; Database Languages; Transaction Management; Storage Management; Database Administrator; Database Users; Overall System Structure

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

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

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

Relational Database Design: Pitfalls in Relational-Database Design; Decomposition; Normalization Using Functional Dependencies; Views

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

Query: Processing Catalog Information for Cost Estimation; Measures of Query Cost; Selection Operation; Sorting; Join Operation; Transformation of Relational Expression Views

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

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

Database Applications: DBMS Applications in Mechanical Engineering for Product Design Databases; CAD-CAM Data Management Requirements; Databases for Shop floor control and Factory information 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 Wizards/Design Masters. Building Application Templates. Introduction to Database programming using OOP languages like Visual Basic, Introduction to Open Database Connectivity (ODBC), Views

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

MME – B 513 ENTERPRISE RESOURCE PLANNING

Introduction to ERP: Introduction, Evolution of ERP, Reasons for growth of ERP, Advantages / disadvantages of ERP, Evaluation of ERP, Various Modules in ERP

Modules in ERP: Finance and Controlling, Sales and Distribution, Materials Management, Production Planning and Control, Quality Management, Planet Maintenance, Human Resource

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

Manufacturing Process Knowledge: Auto Industry, Hi Tech, FMCG, Pharma and Chemical

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

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

Reference Books

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

MME – B 514 SYSTEM DYNAMICS

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
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
System Dynamics Tools Part 5: Linking Feedback with Stock and Flow Structure
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

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

Reference Books

1. **Sterman, J.** Business Dynamics: Systems Thinking and Modeling for a Complex World. Irwin/McGraw Hill
2. **Kim Warren**, Strategic Management Dynamics, John Wiley & Sons, Ltd
3. Books by **Jay Forrester**
4. System Dynamics Review Volumes

MME – B 515 SHEET METAL MODELLING AND MANUFACTURING

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,

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

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

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

Reference Books

1. **Dieter G. E. Bacon David**, Mechanical metallurgy, McGraw Hill, ISBN-0-07-100406-8
2. **Grobh Schuler**, Metal forming handbook, Springer Verlag Berlin, Heidelberg, 1998, ISBN-3-540-61185-1
3. **Cyril Donaldson, George H. Locain, V. C. goold**, Tool Design, Tata McGraw Hill, ISBN-0-07-099274-6
4. **Frank w. Wilson**, Fundamentals of tool design, ASTME, prentice Hall of India, New Delhi ISBN-0-87692-058-10

5. **Roy A. Lindberg**, Processes and materials of manufacturing, Prentice Hall of India, New Delhi, ISBN-81-203-0663-5
6. **Prakash H. Joshi**, Press tools: design and construction, Wheeler Publishing, New Delhi, ISBN-81-85814-46-5

MME – B 516 RELIABILITY ENGINEERING AND LIFE TESTING

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

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

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.

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

Case Application of complex systems: Marine power plant, computer system, Nuclear power plant, combats aircraft, etc.

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

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

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

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

MME – B 517 LEAN MANUFACTURING

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

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

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.

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.

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

MME – C 541 SIMULATION LAB

A minimum of eight assignments based on the syllabus of MME A13 (four each from System Dynamics and Simulation). Simulation assignments must consist of a complete simulation experiment using some simulation package.

MME – C 542 GEOMETRIC MODELING LAB

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

MME – C 543 SEMINAR-I

The seminar shall consist of study of a particular topic based on 4-6 research papers or case study of 1/2 industries. The internal marks shall be awarded as the basis of performance of the individual student during his/her seminar presentation. Each student is also required to submit a report based on above study in the prescribed format.

AUDIT COURSE PROFESSIONAL COMMUNICATION

Grammar and commonly misspelt words. Body language and presentation skills. Speech communication. Meetings, group discussions, and seminars and conferences. Writing — resume, technical reports, articles and research papers.

MME – A 551 COMPUTER AIDED ANALYSIS

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

Finite Element Method: Introduction, Overview of FEM, Advantages and applications, recent advance in FEM, FEA software Basic principals and general procedure of FEM. Discretization, Bandwidth and its minimization, Interpolation models, Pascal triangle, Convergence requirements, Shape functions, variational 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

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.

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

Applications: FEA to fluid mechanics and heat transfer

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

MME – A 552 COMPUTER AIDED MANUFACTURING

Introduction of Automation: Introduction, basic elements of an automated system, advanced automation functions, levels of automation

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

Flexible Manufacturing Systems - Introduction to FMS, components, applications, benefits, FMS layout, FMS planning and implementation issues, quantitative analysis of FMS

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

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

Reference Books

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

MME – A 553 ADVANCED MANUFACTURING TECHNOLOGY

Introduction: Review of basic Manufacturing concept, Manufacturing automation, Nontraditional manufacturing processesRapid prototyping, Economics of nontraditional and automated manufacturing, Introduction to Micromachining and MEMS, Introduction to coatings and tribology

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.

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

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.

Special Processes and Electronic Fabrications: Principles, Salient features, Advantages & applications of Abrasive floor machining, Magnetic abrasive finishing, Wire EDM, Electro chemical grinding, Honing, Lapping and Super finishing.
Principle, Elements, Process, Advantages, Applications & Surface preparation etc. of Physical Vapor Deposition, Chemical Vapor Deposition, Electroless coating and Thermal metal spraying.

Reference Books

1. "Manufacturing Processes", **B.H. Amsteal, Philip F. Ostwald & Myron L. Begeman**, John Wiley & Sons, eighth edition.
2. "Advanced Manufacturing processes", **G.F. Benidict**, Marcel Deker 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"

MME – B 561 CUSTOMIZATION OF CAD/CAM SOFTWARE

Introduction To Customization: Customization, Application Programming Interface (API), macros, scripts

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)

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.

Solid Modeling Algorithms: Euler operations, basic solid modeling algorithms

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 Animations using API and animation software.

Reference Books

1. Rapid development; **Steve McConnel**, 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)

MME – B 562 COMPUTATIONAL FLUID DYNAMICS

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.

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

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

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

Reference Books

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

MME – B 563 PRODUCT LIFECYCLE MANAGEMENT

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

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.

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.

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.

MME – B 564 PROJECT MANAGEMENT

Introduction to PM: Projects in Contemporary Organization, Project Life Cycle

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 Charts, Interface Coordination, Conflict and Negotiation in PM: Nature of Negotiation, Conflict and Project Life Cycle

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

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

Reference Books

1. **P. Gopalakrishnan and V. E. Rama Moorthy**, Project Management, Macmillan India Ltd., New Delhi, 1993.

2. **Prasanna Chandra,** Projects: Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.
3. **B. B. Goel**, Project Management: Principles and Techniques, Deep & Deep Publications, New Delhi, 1986.
4. **UNIDO Series** on Project Management.

MME – B 565 DESIGN FOR 'X'

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

Design for Manufacturing, Assembly and Disassembly: Principles, approaches, Product and component DFMA, The B & d Experience, Evaluations for DFMA.

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

Design for Life Cycle: Approaches to product development, Inspectability, Serviceability.

Design for Reliability, Quality: Approaches, QFD, Evaluations and Procedures.

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

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

MME – B 566 ROBUST DESIGN OF PRODUCTS/PROCESSES

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.

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.

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; 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.

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**.

MME – B 567 DIGITAL MANUFACTURING

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

Manufacturing process simulation solution customisation: Functionality enhancements as extensions of OOTB software solution, Reports customisation, User interface customisation

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

Reference Books

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

MME – C 591 DESIGN AND ANALYSIS LAB

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.

MME – C 592 CAM & PLM LAB

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.

MME – C 593 SEMINAR-II

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

Literature review from sizable number of publications. 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.

MME – 601 DISSERTATION PART – I

The dissertation Part – I has the following three components:

1. Term Paper
2. Part Implementation
3. Proficiency Development

Each component carries weightage and every student has to comply to all theses components. The students will be evaluated separately for each of these components and shall be considered for collective performance in the score as Dissertation Part – I.

MME – 651 DISSERTATION PART – II

Dissertation Part – II may consist of the following:

The dissertation work may consist of an extensive work, study or analysis of field/industrial problems with appropriate solutions or remedies. It includes like:

1. Fabrication of model, machine, prototype on the basis of innovative ideas.
2. Modeling and/or simulation of a system and improvements in the system.
3. Design of experiments, experimental setups, fabrication of test equipment/rigs, experimentation and statistical analysis, comparison with the existing data.
4. Renovation of machines, testing equipments.
5. Extensive analysis of some problems solved with the help of suitable software.
6. Design, modeling, analysis and so on as deemed fit.

The bonafide work carried out for Dissertation Part – II should be potentially rich in terms of academics.

Dissertation Report

The project report shall be hard bound. It is a report on the work done by the student. It should have literature review, problem definition and formulation, adopted methodology, experimentation plan if any, results, conclusions, discussion and its relevance to the further work.

Examination

The viva-voce examination of the Dissertation Part – II shall consist of a presentation by the candidate and demonstration of the work, model and software.