TWO YEAR POST GRADUATE DEGREE COURSE IN MASTER OF ENGINEERING (FULL TIME)

MECHANICAL ENGINEERING (Advanced Manufacturing & Mechanical System Design)

CREDIT GRADE SYSTEM

Appendix - C

First Semester

			TEACHING SCHEME						EXAMINATION SCHEME									
			HOURS / WEEK						THEORY						PRACTICAL			
Sr. No.	Subject Code	Subject	Lecture	Tutorial	Practical	Total HOURS	CREDITS		DURATION OF PAPER (Hr.)	MAX. MARKS THEORY PAPER	MAX. MARKS COLLEGE ASSESMENT	TOTAL	MIN. PASSING MARKS		MAX. MARKS		TOTAL	MIN. PASSING MARKS
													THEORY PAPER	SUBJECT	EXTERNAL	INTERNAL		
01	1MMD1	Advanced Manufacturing Processes	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
02	1MMD2	Advanced Machine Design	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
03	1MMD3	Computer Aided Design and Engineering	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
04	1MMD4	Design of Material Handling Equipments	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
05	1MMD5	Elective – I	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
06	1MMD6	Advanced Manufacturing Processes- Lab	0	0	2	2	1		_	_	_	_	_	_	25	25	50	25
07	1MMD7	Computer Aided Design and Engineering Lab	0	0	2	2	1		_	_	_	_	_	_	25	25	50	25
		TOTAL	20	0	4	24	22					500					100	
																TOTAL		600

Elective – I 1) Reliability, Maintenance Management & Safety, 2) New Product design 3) Lean Manufacturing
4) Design for Manufacturing and Assembly 5) Ergonomics of Manufacturing

Second Semester

01	2MMD1	Advanced Material Technology	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
02	2MMD2	Required Prototyping and Tooling	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
03	2MMD3	Mechatronics in System Design	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
04	2MMD4	Experimental Stress Analysis	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
05	2MMD5	Elective – II	4	0	0	4	4		3	80	20	100	40	50	_	_	_	_
06	2MMD6	Mechatronics in System Design Lab	0	0	2	2	1		_	_	_	_	_	_	25	25	50	25
07	2MMD7	Experimental Stress Analysis Lab	0	0	2	2	1		_	_	_	_	_	_	25	25	50	25
		TOTAL	20	1	2	23	22					500					100	
																TOTAL		600

Elective –II – 1) Optimization Methods in Engineering Design, 2) Advanced Machine Tool Design 3) Total Quality Management
4) Computer Assisted Production Management, 5) Concurrent Engineering & Product Lifecycle Management

SYLLABUS PRESCRIBED FOR
TWO YEAR P.G. COURSE IN
MASTER OF ENGINEERING (FULL TIME)
MECHANICAL ENGINEERING (ADVANCED MANUFACTURING
& MECHANICAL SYSTEMS DESIGN)

SEMESTER-I

1MMD1 ADVANCED MANUFACTURING PROCESSES

SECTION - A

Advance machining theory: mechanics of chip formation, shear angle relations, and theoretical determination of cutting force in orthogonal cutting, analysis of turning, drilling, and milling operations. Mechanics of grinding, dynamometry, thermal aspects of machining, tool life and tool wear, economics of machining.

NC/CNC: basic concept, NC control, special features of CNC machine: turret head, tool magazine, servomotors, ball lead screw, automatic tool changer (ATC), and classification of CNC machines, cutting tool and tool holders, point to point, straight cut and continues path, control codes, machine control units, closed system, NC, machine components, CNC, DNC, Manual part programming, formats, coding, programming languages. APT, ADAPR, EXAPT etc. sensors and adaptive control, Manual part programming for drilling, milling and lathe, examples in APT. applications and economics of CNC.

Metal casting: Metal casting processes, pattern and mould, moulding materials, elements of gating system design, riser design, solidification structure, solidification shrinkage structure, defects and properties of finished casting, heat treatment.

SECTION - B

Welding process, heat flow in welding, metallurgy of fusion weld, welding stresses and distortions, preheat and post weld heat treatment weld ability tests, weld defects, weld inspection and quality control. Electron beam welding, ultrasonic welding, laser beam welding.

Metal forming: Nature of plastic deformation, fundamentals of plasticity, mechanics of metal forming processes like rolling, forging, drawing, extrusion etc. various forming operations, defects in metal forming, local instability and tearing, bending of sheets, hydro forming. Electro magnetic forming, explosive forming, electro hydraulic forming, stretch forming, contour roll forming.

Unconventional machining process: parametric study, applications and fundamentals of Ultrasonic Machining USM, Abrasive Jet Machining AJM, Water Jet Machining WJM, Abrasive Water Jet Machining AWJM, Electro- chemical Machining ECM, Electro Discharge Machining EDM, Electron Beam Machining EBM, Laser Beam Machining LBM.

Books Recommended:
TEXT BOOKS:

1. Juneja, Fundamentals of metal cutting
2. A. Ghosh, and A. K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi "Manufacturing Science"

REFERENCE BOOKS:

1. Arshinov, Metal cutting theory & cutting tool design
2. Mikhal Groover, CAD/CAM
3. N. K. Mehta, Machine tool design
4. E. P. DeGarmo, J. T Black, R. A. Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-
5. 978760) "Materials and Processes in Manufacturing" (8th Edition), ,
6. G.F. Benedict, Marcel Dekker, Inc. New York (ISBN 0-8247-7352-7) "Nontraditional Manufacturing Processes".

1MMD2 ADVANCED MACHINE DESIGN

SECTION-A

Introduction: Role of failure prevention analysis in mechanical design, Modes of mechanical failure, Review of failure theories for ductile and brittle materials including Mohr's theory and modified Mohr's theory, Numerical examples.

Fatigue of Materials: Introductory concepts, High cycle and low cycle fatigue, Fatigue design models, Fatigue design methods, Fatigue design criteria, Fatigue testing, Test methods and standard test specimens, Fatigue fracture surfaces and macroscopic features, Fatigue mechanisms and microscopic features.

Stess-Life (S-N) Approach: S- N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behaviour, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach.
Strain-Life(-N)approach: Monotonic stress-strain behavior ,Strain controlled test methods ,Cyclic stress-strain behavior, Strain based approach to life estimation, Determination of strain life fatigue properties, Mean stress effects, Effect of surface finish, Life estimation by N approach.

SECTION-B

LEFM Approach: LEFM concepts, Crack tip plastic zone, Fracture toughness, Fatigue crack growth, Mean stress effects, Crack growth life estimation.

Statistical Aspects of Fatigue: Definitions and quantification of data scatter, Probability distributions, Tolerance limits, Regression analysis of fatigue data, Reliability analysis, Problems using the Weibull distribution.

Fatigue from Variable Amplitude Loading: Spectrum loads and cumulative damage, Damage quantification and concepts of damage fraction and accumulation, Cumulative damage theories, Load interaction and sequence effects, Cycle counting methods, Life estimation using stress life approach.

Surface Failure: Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.

Books Recommended:

TEXT BOOKS:

1. Robert L. Norton, Pearson: "Machine Design"
2. S. Suresh: "Fatigue of Materials" - Press, Cambridge, U.K.

REFERENCE BOOKS:

1. Jack. A. Collins, John Wiley, Newyork: "Failure of Materials in Mechanical Design"- 1992.
2. Julie. A. Benantine: "Fundamentals of Metal Fatigue Analysis"- Prentice Hall,1990
3. ASM Hand Book: "Fatigue and Fracture"- Vol. 19, 2002.
4. Ralph I. Stephens, Ali Fatemi, Robert .R. Stephens, Henry Fuchs, John: "Metal Fatigue in Engineering"- Wiley Newyork, Second edition. 2001.

1MMD3 COMPUTER AIDED DESIGN AND ENGINEERING

SECTION - A

CAD – Introduction, typical Product Cycle, Implementation of a typical CAD process, Application of CAD and their Advantages

3D modeling and viewing: Introduction, Modeling Approaches, Types of Geometric Models, Coordinate System, sketching and Sketch Planes,

Parameters and Dimensions, Basic Features, Datum Features, Geometric Constraints, Modeling Operations and Strategies

Modeling Aids and Tools: Introduction, Geometric Modifiers, Layers, Colors, Grids, Groups, Dragging and Rubbering, Clipping, Entity Selection methods, Geometric Arrays, Transformations, Editing.

Geometric Modeling: Types of Curves and Curve Manipulations, Types of Surfaces and Surface Manipulations, Solids: Introduction, Geometry and Topology, Solid Entities, Fundamentals of Solid Modeling, Boundary Representation (B-rep), Constructive Solid Geometry (CSG) examples, Sweeps and Solid Manipulations, Feature based Modeling: Introduction, Feature Entities, Parametrics, Feature Manipulations

CAD/CAM Data exchange and data storage: Introduction, graphics and computing standards, data exchange standards like IGES, STEP

Assembly Modeling: Introduction, Assembly Modeling, Assembly Tree, Assembly Planning, Mating Conditions, Bottom – Up and Top – Down Assembly Approaches with examples, Tolerance Analysis and Mass Property calculations

SECTION - B

Review of One Dimensional FEM: FEM Methodology – Modeling and discretization Interpolation, elements, nodes and degrees-of-freedom-applications of FEA. One-Dimensional Elements: Bar element – truss element – assembly of elements – properties of stiffness matrices-boundary conditions-solution of equations-mechanical loads and stresses-thermal loads and stresses-example problems.

Review of Two and Three Dimensional FEM: Interpolation and shape functions - element matrices-linear triangular elements (CST)-quadratic triangular elements – bilinear rectangular elements solid elements-higher order elements – stress calculations.

Applications to Field Problems: Solution to problems in linear elasticity- plane problems in elasticity- plates and shells- solution of problems in heat-transfer and fluid mechanics- numerical examples-discussion on error estimates

Books Recommended:

TEXT BOOKS:

1. Ibrahim Zeid, Matering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

2. Chandrupatla & Belagundu, Finite Elements in Engineering, Prentice Hall of India Private Ltd., 1997.

REFERENCE BOOKS:

1. P. N. Rao, CAD/CAM, Prentice Hill, International
2. Daryl L. Logan, A first course in the Finite Element Method, Fourth edition, Thomson
3. Ibrahim Zeid, CAD/CAM – Theory and Practice, MGH International
4. Mikell P Groover and Emory W Zimmers Jr., CAD/CAM – Computer Aided Design and Manufacturing, Prentice Hill, International
5. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
6. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
7. Cook, Robert Davis et al "Concepts and Applications of Finite Element Analysis ", Wiley, John & Sons, 1999.
8. Bathe, K.J., Finite Element Procedures in Engineering Analysis, 1990.
9. S. S. Rao, Finite Element Analysis, 2002 Edition.
10. David V Hutton, Fundamentals of Finite Element Analysis, McGraw-Hill International Edition, 2004.

1MMD4 DESIGN OF MATERIAL HANDLING EQUIPMENTS

SECTION-A

Introduction: Transmission and its requirements. Matching of load and prime mover. Types of material equipment's – Characteristics applications selection of the system.

Design Of Hoists: Design of hosting elements – ropes, chains, pulleys, sheaves, hoists of different types. **Design Of Elevators**: Types – Design of chair and bucket elevators – belt and bucket elevators - discharges.

SECTION-B

Design Of Conveyors: Types of conveyors – design of belt, pneumatic, hydraulic, screw and vibratory conveyors – selection of the conveyors.

Selection Of Drives: Types of drives – rails traveling mechanism – slewing with rotary pillar, fixed pillar and turn tablets – traveling gear. Selection of

Grabbing Attachments: Cranes grabs – grabbing attachments for loose pieces – lifting magnets grab buckets and liquid handling buckets. Design of Arresting Mechanism: Brakes – Shoes, Band, cone disc and Centrifugal types.

Books Recommended:

TEXT BOOKS:

1. Spivakovsky, A. & Dychnov, V.K., "Conveying Machines Volumes I & II", MIR Publishers Moscow.
2. Rudenko, N., "Material Handling Equipments", MIR Publishers, Moscow

REFERENCE BOOKS:

1. Boltz, Hord, A., "Material Handling Handbook ", The Ronald Press CO.
2. V. Dobrovolsky et. al, "Design of Machine Elements", MIR Publishers
3. Spivakovsky, F. and Dyachkov, V.,"Conveyours and Related Equipments". MIR Pulishers, Moscow.
4. Duglas, R WOODLEY, "Encyclopaedia of Materials Handling – Vol 1 Pregmen.
5. Hudson Wilbur, G., "Conveyors and Related Equipments ", Join Wiley and Sons.
6. M. F. Spotts and T. E. Shoup, " Design of Machine Elements", PHI
7. J.E.Shiegley, "Mechanical Engg Design", Mc-Graw Hill Book Co
8. D.N. Reshetov, "Machine Design", MIR Publishers.

1MMD5 ELECTIVE-I

(1) RELIABILITY, MAINTENANCE MANAGEMENT & SAFETY

SECTION-A

Reliability Engineering: System reliability - series, parallel and mixed configuration, Block diagram, r-out-of-n structure,Solving problems using mathematical models. Reliability improvement and allocation-Difficulty in achieving reliability,Method of improving reliability during design, different techniques available to improve reliability, Optimization, Reliability – Cost trade off, Prediction and analysis, Problems.

Maintainability, Availability & Failure Analysis: Maintainability & Availability – Introduction, formulae, Techniques available to improve

maintainability & availability, trade off among reliability, maintainability & availability, simple problems, Defect generation – Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis, TA, FMEA, FMECA.

Maintenance Planning and Replacement: Maintenance planning – Overhaul and repair; Meaning and difference,Optimal overhaul/Repair/ Replace maintenance policy for equipment subject to breakdown, Replacement decisions –Optimal interval between preventive replacements of equipment subject to breakdown, group replacement.

SECTION-B

Maintenance Systems: Fixed time maintenance, Condition based maintenance, Operate to failure, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency, non-destructive inspection, PERT & CPM in maintenance, Concept of terrotechnology.

Condition Monitoring: Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies, Examples of monitoring and diagnosis, Control structure for machine diagnosis.

Safety Aspects: Importance of safety, Factors affecting safety, Safety aspects of site and plant, Hazards of commercial chemical reaction and operation, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial safety.

Books Recommended:

TEXT BOOKS :

1. Concepts in Reliability Engineering L.S. Srinath Affiliated East West Press
2. Maintainability and Reliability Handbook Editors: Ireson W.A. and C.F. Coombs McGraw Hill Inc.

REFERENCE BOOKS:

1. Failure Diagnosis and Performance Monitoring L.F. Pau Marcel Dekker
2. Industrial Maintenance Management S.K. Srivastava S. Chand & Co Ltd.
3. Management of Industrial Maintenance Kelly and M.J. Harris Butterworth and Co.

4. Maintenance, Replacement and Reliability A.K.S. Jardine Pitman Publishing
5. Engineering Maintainability: How to Design for Reliability and Easy Maintenance B.S. Dhillon Prentice Hall of India

1MMD5 ELECTIVE-I

(2) NEW PRODUCT DESIGN

SECTION - A

Introduction: Types of design, importance of design, design considerations, product life cycle, technology life cycle, benchmarking and mass customisation, stages, objectives, success factors, concurrent approach in NPD

Product Development Process & Methodologies: Integrated Product development process - *Identifying Customer Needs***:** Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process, *Conceive* – Specification, Concept design: the activities of concept generation, Concept Selection**:** Overview of methodology, concept screening, and concept scoring, *Design* - Detailed design, Validation and analysis (simulation), Tool design, *Realize* - Plan manufacturing: Factors influencing material and process selection, approaches, tools and software used in selection, Manufacture, Build/ Assemble, Test (quality check), *Service* - Sell and Deliver, Use, *Maintain and Support*, *Dispose*

Product Development Approaches: Bottom-up design, Top-down design, Front-loading design workflow, Design in context, Modular design. Concurrent engineering, partnership with supplier, collaborative and Internet based design, work structuring and team deployment, Product and process systemization, problem, identification and solving methodologies, improving product development solutions

SECTION - B

Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes, practical examples

Design Analysis Tools: Product Reliability, Mortality Curve. Design for Manufacturing: machining, casting, forging and metal forming, optimum design, Design for Assembly and Disassembly, Design for Six Sigma, Design for reliability, Design for product life cycle Deign for maintainability and serviceability, Design for environment, Design for aesthetic, Design for packaging, Design for handling, Design for safety, etc., Estimation of Manufacturing costs, Reducing the component costs and assembly costs, Minimize system complexity.

Probabilistic Design Concepts: FMEA, QFD, Taguchi Method for design of experiments, Estimation of Manufacturing costs, Reducing the component costs and assembly costs, Minimize system complexity.

Books Recommended:

TEXT BOOKS:

1. Dieter George E., Engineering Design, McGraw Hill Pub. Company, 2000.
2. Chitale A. K. and Gupta R. C., Product Design and Manufacture, Prentice-Hall of India, New Delhi.

REFERENCE BOOKS:

1. Ulrich Karl T and Eppinger Steven D., Product design and development, McGraw Hill Pub. Company, 1995.
2. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub. 1986

1MMD5 ELECTIVE-I
(3) LEAN MANUFACTURING
SECTION -A

Introduction: Introduction, background, and lean thinking. Importances of philosophy, strategy, culture, alignment, focus and systems view.

Toyota Production System: Discussion of Toyota Production System. Lean production preparation – System assessment, process and value-stream mapping – Sources of waste.

Lean production processes: Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools include: Workplace organization, Stability. Just-In-Time – One piece flow – Pull.

SECTION -B

Cellular systems: Cellular systems, Quick change and set-up reduction methods.

Total productive maintenance: Total productive maintenance, Poka-Yoke – mistake proofing, quality improvement. Visual management. Startup of lean processes, examples and applications.

Sustaining improvement: Sustaining improvement and change, auditing, follow-up actions

Books Recommended:

TEXT BOOKS:

1. N. Gopalkrishnan, Simplified Lean Manufacture, PHI Learning Private Limited. New Delhi

2. B.S Nagendra Parashar, Cellular Manufacturing system: An integrated approach, PHI Learning Private Limited. New Delhi

REFERENCES BOOKS:

1. William M. Feld , Lean Manufacturing: Tools, Techniques, and How to Use Them ,The st Lucie Press.
2. Lonnie Wilson, How To Implement Lean Manufacturing: by McGraw Hill, August 2009.
3. Walter W Mc Intyre, Lean and Mean Process Improvement:
4. Dale H. Besterfield, Total Quality Management, Pearson Educations.

1MMD5 ELECTIVE-I
(4) DESIGN FOR MANUFACTURING AND ASSEMBLY
SECTION – A

Introduction: Design philosophy steps in Design process , General Design rules for manufacturability , basic principles of design Ling for economical production , creativity in design. Materials: Selection of Materials for design Developments in Material technology , criteria for material selection , Material selection interrelationship with process selection process selection charts.

Machining process: Overview of various machining processes , general design rules for machining - Dimensional tolerance and surface roughness , Design for machining , Ease ,Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Metal casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting , casting tolerances , use of solidification simulation in casting design , product design rules for sand casting.

SECTION – B

Metal joining: Appraisal of various welding processes, Factors in design of elements, general design guidelines , pre and post treatment of welds , effects of thermal stresses in weld joints , design of brazed joints. Forging, Design factors for Forging , Closed die forging design , parting lines of die5 drop forging die design , general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing, Keeler Goodman Forming Line Diagram, and Component Design for Blanking.

Assemble advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.

Automatic assembly transfer systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

Design of manual assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

Books Recommended:

TEXT BOOKS:

1. Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
2. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekken, N.Y. 1990.

REFERENCE BOOKS:

1. Engineering Design – Material & Processing Approach – George E. Deiter, McGraw Hill Intl. 2nd Ed.2000.
2. A Delbainbre "Computer Aided Assembly London, 1992.

1MMD5 ELECTIVE-I
(5) ERGONOMICS OF MANUFACTURING
SECTION -A

Introduction: Introduction and Human performance - Interdisciplinary nature of ergonomics, modern ergonomics. Information input and processing, factors affecting human performance, physical work load and energy expenditure, heat stress, manual lifting.

Work Space Design: Work Space Design, Anthropometry, Workspace designs for standing and seated workers, arrangement of components within a physical space, interpersonal aspect of workplace design.

SECTION -B

Design of Equipments: Design of Equipments, Ergonomic factors to be considered, design of displays and controls, design for maintainability.
Design of Environment: Design of Environment, Illumination – climate – Noise – motion

TEXT BOOKS:

1. Martin Helander,A guide to Ergonomics of Manufacturing, TMH, 1996.
2. Bridger, R.S., "Introduction to Ergonomics", McGraw Hill, 1995.

REFERENCES BOOKS:

3. McCormick, J., Human Factors in Engineering and Design, McGraw Hill, 1992.
4. W Karwowski, Ergonomics in Manufacturing: Raising Productivity through Workplace Improvement, Engineering and management press.

1MMD6 ADVANCED MANUFACTURING PROCESSES -LAB

At least five practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students

List of Practicals:-

1. Demonstration of job setting on CNC turning center and vertical machining center.
2. Preparation of program for plain turning of shaft.
3. Preparation of program for taper turning.
4. Preparation of program for grooving.
5. Preparation of program for threading.
6. Preparation of program for pocket milling.
7. Preparation of program for drilling.
8. Preparation of program for 2D profile cutting.
9. Preparation of program for boring and tapping.

Practical Examination:
Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

1MMD7 COMPUTER AIDED DESIGN AND ENGINEERING -LAB

At least five practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students

List of Practicals:-

1. Study of at least one CAD software in each of the following category,
    a. High-End CAD like UG/NX, CATIA, Pro/E
    b. Middle-range CAD like Solid Edge, AIP, Solid Edge
    c. Low-end CAD like AutoCAD, Turbo CAD, AutoCAD LT
2. Assembly modeling (for any 2 assemblies or sub-assemblies) using top down and bottom-up approaches inclusive of sketching, parts modeling (using solid and surface modeling/styling toolboxes), drafting (parts and assemblies)
3. Part families and design table creation using spreadsheet interface
4. CAD File/data exchange amongst the various CAD software and software for CMM, CAE, CNC, CAM
5. Customization/Program development for parts modeling and drafting using API and other development tools
6. **FEA:** Using any FEA software packages solve 2 problems each on structural mechanics and heat transfer, Introduction to nonlinear analysis

Practical Examination:

Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

SEMESTER-II

2MMD1 ADVANCED MATERIALS TECHNOLOGY

SECTION - A

Materials and Classification: Solid materials- Classification, Ceramics, composites and metal glasses, selection and application of tool steel, Magnetic alloys, Copper, aluminum and magnesium alloys, Bearing alloys, Super hard materials, Plastics, Alloying techniques-Thermal, mechanical and chemical methods, Power metallurgy techniques.

Mechanical Properties: Strengthening mechanism of materials, elements of dislocation theories, Strain hardening, Grain size control, Single crystal growth, Reinforcing fibres for polymers, Composite structure, determination of mechanical properties of materials, Dynamic tests, Fracture and toughness tests, Low temperature and high temperature tests, Creepm characteristics, Hot hardness tests.

SECTION - B

Processing of Materials for Casting and Joining: Plastic working of materials, Strain hardening, Recovery and recrystallisation, Formability, Forgibility and drawability of materials, Powder processing of materials, Ceramic processing, Composite processing, Features controlling machinability of materials, thermal treatment for better mach inability of metals, Universal mach inability index.

Modern Materials and Alloys: Super alloys-refractory materials, Ceramic and their applications, Low melting alloys, Shape memory alloys, Advanced Composites-Particulate and dispersioned composites, Metal matrix and ceramic matrix composites, Carbon-Carbon composites, Ti and Ni based alloys for gas turbine applications, Managing and cryogenic steels, smart and nano materials.

Non metallic materials: Polymeric materials - Formation of polymer structure - Production techniques of fibres, foams, adhesives andcoatings - Structure, properties and applications of engineering polymers - Advanced structural ceramics, WC, TiC, TaC, AI2O3, SiC, Si3N4, CBN and diamond – properties and applications.

Books Recommended:

TEXT BOOKS:

1. Engineering Materials and Applications P. Flinn and P.K. Trojan MIR Publications
2. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall of India

REFERENCE BOOKS:

1. Manufacturing processes for Engineering Materials Serope Kalpakjian Wesley Publishing Co.
2. An introduction to Physical Metallurgy S.H. Avner McGraw Hill
3. Advances in Materials and Their Applications P. Rama Rao Wiley Eastern
4. Mechanical Metallurgy Dieter McGraw Hill:
5. P.C.Shrma, Production technology
6. Thomas H.Courtney, " Mechanical Behaviour of Materials ", (2nd Edition), McGraw-Hill,
7. Charles J.A., Crane, F.A.A and Furness, J.A.G, " Selection and use of Engineering Materials ", (3rd Edition), Butterworth-Heiremann, 1977.

8. Flinn, R.A. and Trojan, P.K., " Engineering Materials and their Applications ", (4th Edition),
Jaico, 1999.
9. George E.Dieter, " Mechanical Metallurgy ", McGraw Hill, 1988.
10. Metals Hand Book, Vol.10, " Failure Analysis and Prevention ", (10th Edition), 1994.

2MMD2 RAPID PROTOTYPING AND TOOLING

SECTION-A

Introduction: Need for time compression in product development, Product development conceptual design, Development, Detail design, Prototype, Tooling, Applications of RP.

Stereolithography systems: Principle, Process parameters, Process details, Machine details, Applications.

Laser sintering systems: Principle, Process parameters, Process details, Machine details, Applications. Fusion deposition modeling: Principle, Process parameters, Process details, Machine details, Applications.

SECTION-B

Laminated object manufacturing: Principle, Process parameters, process details, Machine details, Applications. Laser engineering net shaping (lens): Ballistic Particle Manufacturing (BPM), 3D printing. Principle, introduction to rapid tooling, Direct and indirect method. Commercial softwares for RP, STL file generation. Rapid tooling techniques- vacuum casting, DMLS, etc. Introduction to reverse engineering.

Books Recommended:

TEXT BOOKS:

1. Ghosh A., "Rapid Prototyping: A Brief Introduction", Affiliated East West,
2. Kenneth G. Cooper, "Rapid Prototyping Technology: Selection and Application", CRC Press, 2001.

REFERENCE BOOKS:

1. Pham, D.T. & Dimov.S.S., "Rapid manufacturing", Springer - Verlag, London, 2001.
2. Terry wohlers, "Wohlers Report 2007", Wohlers Associates, USA, 2007.

3. Chua Chee Kai, Leong Kah Fai, Lim Chu -Sing, "Rapid Prototyping:
4. Principles and Applications", World Scientific, 2003.

2MMD3 MECHATRONICS IN SYSTEM DESIGN

SECTION - A

Fundamentals of Mechantronics: Evolution, Definition and concepts of Mechatronics, Conventional system vs. mechatronic system, Need and Role of Mechantronics in Design, Manufacturing and Factory Automation. Hardware components for Mechatronics. Transducer signal conditioning and Devices for Data conversion programmable controllers.

Sensors and Actuators: Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces –Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Robot End effectors– Vacuum, magnetic and air operated grippers, Micro sensors in Mechatronics.

Pneumatic Systems: Physical concepts of pneumatics, electro pneumatic components, operation and application, valves, auxiliary devices, actuation, synchronizing, clamping, declamping etc. Design of pneumatic logic circuit.

SECTION - B

Hydraulic Systems: Study of different control components of Hydraulic Systems, Valves and auxiliary devices, design and analysis of Hydraulic circuits sequencing Synchronizing, hydropneumatics, Design of electrohydraulic circuits.

Programmable Logic Controller: Comparison between microprocessor and microcontroller organization of microcontroller system Review of logic gates, basic structure, features, input/output processing, programming, functional block diagram (FBD), ladder diagram, logic functions, latching, sequencing, jumps, internal relays, counters, shift registers, master and jump control, data handling, data movement, data comparison, arithmetic operations, code conversion, analog input and output, applications of PLC

Books Recommended:

TEXT BOOKS:

1. C.W. De Silva, "Mechatronics: An Integrated Approach, Publisher: CRC.
2. Harry Stewart, "Pneumatics & Hydraulics", D. B. Taraporewala Sons and Co.,

3. M.P. Groover, "Automation, Production Systems and CIM by, PHI

REFERENCE BOOKS :

1. M. B. Histand & D. G. Aiciatore, "Introduction to Mechatronics & Measurement Systems by McGraw Hill.
2. Moh Mazidi and J. Mazidi, "The 8051 Microcontrollers and Embedded Systems", Prentice Hall
3. A. Malov, Y. Ivanov, " Principles of Automation" Automation by, MIR Publication
4. B.W. Anderson, "The Analysis and Design of Pneumatic Systems Wiley Eastern
5. D.V. Hall, "Microprocessor and It's Applications", Tata McGraw Hill
6. Anthony Esposito, "Fluid Power with Applications Prentice Hall of India
7. Phillipe Collet, "Robotic Technology", Prentice Hall
8. Y. Koren, "Robotics for Engineers", McGraw Hill

2MMD4 EXPERIMENTAL STRESS ANALYSIS

SECTION-A

Introduction to Photoelasticity: Photo elasticity, Light and Optics as Related to Photoelasticity Behavior of Light, Plane and circularly polarized light, Bright and dark field setups, Polariscope-Plane Polarizers, Wave Plates, Arrangement of Optical Elements in a Polariscopic, Constructional Details of Diffused Light and Lens, Photo elastic materials

Theory of Photoelasticity: Stress Optic Law in Two Dimensions at Normal Incidence, Effects of a Stressed Model in a Plane Polariscope, Effects of a Plane Model in a Circular Polariscope with Dark and Light Field Arrangements.

Analysis Techniques: Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, separation Techniques, Sealing Model to Prototype Stresses.

Three Dimensional Photoelasticity: Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear difference method in three dimensions, applications of the Frozen-stress method, the scattered light method.

SECTION-B

Strain Measurement Methods: Basic Characteristics of a Strain Gauge, Various types of strain gauges , Types of Shell Gauge, Moire Method of Strain Analysis, Grid Method of Strain Analysis.

Electrical Resistance Strain Gauge: Factors Influencing Strain sensitivity in Metallic Alloys, Gauge Construction Temperature Compensation, Factors-Influencing Gauge Section Gauge Sensitivity and Gauge Factor, Correction for transverse Strain Effects, Semiconductor Strain Gauges. Strain gauge circuits-Rosette Analysis - three element rectangular Rosette, the four Element Delta Rosettee, Stress Gauge, Strain Circuits, Potentiometer Circuits, Wheatstone Bridge.

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

Brittle Coating Method: Introduction, Coating Stresses, Failure Theories, Brittle Coating Crack Patterns Produced by Direct Loading, Brittle Coating Crack Patterns Produced by refrigeration Techniques, Brittle Coating Crack, Pattern Produced by Releasing the Load, Double Crack Pattern, Crack Detection, Ceramic based brittle coatings, Resin based brittle coatings, Test procedures for brittle coatings analysis, Calibration procedures, analysis of brittle coating data. Load-Time Relation and Its influence on the threshold Strain Effects of a Biaxial stress Field.

Birefringent Coatings

Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation methods.

Books Recommended:

TEXT BOOKS:

1. J.W. Dally and W.F. Riley, Experimental Stress Analysis, 2nd Ed. MGH.
2. K. Ramesh, Published by IIT Madras, India, Experimental Stress Analysis, 2009.

REFERENCE BOOKS:

1. A Mubin, Khanna Publications, Experimental Stress Analysis, 2003.
2. Sadhu Singh, Khanna Publishers, Experimental Stress Analysis, 1982

3. Mark B. Moore, Prentice-Hall , Principles of experimental stress analysis, 1954
4. Dureli, An Introduction to Experimental Stress and Strain Analysis.
5. Srinath , An Introduction to Experimental Stress Analysis - MGH.
6. Experimental Stress Analysis - Dally and Riley, McGraw Hill.
7. Photoelasticity Vol I and Vol II - M.M.Frocht,. John Wiley and sons.
8. Strain Gauge Primer - Perry and Lissner.
9. Photo elastic Stress analysis - Kuske, Albrecht and Robertson John Wiley & Sons.
10. Motion Measurement and Stress Analysis - Dave and Adams,
11. Hand Book of Experimental Stress Analysis AS. Kobayassin (Ed), SEMNCH, II edition.

2MMD5 ELECTIVE - II

(1) OPTIMIZATION METHODS IN ENGINEERING DESIGN

SECTION - A

Introduction: Historical Developments, Engineering applications of Optimization

Classical Optimization Techniques: Introduction, Review of single and multivariable optimization methods with and without constraints, Non-linear one-dimensional minimization problems, Examples.

Constrained Optimization Techniques: Introduction, Direct methods - Cutting plane method and Method of Feasible directions, Indirect methods - Convex programming problems, Exterior penalty function method, Examples and problems

Unconstrained Optimization Techniques: Introduction, Direct search method - Random, Univariate and Pattern search methods, Rosenbrock's method of rotating co-ordinates, Descent methods - Steepest Decent methods-Quasi-Newton's and Variable metric method, Examples.

SECTION – B

Geometric Programming: Introduction, Unconstrained minimization problems, solution of unconstrained problem from arithmetic-geometric inequality point of view, constrained minimization problems, generalized polynomial optimization, Applications of geometric problems, Introduction to stochastic optimization.

Novel methods for Optimization: Introduction to simulated annealing, selection of simulated annealing parameters, simulated annealing

algorithm; Genetic Algorithm (GA), Design of GA, Key concepts of GA, Neural Networks, A frame work for Neural Network models, Construction of Neural Network algorithm, Examples of simulated algorithm, genetic annealing and Neural Network method.

Books Recommended:

TEXT BOOKS:

1. Engineering Optimization, S. S. Rao New Age International
2. Optimization for Engineering Design, Kalyanmoy Deb Prentice Hall of India

REFERENCE BOOKS:

1. Applied Optimal Design, E. J. Haug and J.S. Arora Wiley, New York
2. Optimization, G.V. Reklaites, A. Ravindran and K.M. Rogsdeth Wiley, New York

2MMD5 ELECTIVE - II

(2) ADVANCED MACHINE TOOL DESIGN

SECTION - A

Machine Tool Drive: working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.

Regulation of Speed and Feed Rates: Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.

Design of Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

SECTION - B

Design of Guide-ways and power Screws: Function and type of guide-ways, design of slide-ways, Protecting devices for slide-ways, Design of power screws.

Design of Spindles and Spindle Supports: Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.

Dynamics of Machines Tools: General procedure of assessing dynamic stability of EES, Cutting processing, Closed loop system, Dynamic characteristics of cutting process, Stability analysis.

Books Recommended:

TEXT BOOKS:

1. N.K. Mehta Tata McGraw Hill "Machine Tool Design"
2. Acherkan, N., "Machine Tool Design", Vol. 3 & 4, MIR Publishers, Moscow, 1968

REFERENCE BOOKS:

1. CMTI Banglore "Machine Tool design Handbook"
2. Koenisberger, F., "Design Principles of Metal cutting Machine Tools", Pergamon Press, 1964.
3. Sen. G. and Bhattacharya, A., "Principles of Machine Tools", Vol.2, NCB.Calcutta, 1973

2MMD5 ELECTIVE - II
(3) TOTAL QUALITY MANAGEMENT
SECTION – A

Introduction: Quality – Basic concepts, dimensions, economics of quality, quality Gurus.

TQM: Definition, evolution, journey from inspection to TQM, comparison at different stages, dimensions of TQM, TQM viewpoints, reasons for adopting TQM.

Introspection to TQM environment: Sphere of TQM, components of TQM, TQM – Managing Total Quality, Factors affecting TQM environment, Classification and interaction among factors, Researchers' viewpoint, TQM as a system, steps in TQM implementation, Roadblocks in TQM implementation, Reasons for TQM failure.

Role of soft options in TQM: Hard vs. Soft factors, Role and expectation of employer, employee, customer and supplier from organization and vice versa. Human factors in TQM, Role of top management commitment, work culture,motivation,coordination,attitude,innovation.

Section – B

Quality initiatives in organizations: Role of tools and techniques in TQM, Classification of tools and techniques – Problem identification, Data analysis, Graphical, Creativity, Companywide. Brief description of Quality awards: – MBNQA, Deming award, European quality award, Australian quality award.

TQM Effectiveness: Impact of TQM, Need and difficulty in measuring TQM effect, Parameters governing effect of TQM.

Books Recommended:

TEXT BOOKS:

1. Oakland "Total Quality Management" Butterworth – Heinamann Ltd.
2. Waller Jenny, Allen Derek and Burna Andrew "The TQM toolkit – a guide to practical techniques for TQM"

REFERENCE BOOKS:

1. Logothetis N. "Managing for total quality from Deming to Taguchi and SPC" by (PHI)
2. Feigenbaum A.V. "Total Quality Control" (MGH)
3. Besterfield Dale H "Total Quality Management" (Pearson Education)
4. John Gilbert "A slice by slice guide to TQM" (Affiliated East West Press)

2MMD5 ELECTIVE-II
(4) COMPUTER ASSISTED PRODUCTION MANAGEMENT
SECTION-A

Computer aided process planning: Approaches to CAPP, basic part representation methods, shape producing capabilities, Process economics

Computer assisted QC: co-ordinate measuring machines construction and types, automated dimensional gauging and in process gauging

Capacity planning: Roll of capacity planning in manufacturing, planning and control systems, hierarchy of capacity planning decisions links to other system modules, capacity planning and control techniques.

SECTION-B

Just in time: JIT in manufacturing planning and control, leveling the production, pull system introduction, product and process design, JIT applications

Computer aided inventory control: Computer aided purchasing procedure, simulation of inventory problems Computer aided materials management: Material requirement planning, computer integrated materials management.

Books Recommended:

TEXT BOOKS:

1. Groover M.P.- Automation, Production Systems and CIM.

2. CAD/CAM theory and concepts, by Kuldeep Sareen and Chandandeep Grewal, S. Chand & company Ltd.

REFERENCE BOOKS:

1. David Bedworth, M.R. Handerson & Philip Wilze- Computer Integrated Design and manufacturing

2MMD5 ELECTIVE - II

(5) CONCURRENT ENGINEERING & PRODUCT LIFE CYCLE MANAGEMENT

SECTION -A

Introduction: Extensive definition of Concurrent Engineering (CE), CE design methodologies, Review of CE techniques like DFM (Design for manufacture), DFA (Design for assembly), QFD (Quality function deployment), RP (Rapid prototyping), TD (Total design), for integrating these technologies, Organizing for CE, CE tool box, Collaborative product development.

Use of Information Technology: IT support, Solid modeling, Product data management, Collaborative product commerce, Artificial Intelligence, expert systems, Software hardware component design.

Design Stage: Lifecycle design of products, Opportunities for manufacturing enterprises, Modality of concurrent engineering design, Automated analysis Idealization control, CE in optimal structural design, Real time constraints.

SECTION -B

Need for PLM: Importance of PLM, Implementing PLM, Responsibility for PLM, Benefits to different managers, Components of PLM, Emergence of PLM, Lifecycle problems to resolve, Opportunities to seize.

Components of PLM: Components of PLM, Product lifecycle activities, Product organizational structure, Human resources in product lifecycle, Methods, techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information, Standards.

Books Recommended:

TEXT BOOKS:

1. Anderson and LHein , Integrated Product Development M.M. IFS Publications

2. Prasad , Concurrent Engineering Fundamentals: Integrated Product Development Prentice hall India

REFERENCE BOOKS:

3. I Moustapha , Concurrent Engineering in Product Design and Development New Age International. Michael Grieves, Product Lifecycle Management McGraw Hill
4. Andrew Kusiak , Concurrent Engineering: Automation tools and Technology Wiley Eastern Publications

2MMD6 MECHATRONICS IN SYSTEM DESIGN - LAB

At least four practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students

List of Practicals:-

1. Sensors applications in Mechanical System
2. Design and testing of sequencing circuits.
3. Design and testing of Different types of Speed control Circuits.
4. Design and testing of Continuous reciprocation of Double acting Cylinder.
5. Study of different components of a CNC Machine-tool
6. Application of Microcontroller in a Mechatronic system

Practical Examination:

Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

2MMD7 EXPERIMENTAL STRESS ANALYSIS - LAB

At least five practicals (study/trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students

List of Practicals:-

1. Determination of Fringe constant of photoelastic material using.
2. Circular disc subjected to diametric compression.
3. Pure bending specimen (four point bending)
4. Determination of 3- dimensional experimental stress analysis using polariscope.
5. Determine slopes of plates by experimental technique.
6. Determination of Principal stresses 1 and 2 in magnitude and direction
7. Study of effect of pressure on principal stresses.

8. Determination of stress concentration using photo elasticity for simple component like plate with a hole under tension. 2D crane hook.
9. Determination of stress frozen and a slice of cross section are taken to analyze stress & no separate loading frame required.
10. Experiments using strain gauges.
11. Measurement of strain, temperature effects
12. Fixing of gauges on surfaces.
13. Experiments using photoelastic bench.
14. Setting of polariscope and calibration of disc, beam and tension model.

Practical Examination:

Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

SEMESTER - III

3MMDS SEMINAR & DISSERTETION
(As per given Scheme)

Project

SEMESTER-IV

4MMDP PROJECT SEMINAR & DISSERTETION
(As per given Scheme)

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SYLLABUS PRESCRIBED FOR
TWO YEAR P.G. COURSE IN
MASTER OF ENGINEERING (FULL TIME)
M.E. (ELECTRICAL & ELECTRONICS ENGINEERING)

SEMESTER-I
1EEEME1 ADVANCED CONTROL SYSTEMS

Unit I : Signal Processing in Digital Control: Configuration of the Basic Digital Control Scheme, Principles of Signal Conversion, Basic Discrete-Time Signals, Time-Domain Models for Discrete-Time Systems, z-transform, Transfer Function Models, Frequency Response, Stability on the z-plane and the Jury stability criterion, Sample-and-Hold Systems, Sampled Spectra and Aliasing, Reconstruction of Analog Signals, Principles of Discretization.

Unit II: Models of Digital Control Devices and Systems: z-domain description of Sampled Continuous-Time Plants, z-domain description of Systems with Dead-Time, Implementation of Digital Controllers, Tunable PID Controllers, Digital Temperature Control System, Digital Position Control System, Stepping Motors and their Control.

Unit III: Design of Digital Control Algorithms: Introduction, z-plane specifications of Control System Design, Digital Compensator design using Frequency Response Plots, Digital Compensator design using Root Locus Plots, z-plane synthesis.

Unit IV: Control System Analysis Using State Variable Methods: Vectors and Matrices, State Variable Representation, Conversion of state variable models to transfer functions, Conversion of transfer functions to Canonical State Variable Models, Eigen values and Eigen vectors, Solution of state equations, Concepts of Controllability and Observability.

Unit V: State Variable Analysis of Digital Control Systems: State descriptions of Digital Processors, State Description of Sampled Continuous-Time Plants, State Description of Systems with Dead-Time, Solution of State Difference Equations, Controllability and Observability, Multivariable Systems.

Unit VI: Pole-Placement Design and State Observers: Stability Improvement by State Feedback, Necessary and Sufficient Conditions for arbitrary Pole-Placement, State Regulator