

MECHANICAL ENGINEERING DEPARTMENT

M.Tech. INDUSTRIAL DESIGN

**Course of Study & Scheme of Examination
2016-17**



**Maulana Azad National Institute of Technology
Bhopal**

M.TECH. IN INDUSTRIAL DESIGN

First Semester

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
ID 511	Computational Methods	2	2	-	3
ID 512	Mechanism & Synthesis	3	-	-	3
ID 513	Reliability Engineering	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
ID 514	Dynamics of Machines Lab.	-	-	2	2
ID 515	Seminar 1 and mini project	-	2	-	2
Total credit 22					

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
ID 521	Advanced Computer Aided Graphics	3	-	-	3
ID 522	Stress & Vibration Analysis	3	-	-	3
ID 523	Advanced Product Design	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
ID 524	CAD Lab.	-	-	2	2
ID 525	Seminar 2 and mini project	-	2	-	2
Total credit 22					

List of department electives

ID531 Bearing Design & Selection
 ID532 Design and Development of Prototype Product.
 ID533 Computer Aided Facility & Process Planning
 ID 535 Accelerated Product Design & Development
 ID536 Electronics Packaging Design
 ID537 Complex Mechanism & Graph Theory
 ID538 Nature of Materials and Processes
 ID539 Detailed Design of Rotating Machines
 ID541 Advanced Machine Dynamics

List of Open electives

ID 551 Applied Ergonomics.
 ID 552 Concurrent Engineering

Scheme and Syllabus M.Tech. Industrial Design (BOS dt. 24.11.2016)

ID553 Design of Computer Aided Engineering System
ID 554 Product Design for Market
ID 555 Supply Chain Management

SYLLABUS

INDUSTRIAL DESIGN (M.Tech)

ID 511 COMPUTATIONAL METHODS

Various approaches in FEM, direct stiffness method, energy approach and Galerkin's approach, detailed method for structural analysis problems, various elements, development of element stiffness matrices. Applications to bar, beam, truss, spring, shaft problems. Two dimensional elements. Plane stress and plane strain problems. Three dimensional elements and their applications. Iso-parametric elements, plate bending and shell elements, Axi-symmetric problem, vibration problem,

Applications to fluid flow and heat transfer problems. Softwares such as IDEAS, ANSYS, Nastran used in FEM. Nonlinear FEA

References

- | | |
|--------------------------|--------------------|
| 1. Finite element method | O.C. Zienciwicz. |
| 2. Finite element method | C.S. Krishnamurthy |
| 3. Finite element method | Logon |
| 4. Finite element method | Heubner |

ID 512 MECHANISM & SYNTHESIS

Mechanism, link, linkage and mechanism planar and spatial mechanisms, grubler's criteria for degree of freedom, equivalent mechanisms, inversions of four link chain, slider crank chain and double slider crank chain. Mechanism analysis: Relative velocity method, instantaneous' center methods of velocity, acceleration analysis including coriolis component of acceleration. Application to slider crank chain four bar chain, stone crusher mechanism sewing machine mechanism, quick return mechanisms wrapping m/c mechanism etc klein's construction, computer aided analysis of synthesis of mechanisms. Pole, relative pole, inversion overlay freudenstein and block methods least square technique. Application to four link mechanism and slider crank mechanism function generation, modification of timing of cam mechanism. Limit & dead center positions transmission angle, cognate linkages, coupler curves, euler savary equation.

ID 513 RELIABILITY ENGINEERING

Basic Concepts of Reliability, Design for reliability, Component Reliability & Hazard Models, System Reliability Models, Redundancy technique, System Design, Maintainability and Availability Concepts. Reliability problems & measures of reliability. Reliability of non-maintained & maintained systems with & without redundancy allocation of failure & repair rates. Maintenance policies.

ID 514 DYNAMIC OF MACHINES LABORATORY

1. Rotor Balancing On Dynamic Balancing W/C
2. Hydrodynamic Journal Bearing Pressure Distribution.
3. Natural Frequency of Simple, Compound & Torsional Pendulums

ID515 SEMINAR 1 & MINI PROJECT

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

SECOND SEMESTER

ID 521 ADVANCED COMPUTER AIDED GRAPHICS

Introduction to application of computer graphics for visualizing concepts, introduction of hardware including operating systems, file management and hardware limitations introduction to the concepts of programming through by per media. Exploration of various packages for illustration, drawing, desk top publishing page composition and animation.

References

1. Mars Bell G.R. Computer Graphics In Application Prentice Hall
2. Kerlow L.V. And Rosebush J. Computer Graphics For Designers And Artists.
3. Grieman A. The Fusion of Technology And Computer Graphic Design – Hybrid Imagery Architecture, Design And Technology Press.

ID 522 STRESS & VIBRATION ANALYSIS

Introduction, Types of Strain Gauges, Selection of Various Compensations, Installation, D.C & A.C. Systems. Steady & Transient Vibration of Single & Multi – Degree Freedom Systems. Systems with Distributed Mass & Elasticity Structural Damping. Dynamics of Rotating & Reciprocating Machinery. Response of Systems to Random Vibrations. Vibration of Multi Rotor System Holzer's Method, Self Excited Vibration, Criteria Of Stability.

ID 523 ADVANCED PRODUCT DESIGN

The emphasis of the course is on individually planned design projects in different product areas. Selection of these projects is based on consideration like close human interaction with product, wide range or requirements of different users and possibilities of formal and structural innovations. Projects and with a comprehensive presentation through working mock up models design drawing and a report. This project work is supported by theoretical information and short supporting assignment in following topics: Role of creativity in problem solving, study of inhibitions, conformity and vertical thinking: assignments on using techniques like brain storming. Synectics to develop creative attitude and open mind. The development of modern design methods from craft evolution. Detailed discussion on stages in design process. Complimentary nature of systematic and creative thinking in various stages of design processes. Discussion on nature of synthesis. Methodology for visual analysis of products. Principles of value analysis, use esteem, time and exchange values and definition of function.

References

1. Jones J.C: Design Methods, Interscience
2. Buhl H.R. Creative Engineering Design Iowa State Univ. Pres.
3. Hill Percy H: The Science Of Engineering Design, Holt, Rinehart And Winston Inc,
4. De Bono Edward: Lateral Thinking Penguin 1972 William J.J. Gordon: Sysnectics, Collie Books 1968.

ID 524 CAD LABORATORY.

1. Two Dimensional Drawings.
2. Three Dimensional Model of Product.
3. Working Drawings of Components and Assembly.
4. Mechanical and Aesthetic Design of Products.
5. Trying Various Aesthetic Shapes, Shapes, Colours Etc. of the Product by CAD.

ID525 SEMINAR 2 & MINI PROJECT

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

DEPARTMENT ELECTIVES

ID 531 BEARING DESIGN & SELECTION

Lubrication, hydrostatic bearings, hydrodynamics lubrication full journal bearing, friction, pressure distribution, load carrying capacity thermal equilibrium, partial journal bearings influence of end leakage on behaviour of bearings, maximum oil pressure with end leakage, practical considerations in bearing design. Bearing – design, selection of ball & roller bearings

ID 532 DESIGN & DEVELOPMENT OF PROTOTYPE PRODUCT

Marketing: forecasting & market research for a new product. Purchasing and sales procedure. Demand analysis for new product. Intellectual property right :introduction to ipr laws, nature, types of property intellectual property, ip as an economic entity, development of ipr copyright, patents, design, trademarks, forms, global ip structure and iprs in india, infringement and remedies available, patent search, contractual agreements involving patents, case studies.

ID 533 COMPUTER AIDED FACILITY & PROCESS PLANNING

Element of plan design systematic layout planning, industrial component and its consideration. Objectives types, goal, design process and techniques of facility planning. Schematic technique, travel charting, sequence analysis systematic layout – planning mathematical models, optimizing heuristics algorithm, branch and board technique, quadramatic assignment techniques, traveling salesman problem, single goal improvement type models, single goal construction type models. Multiple facility design problem and construction type existing improvement type, multiple goal models and modifications, design problem solving technique. Estimation of distribution parameters. Empirical models, computer aided models. Estimation of distribution parameters in multi goal facilities design problem, computer aided techniques for finding optimum and sub optimum and sub optimum facilities design problem solution.

ID 535 ACCELERATED PRODUCT DESIGN & DEVELOPMENT

Introduction to rapid prototyping and manufacturing, photo polymerization, cationic photo polymerization, stereo lithography, lasers for rapid prototyping and manufacturing, solid modeling, slice process post processing – part removal, part cleaning, post curing and part finishing, case studies. Concurrent engineering: product design and product manufacturing merger is an intimate way to response competitiveness in design and manufacturing. Model of concurrent engineering correlating manufacturing, sales and distribution, market analysis, product design and production system design. Designing for lifetime use (life cycle engineering). Manufacturing decision and life cycle cost. Careful design decision in the area like material selection, selection of features, ease of assembly, product. Concurrent engineering beyond reducing manufacturing cost. More engineering effort. Rapid product development through concurrent engineering. Vendors of suppliers a part of design team, Communication skill

ID 536 ELECTRONICS PACKAGING DESIGN

Electronics packaging introduction -packaging levels, mechanical packaging aspects of electronics packaging connectors, materials for electronics packaging, substrates sealing materials, packaging electronics, pcs, back panel, wire wrap bands cable connectors, wire insulation, electronic enclosures. Thermal management, vibration and shock analysis, noise and control, emi/rfi/esd shielding, reliability & testing, packaging case studies.

ID 537 COMPLEX MECHANISM & GRAPH THEORY

Equivalent planar mechanisms, complex mechanisms of lower and higher degree of complexity and their analysis, basic concepts in graphs. Graph theory Application to detect isomorphic kinematic chains, graph representation of kinematic chain, adjacency, degree and distance matrices, string method, characteristics polynomial computerized methodology. Application to simple, multiple jointed and sliding pair kinematic chains. Detection of distinct mechanism of a kinematic chain: velocity graph method and other methods, complex mechanics & of graph theory for selection of interactive chains, mechanics, fixed input & output link location in multi-degree freedom linkages: mechanism selection and link location, application to partial, fractionated and total degree of freedom linkages.

ID 538 NATURE OF MATERIALS AND PROCESSES

Properties and usage of thermoplastic, thermosetting plastics, selection and use of plastics for engineering and consumer products. Design limitations and specific advantages of molding processes. Properties and use of rubber, ceramics and glass. Ferrous and non ferrous metals- various processes and assembly techniques. Concepts of structure and costing. Properties of natural materials like wood, bamboo cane leather cloth jute and paper and their use at craft and industrial levels.

References

1. Production Engineering Series. Plastic Forming. John D, Beadle,
2. Product Treatment And Finishes Macmillan
3. Basis Wood Working Process. Heman H.Jorth,

ID 539 DETAILED DESIGN OF ROTATING MACHINES

Component & assembly design, use of cad procedure for designing, application of optimization techniques, modeling and evaluation of components & assembly, specific examples to be taken such as centrifugal pump, wind turbines, machine tools etc. calculation of stresses and strengthening of blades.

ID 541 ADVANCED MACHINE DYNAMICS

Gear design: Spur, bevel, worm, balancing & vibration analysis. Gyroscope applications: Motor cycle, four wheel vehicle, aero plane, Naval ship rotor bearing system. Cam dynamics: analysis of an eccentric cam, jump speed analysis of cam, unbalance, spring surge & windup.

Reference

1. Dynamics of Machinery , Farazdak Haideri
2. The theory of machines: a text-book for engineering students, Thomas Bevan
3. Mechanics of mechanism Ghosh and Mallick
4. Theory of Machines S S Rattan
5. Kinematics and dynamics of machines, George Henry Martin

OPEN ELECTIVES

ID 551 APPLIED ERGONOMICS

Human being in man-made world. Gross human anatomy, anthropometrics, static and dynamic, muscles and work physiology, static and dynamic work including maximum capacity. Biomechanics, environmental condition including thermal, illumination noise and vibration, biological transducers and nervous system including their limitations. Controls and displays psycho physiological aspects of design. Research techniques in ergonomic data generation. Interpretation and application as statistical methods. Case analysis. Project work involving ergonomic design research for product systems.

ID 552 CONCURRENT ENGINEERING

Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team. Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools. Quality by design: Quality Function Deployment methodology, Taguchi methods of robust design, Design for manufacturability: Virtual manufacturing, Introduction to Value Engineering, Value Engineering analysis and techniques, Design for assembly: Introduction to various DFA technologies.

Rapid Prototyping: Need and use of RP, various RP technologies, Design for Reliability: Reliability fundamentals and design for reliability principles, Design for Serviceability: Factors affecting serviceability, serviceability evaluation, Design for Maintainability and Economics.

References

1. Concurrent Engineering, shortening lead times, raising quality & lowering costs
John. R. Hartley, Susmu Okamoto.
2. Total quality development, a step by step guide to world class concurrent engineering
Don Clausing,
3. Concurrent engineering, what every engineer should know about series
Thomas A. Salomone

ID 553 - DESIGN OF COMPUTER AIDED ENGINEERING SYSTEM (CAE)

Over view of CAD, CAE system design and implementation processor requirements analysis, functional specifications, outline systems design, components of cae system, project management.

ID 555 Supply Chain Management:

Introduction to Supply chain management: meaning and objectives of Supply Chain, Supply Chain Management, Importance in global economy, Characteristics of global supply chains, Supply chain relationship to business performance, Key tasks of supply chain managers, Dimensions and Drivers of Supply Chain Management. Supply Chain Strategy , Supply chain as a competitive advantage, Supply Chain Competitiveness, Enablers of Supply Chain Competitiveness, Business matching, supply chain design with business strategy, Global Supply chains, Global supply chain strategies, Global Supply Chain Integration, Supply Chain Security-International Sourcing, Planning the global supply chain, Risk management in the global context. Benchmarking the supply chain, Performance measurement and evaluation in global supply chains, The SCOR Model. E commerce advantages and disadvantages for SCM – e-commerce as an enabler, Evolution of world class supply chains – EDI Exchanges, hubs and market places. Importance of Coordination in Supply Chain, Bullwhip Effect, Effect of lack of Coordination on performance, Obstacles to Coordination, Strategies to achieve coordination, Building Strategic Partnership and Trust In Supply Chain, CRM – Introduction, personalization, collaborative filtering, data mining, data warehousing and real-time profiling. Key concepts in relationship, Characteristics of relationships – promise – trust – commitment – satisfaction – quality - Service competition - customer value – customer defections - customer loyalty – loyalty programs, ERP- Introduction and implementation, MRP, MRP-II, ERP-Introduction, Implementation

Sustaining Customer Relationships, The role of service in building relationships, segmentation of service, Measurement of service, Monitoring of customer satisfaction, Analysing customer defections, E-Customer Relationship Management, The importance of trust, The importance of focusing on the "right" customers, Price rational vs. price obsessive consumers, loyalists vs. butterflies - Upselling and cross selling