Sri Satya Sai University of Technology & Medical Sciences, Sehore

School of Engineering

Outcome based Curriculum for

Post Graduate Degree Courses in Engineering & Technology

Department of Mechanical Engineering

Master of Technology (Industrial Design)

Vision

The Mechanical Engineering Department to be recognized globally for outstanding education and research leading to well qualified mechanical engineers, who are innovative, entrepreneurial and successful in advanced fields of mechanical engineering to provide the ever changing industrial demands and social needs.

Mission

1. To imparting highest quality education to the students to build their capacity and enhancing their skills to make them globally competitive mechanical engineers.
2. To maintaining state of the art research facilities to provide collaborative environment that stimulates faculty, staff and students with opportunities to create, examine, apply and disseminate knowledge.
3. To develop alliances with world class R&D organizations, educational institutions, industry and alumni for excellence in teaching, research and consultancy practices. academic environment of excellence, leadership, ethical guidelines and lifelong learning needed for a long productive career.

Program Educational Preambles (PEO's):

PEO .1: To impart concepts of industrial design through the use of analytical techniques, experiments, computer simulation methods, and other modern engineering tools in the analysis and design of variety of mechanical engineering systems and their industrial applications effectively

PEO .2: To spread the recent developments in industrial design field through educating the students using new technologies, software's and recent trends in industrial design.

PEO.3: To develop habit of individual critical thinking in analyzing a complex problem in the industrial design.

Programme Outcomes (PO's) :

POs.1. Industrial Design knowledge: Apply the knowledge of Industrial Design and be able to discriminate, evaluate, analyze and integrate existing and new knowledge

POs.2. Problem analysis: Be able to critically analyze and carry out independent research on complex problems of Industrial Design

POs.3. Design/development of solutions: Be able to carry out systematic research, design appropriate experiments and tools, and interpret experimental and analytical data for development of technological knowledge in Industrial Design

POs.4. Conduct investigations of complex problems: User research-based knowledge including design of Demonstrate an ability to design systems, components or process as per needs and interpretation of data by condition monitoring, and synthesis of the information to provide valid conclusions.

POs.5. Modern tool usage: Demonstrate skills to use modern engineering tools Create, software and equipment to analyze select problems, and apply appropriate techniques, resources, and modern engineering including prediction and modeling activities during production with an understanding of the limitations.

POs.6. The engineer and society: Be able to function productively with others as part of collaborative and multidisciplinary team.

POs.7. Environment and sustainability: Possess a sound understanding in the Product and development to solve the issued with respect to Environment and sustainability.

POs.8. Ethics: Demonstrate a sincere attitude towards professional and ethical responsibilities

POs.9. Individual and team work: Able to works as team member and lead in different role in Refrigeration and Air-conditioning industries,

POs.10. Communication: Understand published literature and technically communicate. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

POs.11. Project management and finance: Implement cost effective and improved sustainable solution .

POs.12. Life-long learning: Continue professional development and learning as a life long activity

Program Specific Outcomes (PSOs)

By the completion of Industrial Engineering program the student will have following Program specific outcomes.

1. Students will have a solid formulation in the mathematics of Industrial Engineering and Operations Research models and supporting quantitative methods by having a firm grasp of the mathematical theory necessary to understand and build such models.

2. Formulate and analyze problems in complex manufacturing and service systems by comprehending and applying the basic tools of Industrial Engineering such as modeling and optimization, stochastic, statistics.

3. Design and Develop appropriate analytical solution strategies for problems in integrated production and service systems involving human capital, materials, information, equipment and energy

PEO/PO Mapping

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓					✓				
II												
III			✓	✓	✓		✓	✓				

Mapping of Course Outcome and Programmer Outcome

S.no	Semester	Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	Ist	Advance Mathematics	*	*			*							*
		Product Design and Development	*	*		*	*	*	*	*	*		*	*
		Materials and Manufacturing Technology	*	*		*	*	*	*	*			*	*
		Computer Aided Geometric Design	*	*	*	*	*	*	*	*	*	*	*	*
		Advance Machine Design	*	*	*	*	*				*			*
		Lab Practice-I	*	*								*		
		Lab Practice-II	*	*								*		
2	IInd	Theory Of Vibration	*	*		*		*	*	*				*
		Product Life Cycle Management	*	*	*	*	*	*	*	*	*		*	*
		Computer Applications In Design	*	*	*	*	*						*	*
		Simulation And Modeling Of Manufacturing Systems	*	*	*	*	*	*				*	*	*
		Quality And Reliability Engineering	*			*	*	*	*				*	
		Lab Practice-III	*	*				*			*	*		*
		Lab Practice-IV	*	*				*			*	*		*
		Elective- I (Mechatronics and Flexible Manufacturing)	*	*	*	*	*	*			*		*	*
		Elective I (Automation In Manufacturing)	*	*	*	*	*	*	*	*	*		*	*

3	**IIIrd**	Elective I (Product Data Management)	*			*	*	*	*	*	*		*	*
		Elective II (Industrial Robotics)	*	*		*	*	*	*	*	*	*	*	*
		Elective II (Product Analysis And Cost Optimization)	*			*		*	*	*		*		*
		Elective II (Composite Materials)	*	*			*	*	*	*	*		*	*
		Thesis phase-1	*	*			*	*			*			*
		Seminar	*				*			*	*	*		*
4	**IVth**	Dissertation Part- II	*	*			*	*			*	*		*

[L= Lecture, T = Tutorials, P = Practical's & C = Credits]

Total Credits*= 104

*Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

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Post Graduate Degree Courses in Engineering & Technology

Department of Mechanical Engineering

Master of Technology (Industrial Design)

Scheme of Examination

I Semester – Master of Technology – (Industrial Design)

S.No.	Subject Code	Subject Name	Periods per week			Credits	Maximum marks (Theory Slot)			Maximum Marks (Practical Slot)		Total Marks
			L	T	P		End Sem. Exam.	Tests (Two)	Assignments/ Quiz	End Sem. Practical / Viva	Practical Record/ assignment/Quiz/Presentation	
1.	MID 101	Advance Mathematics	3	1	-	4	70	20	10	-	-	100
2.	MID 102	Product Design and Development	3	1	-	4	70	20	10	-	-	100
3.	MID 103	Materials and Manufacturing Technology	3	1	-	4	70	20	10	-	-	100
4.	MID 104	Computer Aided Geometric Design	3	1	-	4	70	20	10	-	-	100
5.	MID 105	Advance Machine Design	3	1	-	4	70	20	10	-	-	100
6.	MID 106	Lab practice-I	-	-	6	6	-	-	-	90	60	150
7.	MID 107	Lab practice-II	-	-	6	6	-	-	-	90	60	150
		Total	15	5	12	32	350	100	50	180	120	800

L: Lecture- **T: Tutorial-** **P: Practical** ***w.e.f. July- 2014***

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Master of Technology (Industrial Design)

Scheme of Examination

II Semester – Master of Technology – (Industrial Design)

S.No.	Subject Code	Subject Name	Periods per week			Credits	Maximum marks (Theory Slot)			Maximum Marks (Practical Slot)		Total Marks
			L	T	P		End Sem. Exam.	Tests (Two)	Assignments/ Quiz	End Sem. Practical / Viva	Practical Record/ assignment/Quiz/Presentation	
1.	MID 201	Theory Of Vibration	3	1	-	4	70	20	10	-	-	100
2.	MID 202	Product Life Cycle Management	3	1	-	4	70	20	10	-	-	100
3.	MID203	Computer Applications In Design	3	1	-	4	70	20	10	-	-	100
4.	MID 204	Simulation And Modeling Of Manufacturing Systems	3	1	-	4	70	20	10	-	-	100
5.	MID 205	Quality And Reliability Engineering	3	1	-	4	70	20	10	-	-	100
6.	MID 206	Lab practice-III	-	-	6	6	-	-	-	90	60	150
7.	MID 207	Lab practice-IV	-	-	6	6	-	-	-	90	60	150
		Total	15	5	12	32	350	100	50	180	120	800

L: Lecture- **T: Tutorial-** **P: Practical** ***w.e.f. July- 2014***

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III Semester – Master of Technology – (Industrial Design)

S.No.	Subject Code	Subject Name	Periods per week			Credits	Maximum marks (Theory Slot)			Maximum Marks (Practical Slot)		Total Marks
			L	T	P		End Sem. *Exam*.	Tests (Two)	Assignments/ Quiz	End Sem. Practical / Viva	Practical Record/ assignment/Quiz/Presentation	
1.	MID- 301	Elective -I	3	1	-	4	70	20	10	-	-	100
2.	MID - 302	Elective -II	3	1	-	4	70	20	10	-	-	100
3.	MID- 303	Thesis phase-1			8	8				120	80	200
4.	MID- 304	Seminar			4	4				-	100	100
		Total	6	2	12	20	140	40	20	120	180	500

Elective –I

MID-301 (A) Mechatronics and Flexible Manufacturing
MID-301 (B) Automation In Manufacturing
MID-301 (C)Product Data Management

Elective –II

MID-302 (A) Industrial Robotics
MID-302 (B) Product Analysis And Cost Optimization
MID-302 (C) Composite Materials

L: Lecture- **T: Tutorial-** **P: Practical** *w.e.f.July 2015*

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IV Semester – Master of Technology – (Industrial Design)

S.No.	Sub Code	Subject Name	Periods per Week			Credits	Max Marks Theory			Max. Marks Practical		Total Marks
			L	T	P		End Sem Exam	Mid Sem	TW	End Sem Practical / Viva	Practical Record/ Quiz /Assignment / Presentation	
1	MID 401	Dissertation Part- II	-	-	20	20	-	-	-	300	200	500
TOTAL			-	-	20	20	-	-	-	300	200	500

L: Lecture- **T: Tutorial-** **P: Practical** *w.e.f.July 2015*

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M.TECH.-SEMESTER-I SYLLABUS

MID-101	Advance Mathematics	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

The course is intended to :

- Introduce the Separation Variable Method and Finite Difference Methods for the solution of partial differential equations.
- Introduce Iterative methods-Jacobins method, Gauss-Seidal method.
- Introduce Fuzzy Logic and MATLAB
- Introduce Reliability

Course Outcomes:
At the end of the course, the student should be able to :

- Apply the principles of Analytical Geometry and vector analysis to determine the equations of the straight lines and planes in Three Dimensional Space
- Apply the principles of Differential Calculus to solve a variety of practical problems in Engineering and Applied Science.
- Apply the principles of Partial Differentiation, Directional Derivatives.
- Apply the principles to solve fuzzy relation equations.
- To determine Failure rate, Hazard rate etc.

Unit 1 : Partial Differential Equation
Solution of Partial Differential Equation (PDE) by separation of variable method, Numerical solution of PDE (Laplace, Poisson‟s, Parabola) using finite difference Methods.

(9 Hours)

Unit 2 : Matrices And Linear System Of Equations
Solution of linear simultaneous equations by Gaussian elimination and its modification, Crout's **triangularization method, Iterative methods**-Jacobins method, Gauss-Seidal method, Determination of Eigen values by iteration.

(9 Hours)

Unit 5 : Calculus Of Variations
Euler-Lagrange's differential equation, The Brachistochrone problems and other applications. Isoperi-metric problem, Hamilton's Principle and Lagrange's Equation, Rayleigh-Ritz method, Galerkin method.

(9 Hours)

Unit 4 : Fuzzy Logic
Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relation equations, fuzzy logics. MATLAB introduction, programming in MATLAB scripts, functions and their application.

(9 Hours)

Unit 5 : Reliability

Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard rate, mean time t future & their relations, concepts of fault tolerant analysis.

(9 Hours)

Reference Books:

1. Higher Engineering Mathematics - by Dr. B.S. Grewal; Khanna Publishers
2. Calculus of Variations - by Elsgole; Addison Wesley.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Calculus of Variations - by Galfand & Fomin; Prentice Hall.
6. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
7. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
8. Numerical Solution of Differential Equation by M. K. Jain
9. Numerical Mathematical Analysis By James B. Scarborogh
10. Fuzzy Logic in Engineering by T. J. Ross
11. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

MID-102	Product Design And Development	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

- Design and development of innovative products is the key for manufacturing companies to achieve the long-term success and survive in intensively competitive global market.
- An integrated approach to management of product design and development is also required to create better quality products with enhanced capabilities, at attractive prices with compressed time to market cycles due to the intensified competition, rapidly changing technologies, especially computer-based technology and shorter product life cycles.
- This module is designed with focus on theory, technologies and practical applications in the product design, development and management over whole product lifecycle.

Course Outcomes:

A student passing this module should be able to:

- Identify and analyse the product design and development processes in manufacturing industry.
- Define the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle.
- Analyse, evaluate and apply the methodologies for product design, development and management.
- Undertake a methodical approach to the management of product development to satisfy customer needs.
- Carry out cost and benefit analysis through various cost models.
- Be familiar with the design protection and Intellectual Property.

UNIT 1 : Introduction

Significance of product design, product design and development process, sequential engineering design method, the challenges of product development, **Product Planning and Project Selection:** Identifying opportunities, evaluate and prioritize projects, allocation of resources.

(9 Hours)

UNIT 2 Identifying Customer Needs:

Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs. **Product Specifications:** Establish target specifications, setting final specifications,

(9 Hours)

UNIT 3 Concept Generation:

Activities of concept generation, clarifying problem, search both internally and externally, explore the output, **Industrial Design:** Assessing need for industrial design, industrial design process,management, assessing quality of industrial design,

(9 Hours)

UNIT 4 Concept Selection:

Overview, concept screening and concept scoring, methods of selection. **Theory of inventive problem solving (TRIZ):** Fundamentals, methods and techniques,General Theory of Innovation and TRIZ, Value engineering Applications in Product development and design, Model-based technology for generating innovative ideas.

(9 hours)

UNIT 5 Concept Testing:

Elements of testing: qualitative and quantitative methods including survey, measurement of customers" response, **Intellectual Property:** Elements and outline, patenting procedures., claim procedure, **Design for Environment:** Impact, regulations from government, ISO system.

(9 hours)

Reference Books:

1. Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill
2. Otto K, and Wood K, Product Design, Pearson
3. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
4. Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer.
5. Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, Alla Zusman, CRC Press.

MID-103	Materials And Manufacturing Technology	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

- To state the importance and need to Manufacturing processes
- To choose among various tool materials.
- To aware the students about various Manufacturing processes
- To give them practical exposure of various Manufacturing processes
- To tell them about applications of various Manufacturing processes.

Course Outcomes:

- By the end of the course the students shall be able to
- The Fundamentals of Engineering Materials
- The principle working and controlling parameters of metal forming processes and the principle working and controlling parameters of welding
- The principle working and controlling parameters of foundry and the process of mould making

UNIT 1

Scope and classification of Engineering Materials and Manufacturing Techniques:

Types, properties and uses of Metals and Alloys.

(9 Hours)

UNIT 2

Manufacturing processes for shaping:

casting, deforming, sheet metal forming, particulate processing, machining, and finishing and joining. , Advanced methods of manufacturing: Abrasive jet cutting, Ultrasonic machining, Laser beam machining, Electron beam and electrochemical machining.

(9 Hours)

UNIT 3

Super alloys:

Types, properties, uses and their processing techniques. Nickel-base, Cobalt- base and iron-base superalloys, remelting, Particulate processing, casting, machining, rolling, forging and welding of superalloys,**Polymers:** Classifications Plastics: Types, properties, uses and manufacturing processing techniques. Thermoplastics, Thermosets, and Elastomers.

(9 Hours)

UNIT 4

Composites:

Types, properties, uses and manufacturing processing techniques. Metal matrix composites, polymer matrix composites, ceramic matrix composites, FGM. **Glass:** Types, properties, uses and shaping processes, **Ceramics:** Types, properties, uses and shaping processes.

(9 Hours)

UNIT 5

Property enhancing and surface processing operations:

cleaning and surface treatments., Surface coating technology: Scope and classification of coating techniques. Electroplating (metal or composite coatings), Electroless plating (metal or composite coatings), Weld overlays (metal or ceramic coatings), Thermal spraying (metal, plastic, ceramic, or composite coatings), Cladding (thick metal coatings), Chemical vapor deposition (metals, graphite, diamond, diamond like carbon, and ceramics), Physical vapor deposition (metals, ceramics, or solid lubricants), Thermoreactive deposition/diffusion process (carbides, nitrides, or carbonitrides)., Recent development in materials and manufacturing technology.

(9 Hours)

Reference Books:

1. Groover, M.P., Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Student Edition, John Wiley and Sons, 2005.
2. Budinski, K. G., (1998), „Engineering Materials, Properties and Selection," Pub. Prentice-Hall of India, New Delhi, India.
3. Batchelor, A.W., Lam, L.N. and Chandrasekaran, M, "Materials Degradation and its Control by Surface Engineering," 2nd Edition, Imperial College Press, 2003.
4. Bunshah, R. F., "Handbook of Hard Coatings: Deposition Technologies, Properties and Applications," Noyes Pub. Park Ridge, New Jersey, U. S. A./William Andrew Publishing, LLC, Norwich, New York, U.S.A., 2001.
5. Sims, C. T., Stoloff, N. S., and Hagel, W.C., Superalloys II, John Wiley and Sons, 1987.
6. Callister W. D., Jr., Material Science and Engineering An Introduction, John Wiley & Sons, Inc., 6th Ed., 2003.
7. Patton, W.J., Plastic Technology, Theory, Design and Manufacture; Lenton Publishing Company.

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MID-104	**Computer-Aided Geometric Design**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

- To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design, Computer Aided Manufacturing and Computer Aided Engineering Analysis and to prepare them for taking up further research in the areas.
- To create congenial environment that promotes learning, growth and imparts ability to work with inter- disciplinary groups in professional, industry and research organizations.
- To broaden and deepen their capabilities in analytical and experimental research methods, analysis of data, and drawing relevant conclusions for scholarly writing and presentation.
- To provide guidance to students for their choices in research and professional career outlook and to encourage students to take up research.

Program Outcomes:

At the completion of the M.E. program in CAD/CAM Engineering, the student will be able to

- Apply/develop solutions or to do research in the areas of Design and simulation in Mechanical Engineering
- Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.
- Review and document the knowledge developed by scholarly predecessors and critically assess the relevant technological issues.
- Formulate relevant research problems; conduct experimental and/or analytical study and analyzing results with modern mathematical / scientific methods and use of software tools.
- Design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work.

UNIT 1 Introduction:

Design Methodology, Historical Development. Application of computers in Product Development and Design.

(9 Hours)

UNIT 2 Curve Modeling:

Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems, Hermite curve, four point form, Straight lines. Splines , Bezier curves, B-spline curves, Bezier and B-Spline curve fit. Rational Polynomials, Introduction to NURBS.

(9 Hours)

UNIT 3 Surface Modeling:

Sixteen point form, Algebraic and Geometric form, Tangent and Twist Vectors, Normal, Parametric space of a surface, Blending Functions, Four Curve Form, Plane surface, Cylindrical Surface, Ruled surface, Surfaces of Revolution. Introduction to Bezier Surface, B-Spline Surface and NURBS surface.

(9 Hours)

UNIT 4 Solid Modeling:

Introduction to solid Modeling: CSG and B-Rrep schemes.
Transformations: Translation, Rotation, Scaling Symmetry and Reflection, Homogeneous Transformation.

(9 Hours)

UNIT 5 Reverse Engineering:

Place of Reverse Engineering in Product Development. Data Acquisition Methods, Practical Problems in data acquisition, Preprocessing: Registration, Segmentation, Triangulation, Definition, Surface Fitting Methods- Bezier, B-spline & NURBS, CAD model creation.

(9 Hours)

Reference Books:

1. Mathematical Elements of Computer Graphics, Rogers and Adams, McGraw Hill. 1994
2. CAD CAM Theory and Practice: I. Zeid, Tata-McGraw Hill, 2006
3. Computer-Aided Design, R K Srivastava, Umesh Publications, Delhi, 2007, 3rd edition
4. Geometric Modeling: Michael E. Mortenson, John Wiley, 1992.
5. Computer-Aided Engineering Design, B Sahay and A Saxena, 2004.
6. Kathryn A. Ingle, "Reverse Engineering", McGraw-Hill, 2004.
7. Vinesh Raja, Kiran J. Fernades, "Reverse Engineering: An Industrial Perspective, Springer Verlag, 2006.

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MID-105	**Advance Machine Design**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

- To familiarize the various steps involved in the Design process
- To understand the principals involved in evaluating the shape and dimensions of a Complete to satisfy function and strength requirements.
- Students shall gain a thorough understanding of the different types of failure modes and Criteria. They will be conversant with various failure theories and be able to judge which Criterion is to be applied for a particular situation.
- Student shall gain design knowledge of the different types of elements used in the machine design process, for e.g. fasteners, shafts, couplings etc. and will be able to design these elements for each application.

Course Outcomes:

- Ability to analyze the stress and strain of mechanical components and understand,
- Identify and quantify failure modes for mechanical part.
- Ability to decide optimum design parameters for mechanical systems.
- Ability to design mechanical system for fluctuating loads.
- . Acquire skill in preparing production drawing pertaining to various designs.

Unit 1 Introduction to Advanced Mechanical Engineering Design, Review of materials & processes for machine elements, Case studies of mechanical engineering design failures, Review of static strength failure analysis, theories of failure including Von-Mises theory based strength design, Fatigue Strength Design of Mechanical Elements, Exercises of fatigue design of shafting and gears. Surface fatigue design failures. Exercises of surface fatigue design of rolling contact bearings including linear bearings.

(9 Hours)

Unit 2 Stiffness based design. Design for creep, combined creep and fatigue failure prevention, Tribo-design with applications to design of sliding bearings and mechanical seals, Selection of lubrication systems, Design for corrosion, wear, hydrogen-embrittlement, fretting, fatigue and other combined modes of mechanical failure.

(9 Hours)

Unit 3 Dynamically sound designs of machine elements like springs and shafts, Introduction to dynamic design of mechanical equipment and its implementation.

(9 Hours)

Unit 4 Gear and Gear Trains, Synthesis of tooth profile for circular spur gears, noncircular spur gears with constant distance, Generation of logarithmic function, Elliptical gears, equiangular spirals teeth of lion 'circular, Gear trains, Determination of gear train for a given velocity-ratio up to a desired degree of accuracy, Change speed gears, preferred numbers, three shaft, step change of speed, arrangement of change speed gear box.

(9 Hours)

Unit 5 Cams, Forces in rigid system, Mathematical models, analytical methods, position error, jump, shock, unbalance, spring, surge and winding, Synthesis of cams, High speed cam design, kloomoek and Muffley analytical function of cycloid, harmonic and eigntu power polynomial. Analytical cam design, Analytical ram design, Disc cam with radial flat faced follower, disc cam with radial roller follower and oscillating roller follower, Linkages, Number synthesis , type synthesis dimensional synthesis four bar linkage Freudenstein's Equation.

(9 Hours)

Reference Books:

1. Budynas Richard, Nisbett JK; Shigly's mechanical engineering design; TMH
2. Hall AS, Holowenko AR, Laughlin, Somani SK; Schaums outline Machine design; TMH
3. Spotts; Design of machine elements; Pearson Education
4. Juvinall; Fundamentals of machine component design; John Wiley
5. Sharma Purohit; design of machine elements; PHI
6. M.H.Magic, P.W.Oevirk, J.S. Beggs; Mechanism and dynamics of machinery
7. Baggs; Mechanisms -.
8. Dudley; Gears - Hand book
9. Rothbart; Cams -.
10. Ghosh and Malik; Mechanisms and Machines –

MID - 106	**Lab practice-I**	**L:0T: 6P**	**6credits**	**6Hrs/Week**

Preamble:

- To state the importance and need to Manufacturing processes
- To choose among various tool materials.
- To aware the students about various Manufacturing processes
- To give them practical exposure of various Manufacturing processes

Course Outcomes:

By the end of the course the students shall be able to

- The Fundamentals of Engineering Materials
- The principle working and controlling parameters of metal forming processes and the principle working and controlling parameters of welding

List of Experiments:

1. Metallographic studies – Study of Optical microscope, Optically flat surface preparation, etching reagents, Grain size- ASME no., micro structures, Image analysis, Standard specimen,
2. Carbon, sulphur, Phosphorus determination, Strauhlin's apparatus, Eggert's Method in different samples.
3. Hardness and Hardenability test, Jeremy Cony test. Soft and hard Martensite.
4. To study of tools used for various manufacturing processes, study includes application & live demonstration of hand and machine tools .
5. To study of the Pattern Making

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MID - 107	**Lab practice-II**	**L:0T: 6P**	**6credits**	**6Hrs/Week**

Preamble:

- Students shall gain a thorough understanding of the different types of failure modes and Criteria. They will be conversant with various failure theories and be able to judge which Criterion is to be applied for a particular situation.
- To create congenial environment that promotes learning, growth and imparts ability to work with inter-disciplinary groups in professional, industry and research organizations.

Course Outcomes:

- Ability to analyze the stress and strain of mechanical components and understand.
- Identify and quantify failure modes for mechanical part.
- Ability to decide optimum design parameters for mechanical systems.
- Apply/develop solutions or to do research in the areas of Design and simulation in Mechanical Engineering
- Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.

List of Experiments:

Designing and sketching of components contained in the syllabus.

1. To study design procedure of Knuckle Joint with detailed drawing
2. To study design procedure of cotter joint with detailed drawing
3. To study design procedure of helical and torsion spring with detailed drawings
4. To design a connecting rod
5. To design and sketch of flat belt and pulley

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M.TECH.-SEMESTER-II SYLLABUS

MID-201	Theory Of Vibration	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

- To state the importance theory of Vibrations
- To give them theory exposure of Elements of a Vibrating system
- To tell them about applications of Elements of a Vibrating system
- To make students learn the harmful effects of vibrations and techniques required to make system safe from its ill effects.

Course Outcomes

- The principle and working of Elements of a Vibrating system
- Formulation of Workable model of a Vibrating system
- Formulations and solution of equations of motion for various types of vibrating systems
- Methods to bring reduction in the levels of vibration in system to which they are harmful by learning to design vibration controlling Mechanical systems

Unit 1 Review of single degree freedom free, damped and forced vibration, isolation, Transmissibility; Two degree freedom System: Free vibrations, principal modes of vibration, various examples such as double pendulum, two rotor system torsional oscillations etc, Undamped forced vibrations with harmonic excitation, Principle of vibration absorbers, un-damped dynamic vibration absorber, tuning of vibration absorber, Torsional vibration absorber system.

(9 Hours)

Unit 2 Many degrees of freedom systems (Exact analysis): relation between discrete and continuous system, boundary value and Eigen value problems, Un-damped free vibrations. Influence numbers and Maxwell's reciprocal theorem, axial vibration of rods, bending vibration of bars, torsional vibrations of circular shaft and multi-rotor system, vibrations of geared systems, Vibrations of strings.

(9 Hours)

Unit 3 Finite element and Numerical Methods: Element stiffness matrix and equation of motion, reference system, assembly process, interpolation function, hierarchical FEM and inclusion principle, Rayleigh's method, Dunkerley's method, Stodola's method, Matrix iteration method,

(9 Hours)

Unit 4 Nonlinear Vibration: Various Examples. Perturbation method, forced vibrations with nonlinear spring forces, Jump phenomenon. Self Excited Vibrations: Elementary idea of stable and unstable oscillations, self excited vibrations caused by dry friction, various examples.

(9 Hours)

Unit 5 Random Vibration: introduction, ensemble and time averages, probability density function, autocorrelation function, Fourier transform, narrow band and wide band random process, continuous and multi-degree freedom system to random excitation.

(9 Hours)

Reference Books:

1. Grover GK; Mechanical Vibration;
2. Thomson WT; Theory of Vibration with applications; PHI
3. Ambekar; Mechanical vibrations and noise engineering; PHI
4. Dukkipati, sriniwas; Textbook of mechanical vibrations; PHI
5. Meirovitch; Leonard; Fundamentals of VIBRATION; TMH
6. Grahm Keiiy, Kudari Shashidhar K; Schaum outline Mecanical vibrations; TMH
7. Tongue Benson H; Principles of Vibration; Oxford University Press
8. Srinivas P; Mechanical Vibration Analysis

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MID 202	Product Life Cycle Management	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

The students shall be able to:

- Define the fundamentals of PLCM system.
- Choose a suitable strategy for the requirement.
- Understand the importance of concurrent engineering.
- Discuss the various components of PDM with related concepts.
- Learn the projects and roles.

Understand the change management.

Course Outcomes:

- After going through this course the student will be able to
- Explain product life cycle management concepts.
- Analyse schemes of concurrent engineering.
- Appraise product data management concepts.
- (Adapt PDM system architecture for a case study (L6)

UNIT 1 Product Life Cycle Management – Need for PLM, Components of PLM, Product Data and Product workflow, Drivers for Change, The PLM Strategy, Developing a PLM Strategy, A Five-step Process.

(9 Hours)

UNIT 2 Strategy Identification and Selection: Strategy Elements, Implications of Strategy Elements, Policies, Strategy Analysis, Communicating the Strategy.

(9 Hours)

UNIT 3 Change Management for PLM: Configuration management, cost of design changes, schemes for concurrent engineering, Design for manufacturing and assembly, robust design, failure mode and effect-analysis.

(9 Hours)

UNIT 4 Modeling, Current Concepts: part design, sketching, use of datum's construction features, free ovulation, pattering, copying, and modifying features, reference standards for datum specification, Standards for Engineering data exchange. Tolerance Mass Property Calculations: rapid prototyping and tooling, finite modeling and analysis, general procedure, analysis techniques,

(9 Hours)

UNIT 5

Finite Element Modeling: Applicability of FEM, Static analysis, thermal analysis, dynamic analysis.

(9 Hours)

Reference Books:

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

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MID-203	**Computer Applications In Design**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

This course aims to familiarize the students with basic concepts of computer programming and design tools and teach students how to design, write and Execute a Program in 'C'.

- To teach the behavior of basic Data types, CAD. CAM and CAE, Programming techniques.
- To understand and analyze a Problem and then try to solve the problem.
- To make students familiar with basic Computer Programming Components of CAD/CAM/CAE Systems

Course Outcomes:

- Design an algorithmic solution for a given problem
- Write a maintainable CAD. CAM program for a given
- Basic Concepts of Graphics Programming.
- Geometric Modeling Systems

UNIT 1 Introduction to CAD/CAM/CAE Systems: Overview, Definitions of CAD. CAM and CAE, Integrating the Design and Manufacturing Processes through a Common Database-A Scenario, Using CAD/CAM/CAE Systems for Product Development-A Practical Example. Components of CAD/CAM/CAE Systems: : Hardware Components, Vector-Refresh, Stroke-Refresh, Graphics Devices, Raster Graphics Devices, Hardware configuration, Software Components, Windows-Based CAD Systems.

(9 Hours)

UNIT 2 Basic Concepts of Graphics Programming: Graphics Libraries, Coordinate Systems, Window and View port, Output Primitives - Line, Polygon, Marker Text, Graphics Input, Display List, Transformation Matrix, Translation, Rotation, Mapping, Other Transformation Matrices, Hidden-Line and Hidden-Surface Removal, Back-Face Removal Algorithm, Depth-Sorting, or Painter's, Algorithm, Hidden- Line Removal Algorithm, z-Buffer Method, Rendering, Shading, Ray Tracing, Graphical User Interface, X Window System.

(9 Hours)

UNIT 3 Geometric Modeling Systems: Wireframe Modeling Systems, Surface Modeling Systems, Solid Modeling Systems, Modeling Functions, Data Structure, Euler Operators, Boolean Operations, Calculation of Volumetric Properties, Non-manifold Modeling Systems, Assembly Modeling Capabilities, Basic Functions of Assembly Modeling, Browsing an Assembly, Features of Concurrent Design, Use of Assembly models, Simplification of Assemblies, Web-Based Modeling.

(9 Hours)

UNIT 4 Representation and Manipulation of Curves: Types of Curve Equations, Hermite Curves, Bezier Curve, B-Spline Curve, Evaluation of a B-Spline Curve, Composition of B-Spline Curves, Differentiation of a

BSpline Curve, Non-uniform Rational B-Spline (NURBS) Curve, Evaluation of a NURBS Curve, Differentiation of a NURBS Curve, Interpolation Curves, Interpolation Using a Hermite Curve, Interpolation Using a B-Spline Curve, Intersection of Curves. Representation and Manipulation of Surfaces: Types of Surface Equations, Bilinear Surface, Coon's Patch, Bicubic Patch, Bezier Surface, Evaluation of a Bezier Surface, Differentiation of a Bezier Surface, B-Spline Surface, Evaluation of a-B-Spline Surface, Differentiation of a B-Spline Surface, NURBS Surface, Interpolation Surface, Intersection of Surfaces.

(9 Hours)

UNIT 5 CAD and CAM Integration: Overview of the Discrete Part Production Cycle, Process Planning, Manual; Variant; Generative Approach, Computer-Aided Process Planning Systems, CAM-I CAPP, MIPLAN and Multi CAPP, Met CAPP, ICEM-PART, Group Technology, Classification and Coding, Existing Coding Systems, Product Data Management (PDM) Systems.

(9 Hours)

Reference Books:

1. Principles of CAD/CAM/CAE systems – Kunwoo - Lee Addison Wesley -1999
2. CAD/CAM/CIM - Radhakrishnan P. et al. - New Age International - 2008
3. CAD/CAM – Theory & Practice - Ibrahim Zeid - McGraw Hill - 1998
4. Computer Integrated Design and Manufacturing - Bedworth, Mark Henderson & Philip Wolfe, McGraw hill inc. - 1991.
5. Part Modeling Users Guide - Pro-Engineer - 1998

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MID-204	**Simulation And Modeling Of Manufacturing Systems Design**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

Define the basics of simulation modeling and replicating the practical situations in organizations

- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods.
- Analysis of Simulation models using input analyzer, and output analyzer
- Explain Verification and Validation of simulation model.

Course Outcomes:
After the successful completion of the course, the students will be able to:

- Describe the role of important elements of discrete event simulation and modeling paradigm.
- Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.
- Develop skills to apply simulation software to construct and execute goal-driven system models.
- Interpret the model and apply the results to resolve critical issues in a real world environment.

UNIT 1 Principles of Computer Modeling and Simulation: Monte Carlo simulation. Nature of computer-modeling and simulation. Limitations of simulation, areas of applications.
System and Environment: Components of a system -discrete and continuous systems, Models of a system -a variety of modeling approaches.

(9 Hours)

UNIT 2 Discrete Event Simulation: Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem. Statistical Models in Simulation: Discrete distributions, continuous distributions.

(9 Hours)

UNIT 3 Random Number Generation: Techniques for generating random numbers. Mid square method the mod product method. Constant multiplier technique. Additive congruential method. Linear congruential method -Tests for random numbers -The Kolmogorov-Smirnov test -the Chi-square test.

(9 Hours)

UNIT 4 Random Variable Generation: Inversion transforms technique-exponential distribution. Uniform distribution, Weibul distribution, continuous distribution, generating approximate normal variates. Erlang distribution.

(9 Hours)

Empirical Discrete Distribution: Discrete uniform -distribution Poisson distribution –geometric distribution - acceptance -rejection technique for Poisson distribution gamma distribution.

(9 Hours)

UNIT 5 Design and Evaluation of Simulation Experiments: variance reduction techniques –antithetic variables, variables-verification and validation of simulation models. Simulation Software: Selection of simulation software, simulation package.

(9 Hours)

Reference Books:

1. Discrete Event System Simulation - Jerry Banks & .John S Carson II - Prentice Hall Inc.-1984.
2. Systems Simulation - Gordan. G - Prentice Hall India Ltd -1991.
3. system Simulation With Digital Computer - Nusing Deo - Prentice Hall of India -1979.16
4. Computer Simulation and Modeling - Francis Neelamkovil - John Wilely & Sons -1987.
5. Simulation Modeling with Pascal - Rath M.Davis & Robert M O Keefe - Prentice Hall Inc. -1989.

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MID-205	**Quality And Reliability Engineering**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

- To present a problem oriented in depth knowledge of Quality and Reliability Engineering.
- To address the underlying concepts, methods and application of Quality and Reliability Engineering.

Outcomes

- The student can identify different areas of Quality and Reliability Engineering.
- Can find the applications of all the areas in industry.
- Prediction and Analysis
- Failure Mode and Effect Analysis

UNIT 1 Basic Concepts: Definitions of quality and Reliability, Parameters and Characteristics, Quality control, statistical Quality Control, Reliability concepts. Concepts in Probability and Statistics: Events, Sample Space, Probability rules, Conditional probability, Dependent and Independent Events, Application of Probability concepts in Quality Control, Problems.

(9 Hours)

UNIT 2 Introduction to Probability Distributions: Normal, Poisson and Binomial distribution. Control Charts : Variable Chart – X Bar chart, R-chart and Sigma chart. Attribute Chart : P –Chart, nP Chart, C-Chart and U – Chart.

(9 Hours)

UNIT 3 Acceptance Sampling: Fundamentals of acceptance sampling, types of acceptance sampling, O.C Curve, AQL, LTPD, AOQL. Failure Data Analysis: Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, Problems, Introduction to Failure Mode and Effect Analysis.

(9 Hours)

UNIT 4 System Reliability: Series, parallel and mixed configuration, Block diagram concept, r- out-of-n structure solving problems using mathematical models. Reliability Improvement and Allocation : Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Optimization, Reliability-Cost trade off, Prediction and Analysis, Problems.

(9 Hours)

UNIT 5 Maintainability and Availability: Introduction, Formulas, Techniques available to improve maintainability and availability trade-off among reliability, maintainability and availability, Simple problems

(9 Hours)

Reference Books:

1. Quality Planning and Analysis - Tata McGraw - Juran, J.M and Gryna, F. M.-Hill publishing Company Ltd., New Delhi, India-1982.
2. Maintainability and Reliability Handbook of Reliability Engineering and Management - Editors – Ireson. W.G. and Cooms - C.F. McGraw-Hill Book Company Inc. -1988.
3. Concepts in Reliability Engineering- Srinath L S - Affiliated East-West Press Private Limited, New Delhi, India.-1

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MID - 206	**Lab practice-III**	**L:0T: 6P**	**6credits**	**6Hrs/Week**

Preamble:

- To state the importance theory of Vibrations
- To give them theory exposure of Elements of a Vibrating system
- Define the fundamentals of PLCM system.
- Choose a suitable strategy for the requirement.

Course Outcomes

- The principle and working of Elements of a Vibrating system
- Formulation of Workable model of a Vibrating system.
- After going through this course the student will be able to explain product life cycle management concepts.

List of Experiments:

1. To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account .
2. To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.
3. To find out natural frequency and damped free frequency of a torsion pendulum and , hence to find out coefficient of damping of the oil ;
4. INTRODUCTION to CAD
5. AutoCAD – BASICS Starting with AutoCAD 2.2 Layout and sketching , Drawing environment , Elements of drawing

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MID - 207	**Lab practice-IV**	**L:0T: 6P**	**6credits**	**6Hrs/Week**

Preamble:

- Define the basics of simulation modeling and replicating the practical situations in organizations
- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods
- To address the underlying concepts, methods and application of Quality and Reliability Engineering.

Course Outcomes:

After the successful completion of the course, the students will be able to:

- Describe the role of important elements of discrete event simulation and modeling paradigm.
- Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.
- The student can identify different areas of Quality and Reliability Engineering.
- Can find the applications of all the areas in industry.

List of Experiments:

1. Computer Generation of Random Numbers
2. Chi-square goodness-of-fit test.
3. One-sample Kolmogorov-Smirnov test
4. Test for Standard Normal Distribution
5. Testing Random Number Generators.
6. Monte-Carlo Simulation.
7. Simulation of Single Server Queuing System.

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M.TECH.-SEMESTER-III SYLLABUS

MID 301(A)	**Mechatronics and Flexible Manufacturing**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

- Design a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers
- Determine the performance of a Mechatronics system
- Understand MEMS fabrication techniques

OUTCOMES:
At the end of the course, the student shall be able to:

- Generate conceptual design for Mechatronics products based on potential customer requirements
- Select appropriate sensors and transducers and devise an instrumentation system for collecting information about processes

Unit 1 Defining mechatronics: its characteristics, scope and key issues, advantages and development of CNC horizontal and vertical machining centers, tool monitoring on CNC machines, differentiation between FMC, FMS and CIM, benefits of FMS and suitability to batch production.

(9 Hours)

Unit 2 Design of CNC machines: structure, guide-ways, feed drives, and spindle bearings, measurement and control systems, software and user interfaces, gauging and tool monitoring systems, assembly techniques for guide-ways, ball-screw and nut, spindle bearings, feedback elements and hydraulics.

(9 Hours)

Unit 3 Review of electrical and electronic devices : Drives, spindle and feed drives, servo principle, drive protection and optimization, selection criteria for drives, power supply, electrical cabinets and air cooling, electrical standards.

(9 Hours)

Unit 4

CNC systems, configuration of CNC systems, interfacing, monitoring and diagnostics, compensation for machine accuracies, machine data, Programmable Logic Controllers (PLC), Direct Numerical Control (DNC); testing of CNC machine tools, verification of technical specifications and functional aspects, Idle running tests, machine tool and work-piece accuracies, metal removal capability and safety aspects.

(9 Hours)

Unit 5 Programming and operations of CNC machines: part programming, coordinate system, dimensioning, axes and motion nomenclature, structure of part programs, G02/ G03 circular interpolation, tool compensation, subroutines/ macro, canned cycles (G81/ G89), mirror imaging,parametric programming and R-parameters, constant speed and constant cutting speed (G97/ G96), machining cycles, examples of machine center programming, case studies.

(9 Hours)

Reference Books:

1. HMT edited; Mechatronics; TMH.
2. Kuttan Appu KK; Introduction to Mechatronics; Oxford press
3. Mahalik NP; Mechatronics principles, concepts and applications; TMH
4. Smaili A and Mrad F; MechatronicsIntegrated Technology; Oxford Press

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MID -301(B)	Automation In Manufacturing	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

- Justification of automation
- Knowledge about various components of automation like sensors, actuators, PLC
- Understanding transfer lines and advanced industrial automation

Course Outcome :

Understand the concept and types of automation

- Assessment of degree and level of automation
- Justification of automation
- Knowledge about various components of automation like sensors, actuators, PLC
- Understanding transfer lines and advanced industrial automation

UNIT-I Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, , Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

(9 Hours)

UNIT-II Introduction to Material Handling: Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

(9 Hours)

UNIT –III Manual Assembly Lines : Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

(9 Hours)

UNIT-IVTransfer lines : Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

(9 Hours)

UNIT-V Automated Assembly Systems : Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines , Partial Automation.

(9 Hours)

Reference Books:

1. CAD CAM : Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie . Browne / Pearson edu. (LPE)
2. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

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MID -301(c)	Product Data Management	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

- Familiarize the current principles, practices, and applications of Product Lifecycle Management (PLM).
- Aware that the sustainable design of product and process and the early consideration of the constraints and factors become more important to successfully develop competitive products
- Learn integrated, information driven approach to all aspects of a product's life from its design inception, through its manufacture, deployment and maintenance, and culminating in its removal from service and final disposal
- Aware that PLM technology is playing a critical role in most of the modern industries including aerospace, automobile, medical, etc.

Course Outcome: -

Remember the reasons for adopting PLM strategies and methods –

- Identify PLM's impacts on corporate strategy, structure and operations
- Distinguish product development processes
- Distinguish associated engineering information with the product development process
- Construct and manage product data using PLM/PDM technologies.
- Construct managed product data during the PD process - Defend information technology for supporting product development process

UNIT 1 Centralized Systems: Client Server Systems, Parallel Systems, Distributed Systems, NetworkTypes, Parallel Database, Distributed Database, Security and Integrity, Standardization views **Product Data Management** : Product life cycle, Complexity in Product Development, General Description of PDM

(9 Hours)

UNIT 2 Basic functionality of PDM: Information architecture, PDM System architecture, Applications used in PDM systems. Trends in PDM

(9 Hours)

UNIT 3 Document Management Systems: Document management and PDM, Document life cycle, Content Management, Document management and related technologies, Document management resources on the Internet.

(9 Hours)

UNIT 4 Workflow Management in PDM: Structure Management, Engineering ChangeManagement, Release Management, Version Management, Configuration Management **Creating Product Structures:** Part centric approach, CAD centric approach, Product Structure configuration, Managing Product Structures PDM Tools: Matrix One, TeamCenter, Windchill.Enovia, PDM resources on the Internet.

(9 Hours)

UNIT 5 PDM Implementation Case Studies: Sun Microsystems, Inc., Mentor Graphics Corporation, Ericsson Radio Systems AB, Ericsson Mobile Communications AB, ABB Automation Technology Products, SaabTech Electronics AB

(9 Hours)

Reference Books:

1. Implementing and Integrating Product Data Management and Software
2. Configuration Management - 21 - Ivica Cmkovic Ulf Asklund - Annita Persson Dahlqvist - Archtech House Publishers.
3. Product Data Management - Rodger Burden - Publisher: Resource Publishing ISBN-10: 0970035225, ISBN-13: 978-0970035226 – 2003.
4. The AutoCAD Database Book – Accessing and Managing CAD Drawing Information - Galgotia Publications - Third Edition.

MID -302(A)	Industrial Robotics	3L:1T:0P	4 credits	4Hrs/Week

Preamble::

Graduates shall be able to

- Understand the structure and configuration of Industrial robots.
- Analyze the kinematic and dynamic related analysis of industrial robots.
- Demonstrate the basic structure of trajectory interpolator
- Describe the configuration of various types of autonomous robots

Course Outcomes:

- After going through this course the student will be able to:
- Analyze the manipulator design including actuator, drive and sensor issues
- Calculate the forward kinematics, inverse kinematics and Jacobian industrial robots Solve trajectory and dynamic related robotic problems
- Evaluate the different configurations and stability of autonomous robots

UNIT: I Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. Control System and Components: basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

(9 Hours)

UNIT: II Motion Analysis and Control: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller,

(9 Hours)

UNIT: III End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics. MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

(9 Hours)

UNIT: IV ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAlT, SINONAL AND DELAY commands, Branching capabilities and Limitations. ROBOT LANGUAGES: Textual robot Janguages, Generation, Robot language structures, Elements in function.

(9 Hours)

UNIT: V ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work eel 1 controller. ROBOT APPLiCATION: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

(9 Hours)

Reference Books:

1. Industrial robotics, Mikell P.Groover/McGraw Hill.
2. Robotics, K.S.Fu / McGraw Hill.

MID 302 (B)	Product Analysis And Cost Optimization	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

- To understand the role of Operations in overall Business Strategy of the firm.
- To understand the application of operations management policies and techniques to the service sector as well as manufacturing firms.
- To identify and evaluate the key factors and their interdependence of these factors in the design of effective operating systems.
- To understand the trends and challenges of Operations Management in the current business environment.
- To familiarize the students with the techniques for effective utilization of operational resources and managing the processes to produce good quality products and services at competitive prices.

Course Outcomes:

- Understand the role of Operations in overall Business Strategy of the firm - the application of OM policies and techniques to the service sector as well as manufacturing firms.
- Understand and apply the concepts of Material Management, Supply Chain Management and TQM perspectives.
- Identify and evaluate the key factors and their interdependence of these factors in the design of effective operating systems.
- Analyze / understand the trends and challenges of Operations Management in the current business environment.

UNIT 1 Introduction: New products, new product strategy -market definition Idea generation introduction to the design process -forecasting sales potential -product engineering and marketsmonopoly competitive.

(9 Hours)

UNIT 2 Manufacturing Planning: Selection of optimum process, standardization. Break even analysis application and area of use -problems -multi - product analysis.

(9 Hours)

UNIT 3 Value Analysis: Steps in selection, analysis and implementation, Selection of cutting speed for optimum cost -problems. **Cost Accounting:** Cost estimation -difference -types -steps involved in cost estimation. **Types of Cost:** Cost Centres, Direct –indirect, material cost -direct indirect material cost Overhead cost, Elements in overheads: Preparation of cost sheet, machine hour rate, apportioning methods.

(9 Hours)

UNIT 4 Variance Analysis : Labour variance, Material variance and Overhead variance, Activity based costing - Introduction to target costing. **Cost Calculation:** Cost calculation for machined components, welding, casting and forged components illustrations -calculation of sales cost.

(9 Hours)

UNIT 5 Cost Optimization Techniques: Analytical, Graphical and incremental methods Learning curves. **(9 Hours)**

Reference Books:

1. Design and Marketing of New Products - Glen L Urban - John R Hauser- Prentice Hall. New Jersey, 1980.
2. Production and Costing - Narang CBS & Kumar V - Khanna Publishers- 2001.
3. Cost management in the New Manufacturing Age -Yasuhiro Monden, ProductivityPress-1992.
4. Technique for Value Analysis And Engineering - Miles Lewrence.D - McGraw Hill, New york-1972.

MID – 302 (C)	Composite Materials	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

- Ability to solve mechanics of composite materials problems using classical methods Assignments: Weekly problem sets are assigned.
- Ability to do research and present on an advanced material topic Assignment: Students submit a research paper and present it in class.

Course Outcomes:

Some understanding of types, manufacturing processes, and applications of composite materials

- Ability to analyze problems on macro mechanical behavior of lamina
- Ability to analyze problems on micro mechanical behavior of lamina
-

UNIT –I Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

(9 Hours)

UNIT – II Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

(9 Hours)

UNIT – III Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

(9 Hours)

UNIT –IV Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

(9 Hours)

UNIT – V Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

(9 Hours)

Reference Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
3. Hand Book of Composite Materials-ed-Lubin
4. Composite Materials – K.K.Chawla
5. Composite Materials Science and Applications – Deborah D.L. Chung