D.K.T.E. Society's
Textile and Engineering Institute,
Rajwada, Ichalkaranji- 416115

(An Empowered Autonomous Institute Affiliated to Shivaji University, Kolhapur)

NAAC Accredited with A+ Grade, ISO 9001:2015 Certified

DEPARTMENT: <MECHANICAL ENGINEERING>
CURRICULUM

First Year M.Tech. Mechanical Engineering (Product Design & Development) Program

With effect from 2024-25

BOS Chairman **Dean Academics** **Director**

D.K.T.E Society's Textile and Engineering Institute, Ichalkaranji

(An Empowered Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Teaching and Evaluation Scheme for Year 2024-25

Program: M. Tech. Mechanical Engineering (Product Design and Development)

Class.: First Year, B. Tech. Semester: SEM-I NCrF Level : 7.0 W.E.F.: 2024-2025

Sr. No.	Course Code	Course Title	Course Category	Teaching Scheme				Course Credits	Evaluation scheme					
									Theory			Practical		Total
									CIE		SEE	CIE	SEE	
				L	T	P	Contact Hrs/wk		SE-I	SE-II				
01	01MEL501	Applied Machine Design	D	3	-	-	3	3	25	25	50	-	-	100
02	01MEL502	Computer Aided Design and Simulation	D	3	-	-	3	3	25	25	50	-	-	100
03	01MEL503	Design of Experiments & Research Methodology	B	3	-	-	3	3	25	25	50	-	-	100
04	01MELEL1	Elective-I:	D	3	-	-	3	3	25	25	50	-	-	100
05	01MELEL2	Elective-II:	D	3	-	-	3	3	25	25	50	-	-	100
06	01MEP510	Applied Machine Design	D	-	-	2	2	1	-	-	-	50	50	100
07	01MEP511	Computer Aided Design and Simulation	D	-	-	2	2	1	-	-	-	50	50	100
08	01MEP512	Design of Experiments & Research Methodology	B	-	-	2**	1	1	-	-	-	50	-	50
09	01MEPEL1	Elective-I:	D	-	-	2**	1	1	-	-	-	50	-	50
10	01MEPEL2	Elective-II:	D	-	-	2	2	1	-	-	-	50	-	50
Total				**15**	**-**	**8**	**23**	**20**	**125**	**125**	**250**	**250**	**100**	**850**

** Practical for Alternate Week

L- Lecture T-Tutorial P-Practical SE-I: Semester Examination-I SE-II: Semester Examination-II CIE – Continuous in Semester Evaluation SEE- Semester End Examination

	BSC/ESC		Program Courses		Multidisciplinary Courses		Skill Courses	Humanities Social Science and Management (HSSM)				Experiential Learning Courses				Liberal Learning Courses
Course Category	**BSC**	**ESC**	**PCC**	**PEC**	**MDM**	**OE**	**VSEC**	**AEC**	**Entrp / Mgmt**	**IKS**	**VEC**	**RM**	**CEP/ FP**	**Proj**	**Int/ OJT**	**CC**
Credits	--	4	16	--	--	--	--	--	--	--	--	--	--	--	--	--
Cum. Sum	--	4	16	--	--	--	--	--	--	--	--	--	--	--	--	--

D.K.T.E Society's Textile and Engineering Institute, Ichalkaranji

(An Empowered Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Teaching and Evaluation Scheme for Year 2024-25

Program: M. Tech. Mechanical Engineering (Product Design and Development)

Class.: First Year, B. Tech. Semester: SEM-II NCrF Level : 7.0 W.E.F.: 2024-2025

Sr. No.	Course Code	Course Title	Course Category	Teaching scheme				Course Credits	Evaluation scheme					
									Theory			Practical		Total
									CIE		SEE	CIE	SEE	
				L	T	P	Contact Hrs/ wk		SE-I	SE-II				
01	01MEL520	Manufacturing System Design	D	3	-	-	3	3	25	25	50	-	-	100
02	01MEL521	Creativity, Innovation & New Product Development	D	3	-	-	3	3	25	25	50	-	-	100
03	01MEL522	Product Life Cycle Management	D	3	-	-	3	3	25	25	50	-	-	100
04	01MELEL3	Elective-III:	D	3	-	-	3	3	25	25	50	-	-	100
05	01MELEL4	Elective-IV:	D	3	-	-	3	3	25	25	50	-	-	100
06	01MEP529	Manufacturing System Design	D	-	-	2	2	1	-	-	-	50	50	100
07	01MEP530	Creativity, Innovation & New Product Development	D	-	-	2**	1	1	-	-	-	50	-	50
08	01MEP531	Product Life Cycle Management	D	-	-	2**	1	1	-	-	-	50	-	50
09	01MEPEL3	Elective-III:	D	-	-	2	2	1	-	-	-	50	50	100
10	01MEPEL4	Elective-IV:	D	-	-	2	2	1	-	-	-	50	-	50
Total				**15**	**0**	**8**	**23**	**20**	**125**	**125**	**250**	**250**	**100**	**850**

** Practical for Alternate Week

L- Lecture T-Tutorial P-Practical SE-I: Semester Examination-I SE-II: Semester Examination-II

CIE – Continuous in Semester Evaluation SEE- Semester End Examination

	BSC/ESC		Program Courses		Multidisciplinary Courses		Skill Courses	Humanities Social Science and Management (HSSM)				Experiential Learning Courses				Liberal Learning Courses
Course Category	**BSC**	**ESC**	**PCC**	**PEC**	**MDM**	**OE**	**VSEC**	**AEC**	**Entrp / Mgmt**	**IKS**	**VEC**	**RM**	**CEP/ FP**	**Proj**	**Int/ OJT**	**CC**
Credits	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--
Cum. Sum	--	4	36	--	--	--	--	--	--	--	--	--	--	--	--	--

D.K.T.E Society's Textile and Engineering Institute, Ichalkaranji

(An Empowered Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Teaching and Evaluation Scheme for Year 2025-26

Program: M. Tech. Mechanical Engineering (Product Design and Development)

Class.: First Year, B. Tech. Semester: SEM-III NCrF Level : 7.5 W.E.F.: 2025-2026

Sr. No.	Course Code	Course Title	Course Category	Teaching scheme				Course Credits	Evaluation scheme					
				L	T	P	Contact Hrs/ wk		Theory			Practical		Total
									CIE		SEE	CIE	SEE	
									SE-I	SE-II				
01	01MED601	Dissertation Phase-I	F	-	-	16	16	16	-	-	-	50	50	100
02	01MED602	Mini Project/ Industrial Trg*	F	-	-	2	2	2	-	-	-	50	-	50
03	01MED603	Seminar	F	-	-	2	2	2	-	-	-	50	-	50
Total				**0**	**0**	**20**	**20**	**20**	**0**	**0**	**0**	**150**	**50**	**200**

* Should be completed at the end of Sem.II and evaluation is to be carried out at the end of Sem.III based on training report.

L- Lecture T-Tutorial P-Practical SE-I: Semester Examination-I SE-II: Semester Examination-II

CIE – Continuous in Semester Evaluation SEE- Semester End Examination

	BSC/ESC		Program Courses		Multidisciplinary Courses		Skill Courses	Humanities Social Science and Management (HSSM)			Experiential Learning Courses					Liberal Learning Courses
Course Category	BSC	ESC	PCC	PEC	MDM	OE	VSEC	AEC	Entrp / Mgmt	IKS	VEC	RM	CEP/ FP	Proj	Int/ OJT	CC
Credits	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--
Cum. Sum	--	4	36	--	--	--	--	--	--	--	--	--	--	20	--	--

Teaching and Evaluation Scheme for Year 2025-26

Program: M. Tech. Mechanical Engineering (Product Design and Development)

Class.: First Year, B. Tech. Semester: SEM-IV NCrF Level : 7.5 W.E.F.: 2025-2026

Sr. No.	Course Code	Course Title	Course Category	Teaching scheme				Course Credits	Evaluation scheme					
				L	T	P	Contact Hrs/ wk		Theory			Practical		Total
									CIE		SEE	CIE	SEE	
									SE-I	SE-II				
01	01MED604	Dissertation Phase-II	F	-	-	20	20	20	-	-	-	50	50	100
Total				-	-	20	20	20	-	-	-	50	50	100

L- Lecture T-Tutorial P-Practical SE-I: Semester Examination-I SE-II: Semester Examination-II

CIE – Continuous in Semester Evaluation SEE- Semester End Examination

	BSC/ESC		Program Courses		Multidisciplinary Courses		Skill Courses	Humanities Social Science and Management (HSSM)				Experiential Learning Courses				Liberal Learning Courses
Course Category	BSC	ESC	PCC	PEC	MDM	OE	VSEC	AEC	Entrp / Mgmt	IKS	VEC	RM	CEP/ FP	Proj	Int/ OJT	CC
Credits	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--
Cum. Sum	--	4	36	--	--	--	--	--	--	--	--	--	--	40	--	--

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)								
Course Code		**01MEL501**		**Course Name**	**Applied Machine Design**			
Teaching Scheme					**Evaluation Scheme**			
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks	
3	-	-	3		25	25	50	

Course Objectives:

01	To understand design process.
02	To study design methods.
03	To understand relationship of processing and design.
04	Study of stress-strain relationship in elastic bodies.

Course Outcomes:

On completion of the course, student will be able to –

01	Have understanding of process of design.
02	Recognize the use of design methods for new product design.
03	Be able to select material after studying the requirements of the product.
04	Be able to identify and formulate the class of elasticity problems and apply the analytical techniques for solution of these problems.

Course Contents

Unit I	**< Design Process >**	**8 Hours**

The design process - Morphology of Design - Design drawings -Computer Aided Engineering - Designing of standards - Concurrent Engineering - Product life cycle - Technological Forecasting - Market Identification - Competition Bench marking - Systems Engineering - Life Cycle Engineering - Human Factors in Design - Industrial Design..

Unit II	**< Design Methods >**	**8 Hours**

Creativity and Problem Solving - Product Design Specifications - Conceptual design - Decision theory - Embodiment Design - Detail Design -Mathematical Modeling - Simulation - Geometric Modeling - Finite Element Modeling - Optimization - Search Methods - Geometric Programming - Structural and Shape Optimization..

Unit III	**< Introduction to Solid Mechanics >**	**6 Hours**

Stress, Strain in 2-d and 3-d, relation between stress and strain, theories of failure.

Unit IV	**< Material Selection Processing And Design >**	**8 Hours**

Material selection Process - Economics - Cost Vs Performance - Weighted property Index - Value Analysis - Role of Processing and Design - Classification of Manufacturing Process - Design for Manufacture - Design for Assembly - Design for castings, Forging, Metal Forming, Machining and Welding - Residual stresses - Fatigue, Fracture and Failure.

Unit V	**< Engineering Statistics And Reliability >**	**5 Hours**

Probability - Distributions -Test of Hypothesis - Design of Experiments - Reliability Theory - Design of Reliability - Reliability centered Maintenance.

Unit VI	**< Quality Engineering >**	**4 Hours**

Probability - Distributions -Test of Hypothesis - Design of Experiments - Reliability Theory - Design of Reliability - Reliability centered Maintenance.

Texts Books:	
1	Dieter George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Edition Mechanical Engg. Series ,1991.
2	Karl t. Ulrich and Steven d Eppinger "Product Design and Development", McGraw-Hill, Edition 2000.
3	Palh .G. and Beitz .W. "Engineering Design ", Springer - Verlag NY. 1985.
Reference Books:	
1	Ray .M.S., "Elements of Engg. Design ", Prentice Hall Inc. 1985.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)							
Course Code	**01MEL502**	**Course Name**	**Computer Aided Design And Simulation**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	To develop an ability to Create 2-D drawings
02	Create assembly of simple machine components
03	Introduce students to Finite Element Analysis fundamentals and formulate the design problems into FEA.
04	To provide the student with some knowledge and analysis skills to interpret and draw conclusion the results of computer analysis.

Course Outcomes:	
On completion of the course, student will be able to –	
01	Design a part or assembly of parts using Computer-Aided Design software
02	Use parametric modelling techniques to reflect engineering requirements.
03	Use professional-level finite element software to solve engineering problems
04	To develop the student's skills in modelling, meshing, and setting up material properties, loads, and constraints for computer simulation and solve the problem using software tools.

Course Contents

Unit I	**< Introduction & Design Considerations >**	**8 Hours**

Nature and scope of product engineering - creative thinking and organizing for product innovation criteria for product success in life cycle of a product, role of models in product design, Material selection - problems of material selection- performance characteristics of materials - the materials selection process-economics of materials-cost versus performance relations.

Functional and production design-form design-influence of basic design, pressure die castings, plastic mouldings, welded fabrications, forging and manufacture by machining methods. Influence of space, size, weight, etc., on form design, aesthetic and ergonomic considerations.

Unit II	**< Tolerance And Analysis: Dimensioning and tolerancing a product-functional >**	**6 Hours**

Production and inspection datum-tolerance analysis.

Unit III	**< Introduction To Computer Graphics Fundamentals & Solid Modeling>**	**8 Hours**

Output primitives (points, lines, curves Etc.), 2-D transformation (Translation, scaling, rotators) windowing, view ports clipping transformation. Visual Realism: Hidden - Line – Surface - solid removal algorithms shading - coloring. Introduction to parametric and variational- geometry based on software's and their principles creation of prismatic and lofted parts using these packages.

Solid Modeling: Introduction to solid modeling concepts, sketching and constraining the geometry generating primitive shapes by using part modeling workbench, creation of surfaces-types and applications of various types of surfaces, Assembly of parts , tolerance analysis mass property calculations.

Unit IV	**< Finite Element Analysis & 2D Problem>**	**8 Hours**

Historical background - Weighted residual methods -Basic concept of FEM - Variational formulation of B.V.P. - Ritz method - Finite element modeling - Element Equation - Linear and quadratic shape functions - Bar, Beam and Elements - Application to heat transfer.

Basic boundary value problems in 2 Dimensions - Triangular, quadrilateral, higher order elements - Poisons and Laplace's Equation - Weak formulation - Element Matrices and vectors - Application to solid mechanics, Heat transfer, Fluid Mechanics.		
Unit V	**< ISO-Parametric Formulation >**	**4 Hours**
Natural Coordinate Systems – Lagrangian Interpolation Polynomials – Isoparametric, Elements - Formulation - Numerical Integration ID - IID Triangular elements - Rectangular elements - Illustrative Examples.		
Unit VI	**< Simulation >**	**5 Hours**
System and System Environment: Components of a system, Continuous and discrete systems, Models of a system, Modeling. Random Number Generation: Methods and Tests for random number generation, Random Variable Generation, Simulation of Systems: Simulation of continuous system, Simulation of discrete system, Simulation of event occurrences using random numbers. Simulation of component failures, using Exponential and waybill models. Input modeling and output analysis, Simulation Applications: Single server queue problems and multi-server queue problems, Inventory system, Network problem, Shop Floor problems in a manufacturing environment.		

Texts Books:	
1	Ibrahim Zeid "CAD/CAM Theory and Practice" McGraw Hill, International Edition, 1998.
2	Mikell .P. Grooves and Emory .W. Zimmers Jr. "CAD/CAM Computer - Aided Design and Manufacturing", Prentice Hall, Inc., 1995.
3	Narsingh Deo., System simulation with Digital Computer, Prentice Hall of India, 1979
Reference Books:	
1	William .M. Neumann and Robert .F. Sproul "Principle of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
2	Donald Hearn and .M. Pauline Baker "Computer Graphics", Prentice HallInc., 1992.
3	Jones J.C., "Design Methods", Interscience, 1970.
4	Buhl, H.R., "Creative Engineering Design", Iowa State University Press, 1960.
5	Robert Matouseek, "Engineering Design", Blackie & Sons Ltd., 1963.
6	Niebel, B.W. & Draper, A.B., "Product Design and Process Engineering, McGraw Hill, 1974.
7	Harry Peck, "Designing for Manufacturing", Sir Issac Pitman and Sons Ltd., 1973.
8	Gladman, C.A., "Manual for Geometric Analysis of Engineering Designs", Australian Trade
9	Wade, Or, "Tolerance Control in Design and Manufacture", Industrial Press, Inc. Banks J., Carson. J.S., and Nelson B.L., Discrete Event System Simulation, PHI, New Delhi, 1996.
10	Gottfried B.S., Elements of Stochastic Process Simulation, Prentice Hall, London, 1984.
11	Geoffrey Gordon., System Simulation, Prentice Hall of India, 1984.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)							
Course Code	**01MEL503**	**Course Name**	**Design Of Experiments And Research Methodology**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	To understand the basics of research.
02	To acquire knowledge of research design.
03	To acquire knowledge of research modelling.
04	To study and use the experimentation and factorial design.
05	To study and interpret the analysis in research.

Course Outcomes:	
On completion of the course, student will be able to –	
01	Familiarize with research and types of research.
02	Know various steps in the research methodology.
03	Understand research modelling and simulation
04	Know various methods of experimentation and process optimization.
05	Use various analysis techniques and prepare report of the research work.

Course Contents		
Unit I	**< Introduction >**	**6 Hours**
Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals - Types, contents, sponsoring agent's requirements, Ethical, Training, Cooperation and Legal aspects, Research problem selection, Necessity of defining the problem		
Unit II	**< Research Design >**	**7 Hours**
Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process - Selection of type of research, Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research.		
Unit III	**< Research Modelling: (a) Mathematical >**	**7 Hours**
Classification of Models, Development of Models, Stages in Model building, Principles of Modelling, Use of Analogy, Models as Approximations, Data consideration and Testing of Models (b) Heuristics and Simulation - Definition, Applications and reasons for using Heuristics, Heuristic Methods and approaches, Meta-Heuristics; Simulation - Meaning, Applications and Classification of Simulation Models, Process of Simulation, Steps and Features of Simulation Experiments and their Validation.		
Unit IV	**< Experimentation >**	**7 Hours**
Objective, Strategies, Factorial Experimental Design, Applications of Experimental Design, Basic Principles - Replication, Randomization and Blocking, Guidelines for designing experiments; Laboratory Experiments, Methods of manipulating Variables, Errors in Experiments, Steps in Design of Experiments, Basis.		
Unit V	**< Process Optimization: Factorial Design principles >**	**5 Hours**
Two factor Factorial Design, General Factorial Design, Fitting response Curves and Surfaces, Blocking, Taguchi Approach to Parameter Design, Robust Design, G.R.A.		
Unit VI	**< Analysis and Report Writing>**	**7 Hours**
Analysis of Variance and Co-variance, Hypothesis Testing - Parametric and Non-Parametric Tests, Uni-variate and Bi-variate analysis		

Pre-writing Considerations, Principles of Thesis Writing, Formats of Report Writing & Publication in Research Journals, Oral Presentations (Briefing)	
Texts Books:	
1	Krishnaswamy, K.N., Sivakumar, Appa Iyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2	Montgomery, Douglas C. (2004) - Design & Analysis of Experiments, 5/e. (New York, John Wiley & Sons)
3	Kothari, C.K. (2004) - Research Methodology, Methods & Techniques, 2/e. (New Delhi, New Age International Ltd. Publishers)
Reference Books:	
1	Ross, Phillip J. (1996) - Taguchi Techniques for Quality Engineering, 2/e. (New York, McGraw Hill)
2	Rao S. S. (2004) - Engineering Optimization Theory & Practices, 3/e (New Delhi, New Age International Ltd., Publishers)
3	Handbook of Industrial Automation - Richard L. Shell & Ernest L. Hall (Marcel Decker Inc.)
4	Trochim, William M.K. (2003), - Research Methods 2/e, (New Delhi, Biztantra, Dreamtech)

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)								
Course Code			**01MEL504**	**Course Name**	**Advanced Engineering Materials (Elective I)**			
Teaching Scheme					**Evaluation Scheme**			
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks	
3	-	-	3		25	25	50	

Course Objectives:	
01	Distinguish various classes of advanced materials
02	Interpret new terms and information on advanced materials
03	Distinguish various classes of materials used in medicine and dentistry
04	Identify various classes of composite materials, their properties and applications

Course Outcomes:	
On completion of the course, student will be able to –	
01	Understand basic information on different materials.
02	Understand fundamental knowledge of composite materials.
03	Suggest suitable material for different applications
04	Suggest the property requirements for particular applications

Course Contents

Unit I	**< Special Steels >**	**7 Hours**

Metallurgical aspects, Composition, Properties and applications of: different types of Stainless steels, Dual phase steels, TRIP steels, Maraging steels, High speed steels, Hadfield steels, Free cutting steels, Ausformed steels, Tool Steels, manganese steels, chrome steels, electrical steels, bearing steels, spring steels, heat resistant steels, creep steels, HSLA steels,

Unit II	**< Modern materials- >**	**7 Hours**

Light alloys: Aluminium, magnesium and titanium alloys: Metallurgical aspects, Properties and applications.
Super alloys: Iron base, nickel base and cobalt base super alloys: Strengthening mechanism, Composition, Properties and their applications.
Nano materials: Definition, Types, Properties and applications, Carbon nano tubes, Methods of production.

Unit III	**< Miscellaneous Advanced Materials >**	**7 Hours**

Magnetic materials, ceramics, composites and polymers, surface metal matrix composites, aerospace materials, and cryogenic materials, semi conducting and superconducting materials

Unit IV	**< Selection of Materials >**	**7 Hours**

Motivation for selection, cost basis and service requirements-selection for mechanical properties, strength, toughness, fatigue and creep. Selection for surface durability, corrosion and wear resistance. Relationship between materials selection and processing. Case studies in material selection with reference to aero, auto. Marine, machinery and nuclear applications.

Unit V	**< Rapid Solidification >**	**7 Hours**

Metallic glasses, Atomic arrangement, Comparison with crystalline alloys, properties & applications, Glass transition temperature, Glass forming ability, Techniques for Production of metallic glasses.

Unit VI	**< Functional Materials >**	**4 Hours**

Smart materials: Shape memory alloys, Piezoelectric materials, Electro-rheological fluid, Magneto-rheological fluids **Biomaterials:** Property requirement, biocompatibility, bio functionality, Important bio metallic alloys like: Ni-Ti alloy and Co-Cr-Mo alloys. Applications.

Texts Books:

1	Charles J A, Crane F.A.A. & Furness J A G /'Selection and use of Engineering Materials", (3 rd edition), Butterworth - Heiremann - 1977
2	"Materials and their applications", (4th Edition)- Jaico- 1999
3	Technology of engineering materials by M. Phillip and W Bolten
Reference Books:	
1	W.D.Callister: Materials Science and Engineering: An Introduction, Wiley
2	Charles J A, Crane F.A.A. & Furness J A G ,"Selection and use of Engineering Materials", (3 rd edition), Butterworth – Heiremann
3	Physical Metallurgy and Advanced Materials, Seventh edition, R. E. Smallman & Ngan, Elsevier
4	Materials & Processes in Manufacturing", E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, (PHI)
5	"Design & Manufacturing of Composite Structures", Geoff Eckold (Jaico Publishing House)
6	"Manufacturing Processes for Engineering Materials", S. Kalpaljian, Steven R. Schmidt, (Pearson)
7	"Materials and their applications", (4th Edition) Jaico- 1999
8	"Materials & Processes in Manufacturing", E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, (PHI)
9	Design & Manufacturing of Composite Structures", Geoff Eckold (Jaico Publishing House)

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)							
Course Code	**01MEL505**	**Course Name**	**Industrial Automation (Elective I)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	To expose students to fundamentals of PLC.
02	To enable students to apply PLC programming and SCADA.

Course Outcomes:	
01	Understand PLC and its industrial applications.
02	Develop different programs using basic relay, timer and counter instructions and other
03	Programming instructions.
04	Apply the concept of SCADA system.

Course Contents

Unit I	**< Overview of Automation & Application of PLC in Manufacturing >**	**7 Hours**

Types of automation, significance and importance, evaluation of automation, components of automation in various automation types.
PLC Hardware components, Monory organization, use of PLC for various industrial applications, layout of PLC interfacing.

Unit II	**< Sensors interfacing for PLC >**	**7 Hours**

Sensors used for various applications in industry. Types and classification of sensors, features, construction and working

Unit III	**< Basic of PLC Programming & Data Manipulation >**	**7 Hours**

Ladder Systems used in ladder logic, writing ladder for given condition, guidelines for ladder writing. Basic instructions of ladder programming like Relay type, instructions, logical instructions, program control instructions.
Data comparison instructions, data compilation instructions, data conversion instruction, data transfer instructions. Concept of file handling in PLC.

Unit IV	**< Timers and Counters & Networking PLC >**	**7 Hours**

Introduction to Timers, types of timers, timer instructions. Introduction to counters, types of counters, counter instructions.
Introduction, Levels of industrial control, types of Networking, Network communications, PLC and internet cell control by PLC Network.

Unit V	**< Controlling Robot with PLC >**	**5 Hours**

Introduction, Basic two-axis control with PLC, sequence control, industrial three-axis control with PLC.

Unit VI	**< SCADA (Supervisory Control And Data Acquisition) and PLC Interfacing >**	**6 Hours**

SCADA (Supervisory Control And Data Acquisition) and PLC Interfacing

Texts Books:

1	"Programmable Logic Controller - Principles and Applications" by J. W. Webb, R. A. Reis; Prentice Hall of India Ltd. ISBN 81-203-2308-4.
2	"Programmable Logic Controller : Principles and Applications" by NIT, PHI Pub.
3	"Desirable facility on equivalent make PLC with supporting programming software and interfacing sensor" by Allen Bradley.

Reference Books:

1	"Programmable Logic Controller - Principles and Applications" by J. W. Webb, R. A. Reis; Prentice Hall of India Ltd. ISBN 81-203-2308-4.
2	"Programmable Logic Controller : Principles and Applications" by NIT, PHI Pub.
3	"Desirable facility on equivalent make PLC with supporting programming software and interfacing sensor" by Allen Bradley.
4	"Industrial Robotics - Technology, Programming and Applications"; M. P. Groover, M. Weiss, R. N. Nagel, N. G. Ordey; McGraw Hill International Editions, Industrial Engineering Series, ISBN 0-0-100442-4
5	"Programmable Logic Controller - Programming methods and Applications" Hackworth John R. and Hackworth Frederick D. Jr.; Pearson Education LCE, ISBN 81-297-0340-8.
6	Introduction to 8085 - Gaonkar
7	Process control and instrumentation - Johnson C.D.
8	Introduction to PLC - Gary Dumming - Delmar Pub.
9	Programmable Logic Controller - FESTO Pneumatics, - Bangalore
10	PLC Textbook and related literature by FESTO.
11	Various PLC manufacturers catalogue

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)							
Course Code	**01MEL506**	**Course Name**	**System Design (Elective I)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Develop an ability to apply knowledge of mathematics, science, and engineering outcomes
02	To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
03	To develop an ability to identify, formulate, and solve engineering problems.
04	To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
Course Outcomes:	
01	Define and describe various parameter related to system design using basic principles.
02	Formulate and design complex engineering systems And generate industrial drawings.
03	Estimate design parameters for a various system design elements fulfilling requirement of application, using optimization tools and mathematical models
04	To develop the student's skills in system simulation.

Course Contents		
Unit I	**< Engineering Process & System Approach >**	**7 Hours**
Introduction General model of engineering system, elements of system identification of engineering functions, characteristics of engineering system, Problem formulation, identification & analysis of need, problem scope & constraints.		
Unit II	**< System theories and modeling >**	**7 Hours**
System analysis, various approaches to system design, need for modeling, various modeling concepts-linear graph, mathematical modeling.		
Unit III	**< System Evaluation >**	**7 Hours**
Feasibility assessment, time value of money financial analysis, selection between alternatives		
Unit IV	**< Optimization >**	**6 Hours**
Theory of optimization, calculus methods of optimization for two or more variables.		
Unit V	**< Design Analysis >**	**6 Hours**
Decision models, scientific approach to decision process, quantitative methods in decision making		
Unit VI	**< System Simulation >**	**6 Hours**
Simulation models, Queuing theory, monte carlo method, Application of system approach to mechanical systems		

Texts Books:	
1	Mechanical System Design - Siddiqui, Manoj Kumar Singh; New Age International
2	Machine Design By Dieter

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)							
Course Code	**01MEL507**	**Course Name**	**Dynamic Analysis & Testing Methodology (Elective II)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Understand the complexity of vibration problems.
02	To Study analytical dynamic analysis
03	Measure vibration and study experimental methods of vibration design.
04	Reduction vibration using Vibration control techniques.

Course Outcomes: At the end of the course students will	
01	Have an in-depth understanding of the principles of vibrations.
02	Recognize the type of system and generate model for the same.
03	Understand the behaviour of a mechanical system, by analysing the vibration signature.
04	Be able to predict the performance of a machine, from knowledge of the machine's vibration signature history.

Course Contents

Unit I	**< Fundamentals of Vibration & Two degree freedom system >**	**6 Hours**

Review of Single degree freedom systems - Response to arbitrary periodic executions - Duhamel's integral - Impulse response function - Virtual work - Lagrange's equations - Single degree freedom forced vibration with elastically coupled viscous dampers - System identification from frequency Response-Transient vibration - Laplace transformation formulation.

Free vibration of spring-coupled system -Mass coupled system - Bending variation of two degree freedom system - Forced vibration - Vibration Absorber - Vibration isolation.

Unit II	**< Multi degree freedom system >**	**6 Hours**

Normal mode of vibration – Flexibility matrix and stiffness matrix - Eigen value and Eigen vector - Orthogonal properties - Modal matrix - Modal analysis - Forced vibration by matrix inversion - Modal damping in forced vibration - Numerical methods of fundamental frequencies

Unit III	**< Vibration of continuous systems & Experimental methods in vibration analysis >**	**6 Hours**

Systems governed by wave equations -Vibration of strings - Vibration of rods - Euler's equation for beams - Effect of Rotary inertia and shear deformation - Vibration of plates.

Vibration Instruments-Vibration Exciters Measuring Devices - Analysis - Vibration Tests - Free and Forced-Vibration tests. Collection of FRF, experimental modal analysis methods, Examples of vibration tests - Industrial case studies.

Unit IV	**< Analytical dynamic analysis & Validation of analytical models >**	**6 Hours**

Dynamic analysis - Equation of motions -Mass matrices - Free vibration analysis - Natural frequencies of Longitudinal - Transverse and torsional vibration - Introduction to transient field problem. Nonlinear analysis. Uses of software's - h & p elements - special element formulation.

Preliminary check, correlation of analytical model with experimental model, model updating- fundamentals

Unit V	**< Engineering applications >**	**6 Hours**

Structural Applications-Design of simple truss members. Design Applications-Design of simple axial, Transverse loaded members for minimum cost, maximum Weight-Design of shafts and Torsionally loaded

members- Design of Springs, Dynamic Applications-Optimum design of single, two degree of freedom systems, Vibration absorbers. Application in Mechanisms- optimum design of Simple linkage mechanisms		
Unit VI	**< Vibration Control >**	**6 Hours**
Introduction-Reduction of Vibration at the source-Control of vibration-by structural design-Material selection- Localized additions-Artificial Damping-Resilient isolation, Vibration isolation, Vibration absorbers, Active Vibration control: Introductions-Concepts and Applications, Review of smart materials-Types and characteristic review of smart structures - Characteristic Active vibration control in smart structures Dynamic balancing and alignment of machinery -Dynamic balancing of Rotors, Field Balancing in one plane, Two planes and in several planes, Machinery alignment.		
Texts Books:		
1	Roa, S.S., "Mechanical Vibrations", Addison Wesley Longman, 1995.	
2	D.J. Ewins, Modal Testing: Theory and Practice, Research Press Ltd, Letchworth (Herefordshire, England) (1984).	
3	M.I. Friswell, J.E. Mottershead, Finite Element Model Updating in Structural Dynamics (Solid Mechanics & Its Applications.) Kluwer Academic Publishers (1995)	
Reference Books:		
1	Roa, J.S. & Gupta K., "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd.,1984.	
2	Thomson, W.T., "Theory of Vibration with Applications" CBS Publishers and Distributors, New Delhi ,1990	
3	Den Hartog, J.P., "Mechanical Vibrations", Dover Publications, 1990.	
Supplementary Readings:		
Useful Links: **1.** http://www.ecgcorp.com/velav/ **2.** http://www.auburn.edu/isvd/ **3.** http://www.vibetech.com/techpaper.htm		

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)							
Course Code	**01MEL508**	**Course Name**	**Reverse Engineering (Elective II)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Introduce the process of duplication in domain analysis.
02	Understand the tools which are using in reverse engineering.
03	Provide knowledge about evaluation and verification of data from reverse methodology.
04	Understand the data management and integration of all data used in reverse engineering.

Course Outcomes:	
01	Understand the role of duplication in reverse engineering.
02	Have an understanding of the concepts and techniques of tools which are used in proto typing.
03	Have knowledge of stages and verification of data.
04	Evaluate the reverse engineering tool and integrate it.

Course Contents		
Unit I	**< Introduction >**	**5 Hours**
Scope and tasks of RE - Domain analysis- process of duplicating		
Unit II	**< Tools >**	**8 Hours**
Functionality- dimensional- developing technical data - digitizing techniques - construction of surface model - solid-part material- characteristics evaluation -software and application- prototyping – verification		
Unit III	**< Stages in Reverse Engineering >**	**6 Hours**
History of Reverse Engineering - Preserving and preparation for the four stage process		
Unit IV	**< Evaluation and Verification >**	**5 Hours**
Technical Data Generation, Data Verification, Project Implementation		
Unit V	**< Data Management >**	**8 Hours**
Data reverse engineering - Three data Reverse engineering strategies - Definition - organization data issues - Software application - Finding reusable software components - Recycling real-time embedded software - Design experiments to evaluate a Reverse Engineering tool - Rule based detection for reverse Engineering user interfaces - Reverse Engineering of assembly programs: A model based approach and its logical basics		
Unit VI	**< Integration >**	**7 Hours**
Cognitive approach to program understated - Integrating formal and structured methods in reverse engineering - Integrating reverse engineering, reuse and specification tool environments to reverse engineering --coordinate measurement - feature capturing - surface and solid members		

Texts Books:	
1	Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2	White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3	Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
Reference Books:	
1	Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
2	Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
3	Co-ordinate Measurment and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)								
Course Code		**01MEL509**	**Course Name**	**Computational Fluid Dynamics (Elective II)**				
Teaching Scheme					**Evaluation Scheme**			
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks	
3	-	-	3		25	25	50	

Course Objectives:	
01	To understand the basics of CFD.
02	To acquire knowledge of governing equations of fluid dynamics
03	To acquire knowledge of turbulence modeling of fluid dynamics
04	To study and interpret the Grid formation and grid transformation.
05	To study and use SIMPLE technique for various applications

Course Outcomes:	
01	Familiarize with developments in Computational fluid dynamics field and learn about its applications
02	Know various steps in the solution procedure
03	Solve various fluid dynamics problems using governing equations.
04	Know various methods of grid formation and transformation.
05	Use SIMPLE technique to solve CFD problems

Course Contents		
Unit I	**< Introduction >**	**6 Hours**
What is Computational fluid dynamics? Advantages of CFD, applications of CFD, CFD Solution procedure, Problem setup Pre-Process, Numerical solution – CFD solver, result report and visualisation – Post Process		
Unit II	**< Governing equations of fluid dynamics >**	**7 Hours**
Finite control volume, infinitesimal fluid element, the substantial derivative, the continuity equation, the momentum equation, the energy equation, Navier Stokes equations, Euler equations		
Unit III	**< Turbulence and its modelling >**	**6 Hours**
What is turbulence, effect of turbulence on time averaged Navier Stokes equation, characteristics of simple turbulent flows, turbulence models: mixing length model, k-ε model, Reynolds stress equation models, algebraic stress equation models		
Unit IV	**< Grids with appropriate transformations >**	**6 Hours**
Introduction, general transformation of the equations, form of governing equations particularly suited for CFD, boundary fitted coordinated systems		
Unit V	**< Simple CFD Techniques >**	**7 Hours**
Lax-Wendroff Technique, MacCormack Technique, ADI Technique, pressure correction Technique, SIMPLE Algorithm		
Unit VI	**< Applications of CFD >**	**7 Hours**
Numerical solutions of Quasi One dimensional nozzle flow, Two dimensional Supersonic flows, Supersonic flow over a flat plate		

Texts Books:	
1	Computational fluid dynamics The basics with applications – John Anderson McGraw Hill Publication
2	Computational fluid dynamics a practical approach - Jiyuan Tu, Yeoh, Liu, Elsiever Publication
3	An introduction to Computational fluid dynamics – Veersteeg, Malalasekhra, Longman Scientific and Technical

Website Links :	
1	www.**cfd-online**.com/
2	http://nptel.ac.in/courses/112105045/

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code		**01MEP510**	**Course Name**	**Applied Machine Design**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	50

Course Objectives:	
On completion of the course, student will be able -	
01	To understand design process.
02	To study design methods.
03	To understand relationship of processing and design.
04	
Course Outcomes:	
At the end of the course, students will be able to	
01	Have understanding of process of design.
02	Recognize the use of design methods for new product design.
03	Be able to select material after studying the requirements of the product.
04	Be able to identify and formulate the class of elasticity problems and apply the analytical techniques for solution of these problems.
List of Experiments	
	Minimum six assignments based on the topics
	Submission: Completed Journal.
Texts Books:	
1	Dieter George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Edition Mechanical Engg. Series ,1991.
2	Karl t. Ulrich and Steven d Eppinger "Product Design and Development", McGraw-Hill, Edition 2000.
3	Palh .G. and Beitz .W. "Engineering Design ", Springer - Verlag NY. 1985.
Reference Books:	
1	Ray .M.S., "Elements of Engg. Design ", Prentice Hall Inc. 1985.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code		**01MEP511**	**Course Name**	**Computer Aided Design and Simulation**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	50

Course Objectives:	
On completion of the course, student will be able -	
01	To develop an ability to Create 2-D drawings
02	Create assembly of simple machine components
03	Introduce students to Finite Element Analysis fundamentals and formulate the design problems into FEA.
04	To provide the student with some knowledge and analysis skills to interpret and draw conclusion the results of computer analysis.
Course Outcomes:	
At the end of the course, students will be able to	
01	Design a part or assembly of parts using Computer-Aided Design software
02	Use parametric modelling techniques to reflect engineering requirements.
03	Use professional-level finite element software to solve engineering problems
04	To develop the student's skills in modelling, meshing, and setting up material properties, loads, and constraints for computer simulation and solve the problem using software tools.
List of Experiments	
1	Preparation of solid models for minimum two assemblies of any industrial products using solid modeling software like CATIA, Solid works, UGS etc.
2	Solution of two problems in statics for using FEA software like Ansys, Hypermesh, Nastran etc.
3	Simulation of any mechanical system using simulation software
4	Writing interactive programs to solve design problems and production of drawings using any languages like Auto LISP/C/FORTRAN etc.
5	Two assignments on generation of surfaces using modelling software like CATIA.
	Submission: Completed Journal.
Texts Books:	
1	Ibrahim Zeid "CAD/CAM Theory and Practice" McGraw Hill, International Edition, 1998.
2	Mikell .P. Grooves and Emory .W. Zimmers Jr. "CAD/CAM Computer - Aided Design and Manufacturing"Prentice Hall, Inc., 1995.
3	Narsingh Deo., System simulation with Digital Computer, Prentice Hall of India, 1979
Reference Books:	
1	William .M. Neumann and Robert .F. Sproul "Principle of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
2	Donald Hearn and .M. Pauline Baker "Computer Graphics", Prentice HallInc., 1992.
3	Jones J.C., "Design Methods", Interscience, 1970.
4	Buhl, H.R., "Creative Engineering Design", Iowa State University Press, 1960.
5	Robert Matouseek, "Engineering Design", Blackie & Sons Ltd., 1963.

6	Niebel, B.W. & Draper, A.B., "Product Design and Process Engineering, McGraw Hill, 1974.
7	Harry Peck, "Designing for Manufacturing", Sir Issac Pitman and Sons Ltd., 1973.
8	Gladman, C.A., "Manual for Geometric Analysis of Engineering Designs", Australian Trade
9	Wade, Or, "Tolerance Control in Design and Manufacture", Industrial Press, Inc. Banks J., Carson. J.S., and Nelson B.L., Discrete Event System Simulation, PHI, New Delhi, 1996.
10	Gottfried B.S., Elements of Stochastic Process Simulation, Prentice Hall, London, 1984.
11	Geoffrey Gordon., System Simulation, Prentice Hall of India, 1984.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code	**01MEP512**		**Course Name**	**Design Of Experiments And Research Methodology**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2/ Alt. Wk	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	To understand the basics of research.
02	To acquire knowledge of research design.
03	To acquire knowledge of research modelling.
04	To study and use the experimentation and factorial design.
05	To study and interpret the analysis in research.
Course Outcomes:	
At the end of the course, students will be able to	
01	Familiarize with research and types of research.
02	Know various steps in the research methodology.
03	Understand research modelling and simulation
04	Know various methods of experimentation and process optimization.
05	Use various analysis techniques and prepare report of the research work.
List of Experiments	
1	Collection and review of literature on a specific topic related to design or manufacturing engineering.
2	Assignment on data collection processing, analysis, interpretation, inferences and conclusions for an engineering problem.
3	Assignment on design of experiments using Taguchi technique.
4	Assignment on modelling and simulation of an engineering problem.
5	Presentation of any one above using MS power-point or similar.
	Submission: Completed Journal
Texts Books:	
1	Krishnaswamy, K.N., Sivakumar, Appa Iyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2	Montgomery, Douglas C. (2004) - Design & Analysis of Experiments, 5/e. (NY John Wiley & Sons)
3	Kothari, C.K. (2004) - Research Methodology, Methods & Techniques, 2/e. (New Delhi, New Age International Ltd. Publishers)
Reference Books:	
1	Ross, Phillip J. (1996) - Taguchi Techniques for Quality Engineering, 2/e. (New York, McGraw Hill)
2	Rao S. S. (2004), Engineering Optimization Theory & Practices, 3/e (New Delhi, New Age International)
3	Handbook of Industrial Automation - Richard L. Shell & Ernest L. Hall (Marcel Decker Inc.)
4	Trochim, William M.K. (2003), - Research Methods 2/e, (New Delhi, Biztantra, Dreamtech)

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)					
Course Code	**01MEP513**	**Course Name**	**Advanced Engineering Materials (Elective I)**		
Teaching Scheme				**Evaluation Scheme**	
L	T	P	Credits	CIE Marks	SEE Marks
--	--	2/ Alt. Wk	1	50	--

Course Objectives:	
On completion of the course, student will be able -	
01	Distinguish various classes of advanced materials
02	Interpret new terms and information on advanced materials
03	Distinguish various classes of materials used in medicine and dentistry
04	Identify various classes of composite materials, their properties and applications
Course Outcomes:	
At the end of the course, students will be able to	
01	Understand basic information on different materials.
02	Understand fundamental knowledge of composite materials.
03	Suggest suitable material for different applications
04	Suggest the property requirements for particular applications
List of Experiments	
1	Study of different strengthening mechanisms in steels
2	Selection of material for high temperature applications
3	Selection of material for medical implant
4	Selection of material for sports vehicle parts
5	Study of properties and applications of Smart Materials
6	Study of properties and applications of functional Materials
7	Study of chemical and physical vapour deposition of matrix on fibres
8	Study of Advanced structural ceramics,
9	Study of Processing of polymer matrix composites
10	Study of alloys for modification of structure and properties.
	Submission: Completed Journal.
Texts Books:	
1	Charles J A, Crane F.A.A. & Furness J A G /'Selection and use of Engineering Materials", (3 rd edition), Butterworth - Heiremann - 1977
2	"Materials and their applications", (4th Edition)- Jaico- 1999
3	Technology of engineering materials by M. Phillip and W Bolten
Reference Books:	
1	W.D.Callister: Materials Science and Engineering: An Introduction, Wiley
2	Charles J A, Crane F.A.A. & Furness J A G ,"Selection and use of Engineering Materials", (3 rd edition), Butterworth – Heiremann

3	Physical Metallurgy and Advanced Materials, Seventh edition, R. E. Smallman & Ngan, Elsevier
4	Materials & Processes in Manufacturing", E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, (PHI)
5	"Design & Manufacturing of Composite Structures", Geoff Eckold (Jaico Publishing House)
6	"Manufacturing Processes for Engineering Materials", S. Kalpaljian, Steven R. Schmidt, (Pearson)
7	"Materials and their applications", (4th Edition) Jaico- 1999
8	"Materials & Processes in Manufacturing", E. Paul DeGarmo, J. T. Black & Ronald A. Kohser, (PHI)
9	Design & Manufacturing of Composite Structures", Geoff Eckold (Jaico Publishing House)

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code		**01MEP514**	**Course Name**	**Industrial Automation (Elective I)**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2/ Alt. Wk	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	To expose students to fundamentals of PLC.
02	To enable students to apply PLC programming and SCADA.
Course Outcomes:	
At the end of the course, students will be able to	
01	Understand PLC and its industrial applications.
02	Develop different programs using basic relay, timer and counter instructions and other
03	Programming instructions.
04	Apply the concept of SCADA system.
	List of Experiments
	Maximum Six assignments based on the topics in syllabus giving understanding of practical exposure and working experience.
	Submission; Completed Journal.
Texts Books:	
1	"Programmable Logic Controller - Principles and Applications" by J. W. Webb, R. A. Reis; Prentice Hall of India Ltd. ISBN 81-203-2308-4.
2	"Programmable Logic Controller : Principles and Applications" by NIT, PHI Pub.
3	"Desirable facility on equivalent make PLC with supporting programming software and interfacing sensor" by Allen Bradley.
Reference Books:	
1	"Programmable Logic Controller - Principles and Applications" by J. W. Webb, R. A. Reis; Prentice Hall of India Ltd. ISBN 81-203-2308-4.
2	"Programmable Logic Controller : Principles and Applications" by NIT, PHI Pub.
3	"Desirable facility on equivalent make PLC with supporting programming software and interfacing sensor" by Allen Bradley.
4	"Industrial Robotics - Technology, Programming and Applications"; M. P. Groover, M. Weiss, R. N. Nagel, N. G. Ordey; McGraw Hill International Edi, Industrial Engineering Series, ISBN 0-0-100442-4
5	"Programmable Logic Controller - Programming methods and Applications" Hackworth John R. and Hackworth Frederick D. Jr.; Pearson Education LCE, ISBN 81-297-0340-8.
6	Introduction to 8085 - Gaonkar
7	Process control and instrumentation - Johnson C.D.
8	Introduction to PLC - Gary Dumming - Delmar Pub.
9	Programmable Logic Controller - FESTO Pneumatics, - Bangalore
10	PLC Textbook and related literature by FESTO.
11	Various PLC manufacturers catalogue

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code		**01MEP515**	**Course Name**	**System Design (Elective-I)**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2/ Alt. Wk	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	Develop an ability to apply knowledge of mathematics, science, and engineering outcomes
02	To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
03	To develop an ability to identify, formulate, and solve engineering problems.
04	To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Outcomes:	
At the end of the course, students will be able to	
01	Define and describe various parameter related to system design using basic principles.
02	Formulate and design complex engineering systems And generate industrial drawings.
03	Estimate design parameters for a various system design elements fulfilling requirement of application, using optimization tools and mathematical models
04	To develop the student's skills in system simulation.

List of Experiments	
	Maximum Six assignments based on topics in the syllabus giving understanding of practical exposure and working experience.
	Submission: Completed Journal.

Texts Books:	
1	Mechanical System Design - Siddiqui, Manoj Kumar Singh; New Age International
2	Machine Design By Dieter

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code	**01MEP516**	**Course Name**	**Dynamic Analysis & Testing Methodology (Elective-II)**			
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	Understand the complexity of vibration problems.
02	To Study analytical dynamic analysis
03	Measure vibration and study experimental methods of vibration design.
04	Reduction vibration using Vibration control techniques.
Course Outcomes:	
At the end of the course, students will be able to	
01	Have an in-depth understanding of the principles of vibrations.
02	Recognise the type of system and generate model for the same.
03	Understand the behaviour of a mechanical system, by analysing the vibration signature.
04	Be able to predict the performance of a machine, from knowledge of the machine's vibration signature history.
List of Experiments	
1	Two assignments on measurement of dynamic test data of machine elements
2	One assignment on experimental modal analysis of machine element.
3	Two assignments on dynamic analysis using FEA software like Nastran, HyperWorks etc.
4	One Assignment on model data correlation for any one model used in sr. no. 1 and 2
	Submission: Completed Journal.
Texts Books:	
1	Roa, S.S., "Mechanical Vibrations", Addison Wesley Longman, 1995.
2	D.J. Ewins, Modal Testing: Theory and Practice, Research Press Ltd, Letchworth (Herefordshire, England) (1984).
3	M.I. Friswell, J.E. Mottershead, Finite Element Model Updating in Structural Dynamics (Solid Mechanics & Its Applications.) Kluwer Academic Publishers (1995)
Reference Books:	
1	Roa, J.S. & Gupta K., "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd.,1984.
2	Thomson, W.T., "Theory of Vibration with Applications" CBS Publishers and Distributors, Delhi, 1990
3	Den Hartog, J.P., "Mechanical Vibrations", Dover Publications, 1990.
Supplementary Readings:	
1. http://www.ecgcorp.com/velav/	
2. http://www.auburn.edu/isvd/	
3. http://www.vibetech.com/techpaper.htm	

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code		**01MEP517**		**Course Name**	**Reverse Engineering (Elective-II)**	
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	Introduce the process of duplication in domain analysis.
02	Understand the tools which are using in reverse engineering.
03	Provide knowledge about evaluation and verification of data from reverse methodology.
04	Understand the data management and integration of all data used in reverse engineering.
Course Outcomes:	
At the end of the course, students will be able to	
01	Understand the role of duplication in reverse engineering.
02	Have an understanding of the concepts and techniques of tools which are used in proto typing.
03	Have knowledge of stages and verification of data.
04	Evaluate the reverse engineering tool and integrate it.
List of Experiments	
	Minimum Six assignments based on topics in syllabus, which also include at least one case study.
	Submission: Completed Journal.
Texts Books:	
1	Design Recovery for Maintenance and Reuse, T J Biggerstaff, IEEE Corpn. July 1991
2	White paper on RE, S. Rugaban, Technical Report, Georgia Instt. of Technology, 1994
3	Reverse Engineering, Katheryn, A. Ingle, McGraw-Hill, 1994
Reference Books:	
1	Data Reverse Engineering, Aiken, Peter, McGraw-Hill, 1996
2	Reverse Engineering, Linda Wills, Kluiver Academic Publishers, 1996
3	Co-ordinate Measurment and reverse engineering, Donald R. Honsa, ISBN 1555897, American Gear Manufacturers Association

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–I)						
Course Code	**01MEP518**	**Course Name**	**Computational Fluid Dynamics (Elective-II)**			
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
--	--	2	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	To understand the basics of CFD.
02	To acquire knowledge of governing equations of fluid dynamics
03	To acquire knowledge of turbulence modeling of fluid dynamics
04	To study and interpret the Grid formation and grid transformation.
05	To study and use SIMPLE technique for various applications
Course Outcomes:	
At the end of the course, students will be able to	
01	Familiarize with developments in Computational fluid dynamics field and learn about its applications
02	Know various steps in the solution procedure
03	Solve various fluid dynamics problems using governing equations.
04	Know various methods of grid formation and transformation.
05	Use SIMPLE technique to solve CFD problems
List of Experiments	
	Practical exercises (6 to 8) using Software packages like ANSYS, ICEM HEXA, FLUENT, CFX, COSMOS or equivalent on the following topics like –
1	Convection equation in one dimension.
2	Diffusion equation in one dimension.
3	One dimensional flow through a nozzle.
4	Flow over a cylinder and backward facing step.
	Submission: Completed Journal.
Texts Books:	
1	Computational fluid dynamics The basics with applications – John Anderson McGraw Hill Publication
2	Computational fluid dynamics a practical approach - Jiyuan Tu, Yeoh, Liu, Elsiever Publication
3	An introduction to Computational fluid dynamics – Veersteeg, Malalasekhra, Longman Scientific and Technical
Supplementary Readings:	
1. www.cfd-online.com/ 2. http://nptel.ac.in/courses/112105045/	

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL520**	**Course Name**	**Manufacturing System Design**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Study of die design in sheet metal including the process, measurements, design and selection of parameters and their industrial specifications.
02	Introduce students to development of non-metallic components using injection moulding
03	Study of design of fixtures for fabrication, assembly and inspection
04	Introduce the students to gauge and gauge design

Course Outcomes:	
01	Identify and explain fundamentals of Die design in sheet metal.
02	Design Blanking and Piercing Dies, Bending, Forming and drawing die for component under consideration using fundamental principle
03	Understand development of non-metallic components using injection moulding and Gauge and Gauge design
04	Design of Fixtures for Fabrication, Assembly and Inspection.

Course Contents

Unit I	**< Design of Sheet Metal Blanking and Piercing >**	**7 Hours**

Introduction, Fundamentals of die cutting operations, General Press information types, cutting action in punch and die operations, types of die construction, die clearances, sheet metal material handling and feeding devices.

Unit II	**< Fundamentals of die design >**	**7 Hours**

Introduction, Press work materials and selection criteria, Blanking and piercing die construction, pilots, strippers and pressure pads, short run tooling for piercing, strip layout and design, calculations for sheet optimization.

Unit III	**< Bending, Forming and drawing die design >**	**7 Hours**

Introduction of bending, forming dies, Bending and forming die design, Calculation of various parameters as per ASTME, effect of various process parameters during drawing, Drawing force and related parameter calculation as per ASTME, blank size calculations.

Unit IV	**< Development of nonmetallic components using injection moulding >**	**6 Hours**

Introduction, types of dies, die design considerations, calculation of important parameters, material properties of injection moulding materials.

Unit V	**< Design of Fixtures for Fabrication, Assembly and Inspection >**	**6 Hours**

Introduction, significance of fixtures in fabrication, Assembly and inspection, Types and classification, Materials used for above applications, design considerations, calculation of clamping force, various approaches used in design of fixtures for above applications.

Unit VI	**< Gauge and Gauge Design >**	**6 Hours**

Introduction, requirement of a gauge, Types of gauges, Gauge tolerances, Selection of material for gauges, indicating gauges and automatic gauges, design of simple gauges like snap gauge, plug gauge and thread gauge.

CMM - Construction, working, features, software interface, elaboration of capabilities for various measurement requirements.

Use of CMM in reverse engineering, generation of drawing details from the existing component.	
Texts Books:	
1	Tool Design - Cyrill Donaldson, G.H LeCain, V.C. Goold, Tata McGraw Hill Publi.
2	Jigs & Fixtures- Kempster, ELBS.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL521**	**Course Name**	**Creativity, Innovation & New Product Development**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	To make students aware about the importance of creativity and innovation in new product design.
02	Use various techniques for idea generation and problem solving in.
03	Know the importance of intellectual property and procedures to preserve intellectual property rights.
04	Know journeys in product development.

Course Outcomes:	
01	Able to find opportunities of new product development.
02	Able to use market research, benchmarking in project planning.
03	Use creativity and innovation in new product development.
04	Use design engineering for new product, able to prepare model, build test, refine.
05	Able to track procedures, file patent preserve intellectual property rights.

Course Contents		
Unit I	**< Introduction >**	**7 Hours**
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques.		
Unit II	**< Project Selection and Evaluation >**	**7 Hours**
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques).		
Unit III	**< New Product Development >**	**7 Hours**
Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).		
Unit IV	**< New Product Planning >**	**6 Hours**
Design of proto type - testing - quality standards - marketing research - introducing new products.		
Unit V	**< Journeys in Product Development, Product Development Process Tools, Scoping Product Developments >**	**6 Hours**
Technical and Business Concerns		
Unit VI	**< Understanding Customer Needs, Establishing Product Function >**	**6 Hours**
Product Teardown and Experimentation, Benchmarking and Establishing Engineering Specifications, Product Architecture.		

Texts Books:	
1	HARRY NYSTROM, " Creativity and innovation", John Wiley & Sons, 1979.
2	BRAIN TWISS, " Managing technological innovation", Pitman Publishing Ltd., 1992.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL522**	**Course Name**	**Product Life Cycle Management**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Familiarize the current principles, practices, and applications of Product Lifecycle Management (PLCM).
02	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
03	Experience effective integration of PLCM technologies into the product development process that can put the industry at a competitive advantage to deliver innovative products
04	Experience modern PLCM strategies, methods, and tools

Course Outcomes:	
01	Integrate the various stages of PLCM into engineering product ranges and portfolios that will eventuate into commercial success.
02	Integrate lifecycle management strategies and knowledge to develop new and/or formulate appropriate engineering design solutions in engineering environment.
03	Applying product modelling and using analyse tools for solving engineering problems.
04	Experience Product Data Management (PDM) technology and recent advances in PLCM.

Course Contents		
Unit I	**< Introduction >**	**5 Hours**
Background, Overview, Need, Benefits, Concept of Product Lifecycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement.		
Unit II	**< Product Life Cycle Environment >**	**6 Hours**
Product Data and Product Workflow, Company's PLM vision, The PLM Strategy, Principles for PLM strategy, Preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, Change Management for PLM.		
Unit III	**< Product Development Process & Methodologies >**	**9 Hours**
Integrated Product development process - Conceive - Specification, Concept design, Design - Detailed design, Validation and analysis (simulation), Tool design, Realize - Plan manufacturing , Manufacture, Build/Assemble , Test (quality check) , Service - Sell and Deliver , Use , Maintain and Support, Dispose. Bottom-up design, Top-down design, Front loading design workflow, Design in context, Modular design. Concurrent engineering - work structuring and team Deployment - Product and process systemization - problem, identification and solving methodologies. Product Reliability, Mortality Curve.		
Unit IV	**< Product Modelling: Product Modeling >**	**5 Hours**
Definition of concepts – Fundamental issues - Role of Process chains and product models -Types of product models - model standardization efforts-types of process chains - Industrial demands.		
Unit V	**< Types Of Analysis Tools >**	**5 Hours**
FMEA - QFD - Design for product life cycle. Estimation of Manufacturing costs, Reducing the component costs and assembly costs, Minimize system complexity.		
Unit VI	**< Product Data Management (PDM) Technology >**	**9 Hours**
Product Data		

Management - An Introduction to Concepts, Benefits and Terminology, CIM Data. PDM functions, definition and architectures of PDM systems, product data interchange, portal integration, PDM acquisition & implementation. Recent Advances: Intelligent Information Systems - Knowledge based product and process models - Applications of soft computing in product development process - Advanced database design for integrated manufacturing.	
Texts Books:	
1	Grieves, Michael. Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
2	Product Life Cycle Management - by Antti Saaksvuori, Anselmi Immonen, Springer, 1st Ed. (2003)
3	Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer-Verlag, 2004. ISBN 1852338105
Reference Books:	
1	Product Design & Process Engineering, McGraw Hill - Kogalkusha Ltd., Tokyo, 1974.
2	Product Design & Development - by Kari Ulrich and Steven D. Eppinger, McGraw Hill International Edns, 1999.
3	Effective Product Design and Development - by Stephen Rosenthol, Business One Orwin, Homewood, 1992 ISBN 1-55623-603-4.
4	Burden, Rodger PDM: Product Data Management, Resource Pub, 2003. ISBN 0970035225
5	Clement, Jerry; Coldrick, Andy; & Sari, John. Manufacturing Data Structures, John Wiley & Sons, 1992. ISBN 0471132691
6	Clements, Richard Barrett. Chapter 8 ("Design Control") and Chapter 9 ("Document Control") in Quality Manager's Complete Guide to ISO 9000, Prentice Hall, 1993. ISBN 013017534X
7	Crnkovic, Ivica; Asklund, Ulf; & Dahlqvist, Annita Persson. Implementing and Integrating Product Data Management and Software Configuration Management, Artech House Publishers, 2003. ISBN 1580534988
8	Garwood, Dave. Bills of Materials for a Lean Enterprise, Dogwood Publishing Co., 2004. ISBN 0962111848
9	Fan ,D(Ed.), Virtual Reality for Industrial Applications, Springer

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL523**	**Course Name**	**Experimental Stress Analysis (Elective III)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Understand the relationship between mechanics theory and experimental stress analysis.
02	Apply numerical stress analysis techniques to real world engineering design problem.
03	Apply experimental stress analysis techniques to real world engineering design problem.

Course Outcomes:	
01	Student will be able to understand concept of stress and strain
02	Student will be able to understand underlying principles in using strain gauges
03	Ability to mount strain gauges, take measurements and analyze the obtained data.
04	Student will be able to understand basic principles of photo-elasticity, and use it as an analysis tool.

Course Contents

Unit I	**< Principles of Experimental approach >**	**5 Hours**
Introduction to ESA, Advantages of ESA techniques, Necessity of various ESA methods, methodology of problem solving by ESA Strategy		
Unit II	**< Strain Measurement Techniques >**	**7 Hours**
Introduction to strain measurement: Review of Stress, Strain, and Hooke's Law: Definition of Stress and Strain Tensors, Constitutive Models Strain Gages: Properties of Strain gauge Systems, Types Resistance Strain gauges: Construction, Mounting methods, Gage Sensitivity, Strain Gage Circuits: Wheatstone bridge, constant current circuits Calibration of circuits, Bridge Sensitivity and Measurement Corrections, Thermal Corrections Gage Factor, Performance Characteristics, Environmental effects. Recording Instruments: Static and Dynamic Recording, Digital Data Acquisition Systems, Telemetry Systems Strategy.		
Unit III	**< Strain Analysis Methods >**	**5 Hours**
Three element rectangular strain rosette, correction, stress gauges, over-deterministic methods for strain analysis, residual stress determination Applications: Application of strain gauges for measurement of load, temperature, pressure, vibration, stress and strain etc. Strategy		
Unit IV	**< Optical Methods of Stress Analysis >**	**6 Hours**
Basic of Optics, Optical Instrumentation Moire Fringe technique-theory and experimental procedures, Fractional fringe measurement -Tardy's Method , Babinet Soleil Method. Strategy		
Unit V	**< Theory of Photo-elasticity, Polariscope >**	**7 Hours**
Plane polariscope, Circular polariscope, Different Arrangements photoelastic photography, Photoelastic materials-properties, selection, casting methods, calibration. Analysis Techniques-Determination of direction of Principal stresses at given point, Determination of exact fringe order N and the principal stress Separation methods, Method based on Hooke's Law, Electrical analogy method, Oblique incidence method, Shear difference method, Scaling model results to prototype. Application of photo-elasticity to 2-D and 3-D Stress analysis Strategy		
Unit VI	**< Optical methods for Determining Fracture Parameters >**	**6 Hours**
Irwins methods, application. of moiré and isopachic fringe pattern to determine stress intensity factor, mixed mode intensity factors Strategy.		

Coating Techniques- Bifringent coating- stress-optic and strain-optic relation, sensitivity and coating materials, fringe order determination. Brittle coating technique. Strategy HOLOGRAPHY:Plane and spherical waves - coherence - holographic setup –Interferometry - Displacement measurement -obtaining Isopachics, Strategy.	
Texts Books:	
1	Sadhu Singh - Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.
2	JW Dalley & WF Riley, Experimental Stress Analysis, McGraw Hill Book Co. N.Y. 1991
3	L.S. Srinath et al, Experimental Stress Analysis, Tata McGraw Hill Company, New Delhi, 1984
Reference Books:	
1	R.S.Sirohi, HC Radhakrishna, Mechanical Measurements, New Age International (P)Ltd. 1997
2	F.K Garas, J.L. Clarke and GST Armer, Structural assessment, Butterworths, London, 1987
3	D.E. Bray & R. K.Stanley, Non-destructive Evaluation
4	Dove and Adams, Experimental Stress Analysis and Motion Measurement, PHI, 1965.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL524**	**Course Name**	**Reliability Engineering (Elective III)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	To introduce principles of reliability in engineering design
02	To develop understanding of concepts of failures, maintainability and availability of the intended products/systems and services.
03	To develop an ability to analyze field failure data in order to evaluate system reliability.
04	To develop an ability to apply various reliability techniques to solve interdisciplinary reliability problems.

Course Outcomes:	
01	Recognize the importance of selection of proper manufacturing process and its influence on new product development process and understand the interrelationship between product design and production methods for improving product performance during stage of design itself.
02	Identify the factors contributing reduction in assembly time and understand to incorporate assembly & disassembly guidelines in product design.
03	Utilize reliability concepts, failure analysis tools and techniques and accelerated life test methods for improving product life cycle.
04	Understand the factors controlling cost and time required for the product maintenance and utilize this information for design for maintenance.

Course Contents		
Unit I	**< Elements of Probability >**	**7 Hours**
Probability concepts, Rules for addition of probabilities, Complementary events, Conditional probability, Random events, Sample distribution**.**		
Unit II	**< Reliability >**	**7 Hours**
Fundamental aspects of reliability, Failure patterns and mathematical models (Constant failure rate **models** and Time Dependent failure models), System Reliability, Fault tree analysis, FMEA and FMECA		
Unit III	**< Reliability testing >**	**6 Hours**
Burn in testing, Binomial Testing, Acceptance testing, Accelerated life Testing, Degradation Models.		
Unit IV	**< The Reliability Function >**	**6 Hours**
Failure Rate, Hazard Rate, Bath-tub Curve, Relationship between Various Reliability Characteristics, Component Reliability, Mean-time-to-failure, Time-dependent Hazard Models-Constant-hazard, Linear-hazard, Nonlinear-hazard and Gamma Models		
Unit V	**< System Reliability >**	**7 Hours**
Two-state Modeling, Series Models, Parallel Models, Series-parallel and Parallel-series Models, k-out-of-m Models, Standby Models, Non-series-parallel Models, Fault-tree Approach to System Modeling		
Unit VI	**< Maintained Systems >**	**6 Hours**
Classification of Maintenance Activities: Breakdown, Preventive and Predictive Maintenance, Condition Monitoring, Maintainability and Availability, Reliability-centered Maintenance		
Texts Books:		

1	Antony J (2003). Design and Experiments for Engineers and Scientists, Butterworth- Heinmann.
2	Cochran W and Cox G (2000). Experimental Designs, II edition, John Wiley & Sons Inc.
3	Dean A and Voss D (2006). Design and Analysis of Experiments, Springer.
Reference Books:	
1	Jeff Wu C and Hamada M (2000). Experiments: Planning, Analysis and Parameter Design Optimization, John Wiley and Sons Inc

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL525**	**Course Name**	**Industrial Robotics & Expert Systems (Elective III)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Applications and benefits of group technology, computer aided process planning, material requirement planning (MRP) etc.
02	Enable students to use the concepts of Co-ordinate Measuring Machine (CMM), Flexible Manufacturing Systems (FMS), etc.
03	Emphasize on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively.
04	Application of computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines

Course Outcomes:	
01	Recognize the importance of CIM in today's scenario and its impact on global competition.
02	Students are able to develop CNC programming and work on CNC machine.
03	Students can understand the concept of automation in manufacturing and assembly operations.
04	Understand the engineering and economical aspects of automatic storage and retrieval system.

Course Contents		
Unit I	**< Introduction and Robot Kinematics >**	**7 Hours**
Definition need and scope of Industrial robots - Robot anatomy - Work volume - Precision movement - End effectors - Sensors. Robot Kinematics - Direct and inverse kinematics - Robot trajectories - Control of robot manipulators - Robot dynamics - Methods for orientation and location of objects		
Unit II	**< Robot Drives and Control >**	**7 Hours**
Controlling the Robot motion - 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 - Designing of end effectors - Vacuum, magnetic and air operated grippers		
Unit III	**< Robot >**	**7 Hours**
Transducers and Sensors - Tactile sensor - Proximity and range sensors - Sensing joint forces - Robotic vision system - Image Representation - Image Grabbing -Image processing and analysis - Edge Enhancement - Contrast Stretching - Band Rationing - Image segmentation - Pattern recognition - Training of vision system.		
Unit IV	**< Robot Cell Design and Application >**	**8 Hours**
Robot work cell design and control - Safety in Robotics - Robot cell layouts - Multiple Robots and machine interference - Robot cycle time analysis. Industrial application of robots.		
Unit V	**< Robot Programming and Expert Systems >**	**6 Hours**
Methods of Robot Programming - Characteristics of task level languages lead through programming methods - Motion interpolation.		
Unit VI	**< Artificial intelligence >**	**4 Hours**
Basics - Goals of artificial intelligence - AI techniques - problem representation in AI - Problem reduction and solution techniques - Application of AI and KBES in Robots.		

Texts Books:	
1	K.S.Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 1987

2	Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.
3	Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
Reference Books:	
1	Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering - An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
2	Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
3	Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
4	Timothy Jordanides et al ,"Expert Systems and Robotics ", Springer -Verlag, N, May 1991.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL526**	**Course Name**	**Additive Manufacturing (Elective IV)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Distinguish various types of Rapid prototyping techniques
02	Interpret new terms and information on 3 D Modeling methods
03	Distinguish various classes of materials used in Rapid prototyping techniques
04	Analyze Various RP deposition techniques
05	Distinguish materials suitable for application at elevated temperatures

Course Outcomes: Upon completion of the course, the student should be able to:	
01	Understand and use techniques for processing of CAD models for rapid prototyping.
02	Understand and apply fundamentals of rapid prototyping techniques.
03	Use appropriate tooling for rapid prototyping process.
04	Use rapid prototyping techniques for reverse engineering.

Course Contents		
Unit I	**< Introduction >**	**6 Hours**
Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.		
Unit II	**< CAD Modelling and Data Processing for RP >**	**6 Hours**
CAD model preparation, Data Requirements, Data formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.		
Unit III	**< RP Systems >**	**7 Hours**
Photo polymerization Stereo lithography (SL), SL resin curing process, SL scan patterns, Micro-stereo lithography, Applications of Photo polymerization Processes, Powder Bed Fusion: Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting, (EBM), Applications of Powder Bed Fusion Processes. Extrusion-Based RP Systems: Fused Deposition Modelling (FDM), Principles, Plotting and path control,		
Unit IV	**< Deposition techniques >**	**6 Hours**
Applications of Extrusion-Based Processes. 3D Printing :3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Beam Deposition: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks		
Unit V	**< Rapid Tooling >**	**7 Hours**
Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods		
Unit VI	**< Errors in RP Processes and Applications >**	**7 Hours**
Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS. RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.		

Texts Books:	
1	Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2	Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton,
3	Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing,World Scientific.
Reference Books:	
1	Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping toDirect Digital Manufacturing, Springer.
2	Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
3	Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4	Hilton P, Jacobs P F, Rapid Tooling: Technologies and Industrial Applications, CRC press.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL527**	**Course Name**	**Artificial Intelligence & Neural Network (Elective IV)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	Correlates to program objectives
02	Understand the role of artificial intelligence and neural networks in engineering.
03	Provide knowledge of different forms of search strategies and learning in neural networks.
04	Understand the different applications of AI and ANN in various engineering and industrial problems.

Course Outcomes: At the end of the course students will be able to	
01	Understand the role of artificial intelligence and neural networks in engineering.
02	Have an understanding of the concepts and techniques of neural networks through the study of the most important neural network models.
03	Have knowledge of sufficient theoretical background to be able to reason about the behaviour of neural networks.
04	Evaluate whether neural networks are appropriate to a particular application and apply neural networks to particular applications, and to know what steps to take to improve performance.

Course Contents

Unit I	**< Concept of A.I., Approaches, Foundations of A.I., Underlying assumptions >**	**6 Hours**

Problem Formulation: Problem solving agents, Components of problem definition, defining the problem as state space approach, Problem characteristics, Production System, searching for solutions, Forward and backward reasoning, means end analysis, Graphs and trees, measuring problem solving performance.

Unit II	**< Search Strategies >**	**7 Hours**

Uninformed (blind) search- breadth first, depth first, and their variations, avoiding repeated states; b) Informed (heuristic) search- heuristic function, Generate and test, Best first search, A* search, Local search algorithms- Hill climbing, Simulated annealing, Branch and bound and Local beam search,

Knowledge Representation: Simple rational knowledge, Inheritable knowledge, Inferential knowledge, Procedural knowledge, the Frame problem, Propositional logic- Syntax and semantics, well-formed formulas (WFF), conversion to clausal form, using FOPL, inference rules, unification, non-deductive inference methods, resolution, forward and backward chaining, the knowledge engineering process, Handling uncertain knowledge, probability propositions, atomic events, unconditional (prior) and conditional (posterior), priority Bayes' rule and its use, Bayesian network, its semantics and inference.

Unit III	**< Learning >**	**8 Hours**

Forms of learning, inductive learning, decision tree learning, ensemble learning, Pattern recognition- Introduction, recognition, and classification process, learning classification patterns.

Knowledge based systems: Expert systems, components, characteristic features of expert systems, rule based system architecture, representing & using domain knowledge, expert system shell, explaining the reasoning and knowledge acquisition, applications.

A.I. in Robotics: State space search, path selection, AND-OR graphs, means end analysis in a robotic problem, robot problem solving as a production system, robot learning and task planning, symbolic spatial relationship, obstacle avoidance, graph planning.

Machine Vision: Functions, imaging devices, lighting, A-D conversion, quantization, encoding image storage, image data reduction, segmentation techniques, feature extraction, object recognition, training the vision system, applications.		
Unit IV	**< Significance, Basic building blocks >**	**4 Hours**
Types of ANN - and their representation		
Unit V	**< Learning Modes and Algorithms. >**	**7 Hours**
Applications of ANN to various engineering and industrial problems		
Unit VI	**< Implementation methodology to solve problems, by using software's >**	**7 Hours**
Like – MatLab on equivalent. Desirable facilities. MatLab latest version with ANN Tool box and equivalent Supporting software's preferably like Prolog, LISP, C++.		

Texts Books:	
1	Stuart Russel, Peter Norwig (2003), "Artificial Intelligence : A Modern Approach" 2/e, (Pearson Education)
2	Elaine Rich, Kevin Knight, (1991), "Artificial Intelligence" 2/e, (Tata McGraw Hill)
3	Dan W. Patterson (1999), "Introduction to Artificial Intelligence and Expert Systems" (7th Indian Reprint) (EEE) (Prentice Hall of India)

Reference Books:	
1	Rex Mauss, Jessica Keyes , "Handbook of Expert Systems in Mfg.", (McGraw Hill)
2	Groover, Weiss, Nagel, Audrey, "Industrial Robotics- Technology, Programming and Applications"", (McGraw Hill)
3	Fu, Gonzalea and Lee, "Robotics: Control, Sensing, Vision and Intelligence", (McGraw Hill)
4	Conference Proceedings and current journals for case studies and applications.
5	Introduction to A.N.N. by Anderson, Prentice Hall of India Publication.
6	A.N.N. by Yadnanarayana, Prentice Hall of India Publication
7	A.N.N. by Zurda J.M.
8	A.N.N. and MatLab by Sivanandan.
9	Fundamentals of A.N.N. by Hasson.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)							
Course Code	**01MEL528**	**Course Name**	**Design Optimization (Elective IV)**				
Teaching Scheme					**Evaluation Scheme**		
L	T	P	Credits		SE-I Marks	SE-II Marks	SEE Marks
3	-	-	3		25	25	50

Course Objectives:	
01	To understand Classical Optimization Techniques
02	Apply Single-variable Optimization Techniques, and Multi-variable Optimization Techniques
03	Understand Constrained Optimization Techniques
04	Accustom with latest techniques like Genetic Algorithm, Simulated Annealing, Artificial Neural Networks
05	Know theory of Constraints

Course Outcomes:	
	At the end of the course students will be
01	Able to understand type of optimization problem
02	Able to apply Single-variable Optimization Techniques, and Multi-variable Optimization Techniques as per requirement
03	Select and apply constraints in a problem
04	Demonstrate ability to use technique like ANN, GA

Course Contents		
Unit I	**< Classical Optimization Techniques >**	**5 Hours**
Single-variable and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers Method and Kuhn-Tucker Conditions.		
Unit II	**< Single-variable Optimization Techniques >**	**10 Hours**
Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval-halving Method, Fibonacci Method, Golden-section Method, Quadratic Interpolation Method, Newton Method, Quasi-Newton Method, Secant Method		
Unit III	**< Multi-variable Optimization Techniques >**	**10 Hours**
Evolutionary Optimization Method, Simplex Search Method, Pattern Search Method, Conjugate Direction Method, Steepest Descent Method, Newton's Method, Conjugate Gradient Method, Davidon- Fletcher-Powell Method		
Unit IV	**< Constrained Optimization Techniques >**	**5 Hours**
Interior Penalty Function Method, Exterior Penalty function Method		
Unit V	**< Genetic Algorithm, Simulated Annealing, Artificial Neural Networks >**	**3 Hours**
Genetic Algorithm, Simulated Annealing, Artificial Neural Networks		
Unit VI	**< Theory of Constraints >**	**6 Hours**
Introduction to TOC, Optimized Production Technology (OPT), Nine principles of OPT, Five Focusing Steps (The 5FS) of TOC, Capacity Constrained Resources and the Time Buffer, Modeling the Time Buffer, Modeling Return-On- Investment (ROI) in TOC, Comparison of TOC and Local Optimization Approaches.		

Texts Books:	
1	Deb K (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India.

2	Dennis J Jr, Schnabel R (1996). Numerical Methods for Unconstrained Optimization and Nonlinear Equations, Society for Industrial and Applied Mathematics.
3	Rao S (1996). Engineering optimization, Theory and Practice, New Age International Publishers.
Reference Books:	
1	Ravindran A, Ragsdell K and Reklaitis G (2006). Engineering Optimization: Methods and Applications, 2nd edition, John Wiley and Sons Inc.
2	Goldratt, E. M. and Cox, J. (2004). The Goal: A Process of Ongoing Improvement. 3rd Edition, North River Press. ISBN-10: 0884271781, ISBN-13: 978-0884271789.
3	Dettmer, H. William (1997). Goldratt's Theory of Constraints: A Systems Approach to Continuous Improvement, American Society for Quality. ISBN 0873893700, 9780873893701.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)					
Course Code	**01MEP529**	**Course Name**	**Manufacturing System Design**		
Teaching Scheme				**Evaluation Scheme**	
L	T	P	Credits	CIE Marks	SEE Marks
-	-	2	1	50	50

Course Objectives:	
On completion of the course, student will be able -	
01	Study of die design in sheet metal including the process, measurements, design and selection of parameters and their industrial specifications.
02	Introduce students to development of non-metallic components using injection moulding
03	Study of design of fixtures for fabrication, assembly and inspection
04	Introduce the students to gauge and gauge design
Course Outcomes:	
At the end of the course, students will be able to	
01	Identify and explain fundamentals of Die design in sheet metal.
02	Design Blanking and Piercing Dies, Bending, Forming and drawing die for component under consideration using fundamental principle
03	Understand development of non-metallic components using injection moulding and Gauge and Gauge design
04	Design of Fixtures for Fabrication, Assembly and Inspection.
List of Experiments	
1	Blanking & Piercing die design.
2	Bending, forming, and drawing die design.
3	Die design for injection molded components.
4	Fixtures for Assembly, fabrication, inspection.
5	Use of CMM for component measurement and reverse engineering.
6	Use of software's like Mould flow / Mouldex for suitable applications.
7	Assignments on syllabus.
8	Assignments on syllabus.
9	Assignments on syllabus.
10	Assignments on syllabus.
	Submission: Completed Journal
Texts Books:	
1	Tool Design - Cyrill Donaldson, G.H LeCain, V.C. Goold, Tata McGraw Hill Publi.
2	Jigs & Fixtures- Kempster, ELBS.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code		**01MEP530**	**Course Name**	**Creativity, Innovation & New Product Development**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2/ Alt. Wk	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	To make students aware about the importance of creativity and innovation in new product design.
02	Use various techniques for idea generation and problem solving in.
03	Know the importance of intellectual property and procedures to preserve intellectual property rights.
04	Know journeys in product development.
Course Outcomes:	
At the end of the course, students will be able to	
01	Able to find opportunities of new product development.
02	Able to use market research, benchmarking in project planning.
03	Use creativity and innovation in new product development.
04	Use design engineering for new product, able to prepare model, build test, refine.
05	Able to track procedures, file patent preserve intellectual property rights.
List of Experiments	
	Creative design - Model Preparation - Testing - cost evaluation - Patent application.
	Submission: Completed Journal.
Texts Books:	
1	HARRY NYSTROM, " Creativity and innovation", John Wiley & Sons, 1979.
2	BRAIN TWISS, " Managing technological innovation", Pitman Publishing Ltd., 1992.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code		**01MEP531**	**Course Name**	**Product Life Cycle Management**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2/ Alt. Wk	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	Familiarize the current principles, practices, and applications of Product Lifecycle Management (PLCM).
02	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
03	Experience effective integration of PLCM technologies into the product development process that can put the industry at a competitive advantage to deliver innovative products
04	Experience modern PLCM strategies, methods, and tools
Course Outcomes:	
At the end of the course, students will be able to	
01	Integrate the various stages of PLCM into engineering product ranges and portfolios that will eventuate into commercial success.
02	Integrate lifecycle management strategies and knowledge to develop new and/or formulate appropriate engineering design solutions in engineering environment.
03	Applying product modelling and using analyse tools for solving engineering problems.
04	Experience Product Data Management (PDM) technology and recent advances in PLCM.
List of Experiments	
	Minimum Six Assignments.
	It shall consist of hands-on case assignments on suitable PLM software and other assignments based on the syllabus
	Submission: Completed Journal.
Texts Books:	
1	Product Life Cycle Management - by Antti Saaksvuori, Anselmi Immonen, Springer, 1st Edition (Nov.5, 2003)
2	Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer-Verlag, 2004. ISBN 1852338105
3	Product Life Cycle Management - by Antti Saaksvuori, Anselmi Immonen, Springer, 1st Edition (Nov.5, 2003)
Reference Books:	
1	Product Design & Process Engineering, McGraw Hill - Kogalkusha Ltd., Tokyo, 1974.

2	Product Design & Development - by Kari Ulrich and Steven D. Eppinger, McGraw Hill International Edns, 1999.
3	Effective Product Design and Development - by Stephen Rosenthol, Business One Orwin, Homewood, 1992 ISBN 1-55623-603-4.
4	Burden, Rodger PDM: Product Data Management, Resource Pub, 2003. ISBN 0970035225
5	Clement, Jerry; Coldrick, Andy; & Sari, John. Manufacturing Data Structures, John Wiley & Sons, 1992. ISBN 0471132691
6	Clements, Richard Barrett. Chapter 8 ("Design Control") and Chapter 9 ("Document Control") in Quality Manager's Complete Guide to ISO 9000, Prentice Hall, 1993. ISBN 013017534X
7	Crnkovic, Ivica; Asklund, Ulf; & Dahlqvist, Annita Persson. Implementing and Integrating Product Data Management and Software Configuration Management, Artech House Publishers, 2003. ISBN 1580534988
8	Garwood, Dave. Bills of Materials for a Lean Enterprise, Dogwood Publishing Co., 2004. ISBN 0962111848
9	Fan ,D(Ed.), Virtual Reality for Industrial Applications, Springer

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code	**01MEP532**	**Course Name**	**Experimental Stress Analysis (Elective III)**			
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	1		50	50

Course Objectives:	
On completion of the course, student will be able -	
01	Understand the relationship between mechanics theory and experimental stress analysis.
02	Apply numerical stress analysis techniques to real world engineering design problem.
03	Apply experimental stress analysis techniques to real world engineering design problem.
Course Outcomes:	
At the end of the course, students will be able to	
01	Student will be able to understand concept of stress and strain
02	Student will be able to understand underlying principles in using strain gauges
03	Ability to mount strain gauges, take measurements and analyse the obtained data.
04	Student will be able to understand basic principles of photo-elasticity, and use it as an analysis tool.
List of Experiments	
1	Determination of strain by attaching strain gauges to minimum two stressed members subjected to tension, bending, and torsion or combined.
2	Use of Strain rosette for principal strain determination by Mohr circle method
3	Model preparation for 2-d and 2-d photo elasticity analysis.
4	Determination of Stresses in 2-D elements
5	Determination of Stresses in 3-D elements
6	Study of coating techniques for stress and strain determination
	Submission: Completed Journal.
Texts Books:	
1	Sadhu Singh - Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.
2	JW Dalley & WF Riley, Experimental Stress Analysis, McGraw Hill Book Co. N.Y. 1991
3	L.S. Srinath et al, Experimental Stress Analysis, Tata McGraw Hill Company, New Delhi, 1984
Reference Books:	
1	R.S.Sirohi, HC Radhakrishna, Mechanical Measurements, New Age International (P)Ltd. 1997
2	F.K Garas, J.L. Clarke and GST Armer, Structural assessment, Butterworths, London, 1987
3	D.E. Bray & R. K.Stanley, Non-destructive Evaluation
4	Dove and Adams, Experimental Stress Analysis and Motion Measurement, PHI, 1965.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code		**01MEP533**	**Course Name**	**Reliability Engineering (Elective III)**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	1		50	50

Course Objectives:	
On completion of the course, student will be able -	
01	To introduce principles of reliability in engineering design
02	To develop understanding of concepts of failures, maintainability and availability of the intended products/systems and services.
03	To develop an ability to analyze field failure data in order to evaluate system reliability.
04	To develop an ability to apply various reliability techniques to solve interdisciplinary reliability problems.
Course Outcomes:	
At the end of the course, students will be able to	
01	Recognize the importance of selection of proper manufacturing process and its influence on new product development process and understand the interrelationship between product design and production methods for improving product performance during stage of design itself.
02	Identify the factors contributing reduction in assembly time and understand to incorporate assembly & disassembly guidelines in product design.
03	Utilize reliability concepts, failure analysis tools and techniques and accelerated life test methods for improving product life cycle.
04	Understand the factors controlling cost and time required for the product maintenance and utilize this information for design for maintenance.
List of Experiments	
	Minimum Six assignments on related topics in syllabus, which should include at least one case study.
	Submission: Completed Journal.
Texts Books:	
1	Antony J (2003). Design and Experiments for Engineers and Scientists, Butterworth- Heinmann.
2	Cochran W and Cox G (2000). Experimental Designs, II edition, John Wiley & Sons Inc.
3	Dean A and Voss D (2006). Design and Analysis of Experiments, Springer.
Reference Books:	
1	Jeff Wu C and Hamada M (2000). Experiments: Planning, Analysis and Parameter Design Optimization, John Wiley and Sons Inc.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code	**01MEP534**	**Course Name**	**Industrial Robotics & Expert Systems (Elective III)**			
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	1		50	50

Course Objectives:	
On completion of the course, student will be able -	
01	Applications and benefits of group technology, computer aided process planning, material requirement planning (MRP) etc.
02	Enable students to use the concepts of Co-ordinate Measuring Machine (CMM), Flexible Manufacturing Systems (FMS), etc.
03	Emphasize on the quality improvement, automation, and advanced manufacturing techniques to create the highest-caliber products quickly, efficiently, inexpensively.
04	Application of computers in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines
Course Outcomes:	
At the end of the course, students will be able to	
01	Recognize the importance of CIM in today's scenario and its impact on global competition.
02	Students are able to develop CNC programming and work on CNC machine.
03	Students can understand the concept of automation in manufacturing and assembly operations.
04	Understand the engineering and economical aspects of automatic storage and retrieval system.
List of Experiments	
	Minimum Six assignments on related topics given in syllabus.
	Submission: Completed Journal.
Texts Books:	
1	K.S.Fu, R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill, 1987
2	Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.
3	Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, 1985.
Reference Books:	
1	Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering - An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
2	Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
3	Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
4	Timothy Jordanides et al ,"Expert Systems and Robotics ", Springer -Verlag, N, May 1991.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code		**01MEP535**	**Course Name**	**Additive Manufacturing (Elective IV)**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	Distinguish various types of Rapid prototyping techniques
02	Interpret new terms and information on 3 D Modeling methods
03	Distinguish various classes of materials used in Rapid prototyping techniques
04	Analyse Various RP deposition techniques
Course Outcomes:	
At the end of the course, students will be able to	
01	Understand and use techniques for processing of CAD models for rapid prototyping.
02	Understand and apply fundamentals of rapid prototyping techniques.
03	Use appropriate tooling for rapid prototyping process.
04	Use rapid prototyping techniques for reverse engineering.
List of Experiments	
1	Review of CAD Modelling Techniques
2	Generating STL files from the CAD Models & Working on STL files
3	Errors in RP Processes and Applications
4	Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
5	Fabricating the physical part on a RP machine
6	Learning techniques for fabricating an assembly
7	Prepare a CAD model with complex geometry
8	Geometrical Analysis of physical prototype
9	Study of operating principles of FDM machine
	Submission: Completed Journal.
Texts Books:	
1	Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2	Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton,
3	Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles & Applications in Mfg, World Scientific.
Reference Books:	
1	Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping toDirect Digital Manufacturing, Springer.
2	Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.
3	Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4	Hilton P, Jacobs P F, Rapid Tooling: Technologies and Industrial Applications, CRC press.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code	**01MEP536**	**Course Name**	**Artificial Intelligence & Neural Network (Elective IV)**			
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	Correlates to program objectives
02	Understand the role of artificial intelligence and neural networks in engineering.
03	Provide knowledge of different forms of search strategies and learning in neural networks.
04	Understand the different applications of AI and ANN in various engineering and industrial problems.
Course Outcomes:	
At the end of the course, students will be able to	
01	Understand the role of artificial intelligence and neural networks in engineering.
02	Have an understanding of the concepts and techniques of neural networks through the study of the most important neural network models.
03	Have knowledge of sufficient theoretical background to be able to reason about the behaviour of neural networks.
04	Evaluate whether neural networks are appropriate to a particular application and apply neural networks to particular applications, and to know what steps to take to improve performance.
List of Experiments	
	Minimum six exercises based on topics given in syllabus, consisting of case studies.
	Submission: Completed Journal.
Texts Books:	
1	Stuart Russel, Peter Norwig (2003), "Artificial Intelligence : A Modern Approach" 2/e, (Pearson Education)
2	Elaine Rich, Kevin Knight, (1991), "Artificial Intelligence" 2/e, (Tata McGraw Hill)
3	Dan W. Patterson (1999), "Introduction to Artificial Intelligence and Expert Systems" (7th Indian Reprint) (EEE) (Prentice Hall of India)
Reference Books:	
1	Rex Mauss, Jessica Keyes , "Handbook of Expert Systems in Mfg.", (McGraw Hill)
2	Groover, Weiss, Nagel, Audrey, "Industrial Robotics- Technology, Programming and Applications"", (McGraw Hill)
3	Fu, Gonzalea and Lee, "Robotics: Control, Sensing, Vision and Intelligence", (McGraw Hill)
4	Conference Proceedings and current journals for case studies and applications.
5	Introduction to A.N.N. by Anderson, Prentice Hall of India Publication.
6	A.N.N. by Yadnanarayana, Prentice Hall of India Publication
7	A.N.N. by Zurda J.M.
8	A.N.N. and MatLab by Sivanandan.
9	Fundamentals of A.N.N. by Hasson.

First Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–II)						
Course Code		**01MEP537**	**Course Name**	**Design Optimization (Elective IV)**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	1		50	--

Course Objectives:	
On completion of the course, student will be able -	
01	To understand Classical Optimization Techniques
02	Apply Single-variable Optimization Techniques, and Multi-variable Optimization Techniques
03	Understand Constrained Optimization Techniques
04	Accustom with latest techniques like Genetic Algorithm, Simulated Annealing, Artificial Neural Networks
Course Outcomes:	
At the end of the course, students will be able to	
01	Able to understand type of optimization problem
02	Able to apply Single-variable Optimization Techniques, and Multi-variable Optimization Techniques as per requirement
03	Select and apply constraints in a problem
04	Demonstrate ability to use technique like ANN, GA
List of Experiments	
	Minimum six exercises based on topics given in syllabus, consisting of case studies.
	Submission: Completed Journal.
Texts Books:	
1	Deb K (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India.
2	Dennis J Jr, Schnabel R (1996). Numerical Methods for Unconstrained Optimization and Nonlinear Equations, Society for Industrial and Applied Mathematics.
3	Rao S (1996). Engineering optimization, Theory and Practice, New Age International Publishers.
Reference Books:	
1	Ravindran A, Ragsdell K and Reklaitis G (2006). Engineering Optimization: Methods and Applications, 2nd edition, John Wiley and Sons Inc.
2	Goldratt, E. M. and Cox, J. (2004). The Goal: A Process of Ongoing Improvement. 3rd Edition, North River Press. ISBN-10: 0884271781, ISBN-13: 978-0884271789.
3	Dettmer, H. William (1997). Goldratt's Theory of Constraints: A Systems Approach to Continuous Improvement, American Society for Quality. ISBN 0873893700, 9780873893701.

Second Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–III)						
Course Code		**01MED601**	**Course Name**	**Dissertation Phase-I**		
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	16	16		50	50

Course Objectives:	
On completion of the course, student will be able -	
01	To identify research issue/problem on advance engineering topics related to Mechanical Engineering.
02	To gain knowledge on the research problems identified through extensive literature survey.
03	To understand the tools required to carry out research work.
Course Outcomes:	
At the end of the course, students will be able to	
01	Ability to identify research issue/problem on complex engineering topics related to Mechanical Engineering.
02	Gain knowledge on the research problem identified through extensive literature survey.
03	Ability to work in group and mange and understand research papers/literature related to research topic through group-discussion.
04	Understanding of professional & ethical research issues.
05	Ability to present/communicate effectively the research topic though synopsis presentation.
06	Understanding of simulator tools required to carry out research work.
	Guidelines :
•	Dissertation Phase-I should be based on the literature survey on any topic relevant to CAD/CAM/CAE, Product Design & Development and related advancement.
•	Each student has to prepare a report of about 30 pages. The report typed on A4 sized sheets and bound in the necessary format should be submitted after approved by the guide and endorsement of the Head of Department.
•	The report shall contain some contribution by the candidate in the form of experimental results, deductions, compilation and inferences etc.
•	The student has to deliver a seminar talk in front of the teachers of the department and his classmates. The Guide based on the quality of work and preparation and understanding of the candidate shall do an assessment of the seminar.

Second Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–III)						
Course Code			**01MED602**	**Course Name**	**Mini Project / Industrial Training**	
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	2		50	--

	Guidelines :
•	Students should undergo training of 2 weeks in industry after Semester II, or
•	Student should undertake small project (mini project) related to the topics given in semester I & II curriculum.
•	The detailed training report of 25 to 30 pages should be submitted during the Semester III.
•	Evaluation will be carried out at the end of Semester III based on training report.

Second Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–III)						
Course Code			**01MED603**	**Course Name**	**Seminar**	
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	2	2		50	--

Guidelines :

- Preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review and develop confidence to present the seminar content by the student on technical topics.

- The seminar shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester.

Second Year M. Tech. Mechanical Engineering (Product Design & Development) (Semester–IV)						
Course Code		**01MED604**		**Course Name**	**Dissertation Phase-II**	
Teaching Scheme					**Evaluation Scheme**	
L	T	P	Credits		CIE Marks	SEE Marks
-	-	20	20		50	50

Course Objectives:	
01	Ability to bring ideas into practice through simulation of analysis of research topic.
02	Ability to identify specific industrial problems in the form of research objectives.
03	Ability to propose a novel idea/modified technique/new interpretation after analyzing the existing research work.
Course Outcomes:	
At the end of the course, students will be able to	
01	Identify specific problems/issues in the form of research objectives.
02	Propose a novel idea/modified technique/new interpretation after analyzing the existing research work.
03	Contribute towards the knowledge up gradation of scientific community and society in general.
04	Impose communication skills (oral as well as writing) through seminars, group discussions, thesis writing and research paper writing.
05	Understate significance of ethical and research professional.
06	Stay updated through continuous learning.
07	Understand research techniques and simulation tools for analysis of research issues.
08	Interpret and compile the simulation results to issue at a meaningful conclusion.
	Guidelines :
•	It shall include the problem definition, literature survey, approaches for handling the problem, finalizing the methodology for the dissertation work and design calculations / experimental design, etc.
•	A report of the work shall be submitted at the end of Semester IV after approval by the Guide and endorsement of the Head of Department.
•	It will be assessed for term work, by the evaluation committee appointed by the Head of Department, for appropriateness.