REGULATION 2017

COURSE STRUCTURE

SYLLABUS

DEPARTMENT OF MECHANICAL ENGINEERING

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, GUNUPUR
(Autonomous)– 765022
(Affiliated to Biju Patnaik University of Technology, Rourkela)
Accredited by NAAC with 'A' Grade with a CGPA of 3.28/4.00
Accredited by NBA

2 Year M.Tech Degree Programme

Regulation 2017

Choice Based Credit System

Outcome Based Assessment

Mechanical Engineering

Programme Educational Objectives

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates of the program will have a successful career of mechanical engineering by imparting Mechanical Engineering concepts and practical knowledge.

PEO2: Graduates of the program will pursue higher education and research in the field of mechanical engineering.

PEO3: Graduates of the program will exhibit Scientific and Engineering expertise and perform as a Professional Entrepreneur.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Ability to apply the acquired Mechanical Engineering knowledge for the development of composite materials for societal application.

PSO 2: Ability to implement the learned principles of Mechanical Engineering to analyze, evaluate and create more advanced mechanical systems by using state-of-art facilities.

PROGRAMME OUTCOMES (POs)

PO-1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO-2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3. Design / Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO- 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO- 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO- 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO- 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO- 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO- 9. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11. Project management and finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO- 12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Subject Category		Subject Name	Sem	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PROFESSIONAL CORE COURSES	PC	APPLIED ELASTICITY AND PLASTICITY	I	3	2	2	1	1	-	-	-	-	-	1	1
				3	3	3	2	1	2	1	-	1	-	1	0
				2	2	2	2	1	1	1	2	1	1	1	0
				3	3	3	2	1	1	1	2	1	1	1	2
	PC	ADVANCED MECHANICS OF SOLIDS	I	3			2				1		1		1
				3		2	2				1		1		1
				3			2				1		1		2
				2	2		3	1			1		1		1
	PC	MACHINE VIBRATION	I	3	2	3	2	1	1			1	2	1	3
				3	2	3	3	1				1	2	1	3
				3	2	3	3	2	1		1	2	2	2	2
				3	2	2	3		3	1	2	3	3	2	3
	PC	MECHANICS OF COMPOSITE MATERIALS	II	3	3	1	1	1	1		1		1	1	2
				3	3	2	2	3			1	1	2		2
				3	3	3	2	2			1	1	2		2
				2	2	3		3	1		1	2	3	2	2

	PC	EXPERIMENTAL STRESS ANALYSIS	II	3	2	2	1	1	-	-	-	-	-	1	1
				3	3	3	2	1	2	1	-	1	-	1	0
				2	2	2	2	1	1	1	2	1	1	1	0
				3	3	3	2	1	1	1	2	1	1	1	2
PROFESSIONAL ELECTIVE COURSES RELEVANT TO CHOSEN BRANCH / SPECIALISATION	PE	FATIGUE, CREEP & FRACTURE	I	3	3	2		2	2	3	2	1		3	2
				2	3		1			3			1	3	1
				2	1				1			1	2	3	1
				1	1		2		1	3		1	2		2
	PE	COMPUTER AIDED DESIGN	I	3	3	2		2	2	3	2	1		3	2
				2	3		1			3			1	3	1
				2	1				1			1	2	3	1
				1	1		2		1	3		1	2		2
	PE	OPTIMUM DESIGN OF MECHANICAL SYSTEMS	I	3								1		1	1
				3	2	2		2		2		1	1	2	1
				3	2	1		2		2		1	1	2	1
				3	2	1		2		2		1	1	1	1
	PE	ANALYSIS AND DESIGN	I	3	2	3	1	1					1		1

		OF PRESSURE VESSELS AND PIPING		2	3	1	2	2	1	2			1		1
				3	2	2	2	2	2		2		1		1
				3	3	1	2	1							1
	PE	NUMERICAL ANALYSIS	I	2	1	1	1		1		1	1		1	2
				3	1	2	1		1	1				1	2
				2	1	1	1					1			2
				1	1	1	2	1	2	1		1			3
	PE	INSTRUMENTATION AND AUTOMATIC CONTROL SYSTEMS	I	3	2	2	1	1	2	2		1		1	3
				3	3	3	2	2	2	2		1		2	3
				3	1	2	1		2	1		2		2	3
				2	1	2	1		1			1		1	2
	PE	ADVANCED MECHANISMS OF MACHINES	I	2	3	3	1	0	1	0	0	0	2	1	1
				3	3	2	2	2	2	2	1	2	1	1	2
				3	3	2	2	1	2	1	1	1	1	1	2
				2	3	3	1	1	1	1	1	1	1	1	2
	PE	MATERIAL SELECTION IN MECHANICAL DESIGN	I	3		1	3	1		2		1	2	2	1
				3	2	2	3	1	1	2					1

				3	2	2	3	2		2		1	1		1
				3	2	2	3	3		2		1		2	1
	PE	MACHINE FAULT DIAGNOSIS AND SIGNAL PROCESSING	II	3	2	2	2	1							2
				3	3	2	2	2	1	1					3
				3	2	2	3		1	1					3
				3	2	2	2								3
	PE	MECHATRONICS	II	3	3	3		2							3
				3	3	3	3	1					1		3
				3	3	3	3	1	1	1					3
				3	3	3	1	2	1						3
	PE	MECHANICAL DRIVES	II	3	3	3	3	2				1	1	2	3
				3	3	3	3	2			1	3	1	2	3
				3	3	3	3	2			1	2	1	2	3
				3	3	3	3	3	2	2	3	3	3	2	3
	PE	MACHINE TOOL DESIGN	II	3	2		1					1			1
				2	3		1	1				1			1
				2	2	1	2	2		1	1	1			1

				2	1	1	2	2	1	1	1	1			1
	PE	FINITE ELEMENT METHOD	II	3	2	2	1	1	1	1		1	1	2	3
				3	2	2	3	2	1			1	2	2	3
				3	2	2	3	2					2	2	3
				3	3	2	3	2	2	1		2	2	3	2
	PE	COMPUTER GRAPHICS AND VISUALIZATION	II	2	3	1	2	1	2		1		2	1	2
				3	3	2	2	3	1	1	1	1	2	1	2
				3	2	2	2	2	1	1	1	1	2		2
				1	2	2	2	2	1		1	2	3	2	2
	PE	BASIC MECHANICAL HANDLING SYSTEMS	II	1	1	1	1		3	3	3	1	1	2	1
				2	3	1	3		3	2	2	2	3	3	1
				1	2	3	2	2	2	2	1	1	1	2	1
				2	1	3	1	2							1
	PE	ANALYSIS AND SYNTHESIS OF MECHANISM	II	3	3	2	1	1				1	1	1	1
				3	3	3	2	1				1	1	1	1
				2	3	2	2	1				1	1	1	1
				2	3	3	2	2				1	1	1	1

	PE	BEARING AND LUBRICATION	II	3	3	1	1	1	1		1		1	1	2
				3	3	2	2	3				1			2
				3	3	3	1	1	1			1			1
				3	3	3	1	3	1	1		2	1	1	2
	PE	ROBOTICS	II	3	1	1	1		2	2	2	1	2	1	3
				3	3	3	3	2	2	3	1	2	2	2	3
				3	2	3	3	2			1	2	2	2	2
				3	2	2			3	3	2	3	3	2	3
	PE	DYANAMICS OF ROTORS	II	3	3	2	1	3	2	3		1		1	1
				2	3	2	1	2	1	3	2		1	1	2
				2	2	1	2	2	1	2	1	1	2		3
				2	2	1	2	2	1	3		1	2		3
	PE	ADVANCED GEAR ENGINEERING	II	3	3	2	1	1	1			1	1	1	1
				3	3	3	2	2	1	1				1	2
				3	3	3	3	2	1	2	1	3	1	2	3
				2	2	2		2	1		1	2	2	1	2
ES	ES	ENGINEERING	I					3				2		2	

		SOFTWARE LAB		3	3			2								
					3	2	2	2				2				
				2	2						3	2	2	3		
	ES	ADVANCED DESIGN ENGINEERING LAB	II	3	2	1	3	1				1	2	1	3	
				3	2	1	3	1				1	2	1	3	
				3	2	3	3	2	1		1	2	2	2	3	
				3	3	3	3					1	3	2	3	
OPEN ELECTIVES	OE	PROJECT MANAGEMENT AND COSTING	III	3	2	1	2	2	1		2	2	1	2	2	
				2	2	1	1	1	2		2	2	2	2	2	
				3	2	1	1	1	2			2	2	1	3	
				3	2	1	1	2			1	1	2	1	2	
	OE	RESEARCH	III	3	2	2	1	2				1	2	1	3	

		METHODOLOGY		3	2	1	1	2			2	1	2	2	2
				3	2	2	1	1			1	2	1	1	1
				2	2	2					2	2	2	1	2
	OE	HUMAN RESOURCE MANAGEMENT	III	2				1	1		2	2	2	1	3
				3	2			2	1		2	1	2	2	3
				3	2			2	2		2	2	2	1	2
				1				2	2		1	2	2	2	3

SEMESTER WISE COURSE STRUCTURE

I SEMESTER								
S.No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**QP**
THEORY								
1.	PC	MMDPC1010	APPLIED ELASTICITY AND PLASTICITY	3	1		4	
		MMDPC1020	ADVANCED MECHANICS OF SOLIDS	3	1		4	
		MMDPC1030	MACHINE VIBRATION	3	1		4	
2.	PE	MMDPE1041	FATIGUE, CREEP & FRACTURE	3	0		3	
		MMDPE1042	COMPUTER AIDED DESIGN	3	0		3	
		MMDPE1043	OPTIMUM DESIGN OF MECHANICAL SYSTEMS	3	0		3	
		MMDPE1044	ANALYSIS AND DESIGN OF PRESSURE VESSELS AND PIPING	3	0		3	
3.	PE	MMDPE1051	NUMERICAL ANALYSIS	3	0		3	
		MMDPE1052	INSTRUMENTATION AND AUTOMATIC CONTROL SYSTEMS	3	0		3	
		MMDPE1053	ADVANCED MECHANISMS OF MACHINES	3	0		3	
		MMDPE1054	MATERIAL SELECTION IN MECHANICAL DESIGN	3	0		3	
PRACTICAL								
1.	ES	MMDES1160	ENGINEERING SOFTWARE LAB	2	0		4	
TOTAL				**17**	**3**		**22**	

II SEMESTER								
SL.No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**QP**
THEORY								
1.	PC	MMDPC2010	MECHANICS OF COMPOSITE MATERIALS	3	1		4	
		MMDPC2020	EXPERIMENTAL STRESS ANALYSIS	3	1		4	
2.	PE	MMDPE2031	MACHINE FAULT DIAGNOSIS AND SIGNAL PROCESSING	3	0		3	
		MMDPE2032	MECHATRONICS	3	0		3	
		MMDPE2033	MECHANICAL DRIVES	3	0		3	
		MMDPE2034	MACHINE TOOL DESIGN	3	0		3	
3.	PE	MMDPE2041	FINITE ELEMENT METHOD	3	0		3	
		MMDPE2042	COMPUTER GRAPHICS AND VISUALIZATION	3	0		3	
		MMDPE2043	BASIC MECHANICAL HANDLING SYSTEMS	3	0		3	
		MMDPE2044	ANALYSIS AND SYNTHESIS OF MECHANISM	3	0		3	
4.	PE	MMDPE2051	BEARING AND LUBRICATION	3	0		3	
		MMDPE2052	ROBOTICS	3	0		3	
		MMDPE2053	DYANAMICS OF ROTORS	3	0		3	
		MMDPE2054	ADVANCED GEAR ENGINEERING	3	0		3	
PRACTICAL								
1	ES	MMDES2160	ADVANCED DESIGN ENGINEERING LAB	2	0		4	
2	ES	MTEES2170	SEMINAR I	2	0		2	
TOTAL				**19**	**2**		**23**	

APPLIED ELASTICITY AND PLASTICITY								
III SEMESTER								
SL.No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**QP**
THEORY								
1.	OE	MMDOE3011	RESEARCH METHODOLOGY	3	0		3	
2.		MMDOE3012	HUMAN RESOURCE MANAGEMENT	3	0		3	
3.		MMDOE3013	PROJECT MANAGEMENT AND COSTING	3	0		3	
PRACTICAL								
1.	ES	MMDES3120	SEMINAR II				2	
2.		MMDES3130	THESIS I	2			18	
TOTAL				**5**	**0**	**0**	**23**	

IV SEMESTER								
SL.No	**Course Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**QP**
PRACTICAL								
1.	ES	MMDES4110	SEMINAR III	2			2	
2.		MMDES4120	THESIS II	2			18	
3.		MMDES4130	COMPREHENSIVE VIVA VOCE				2	
TOTAL				**4**			**22**	

ADVANCED MECHANICS OF SOLIDS					
Subject Code		L	T	P	C
MMDPC1020		3	1		4

Course Outcome

CO 01	Apply principles of elasticity theory to determine stresses and strains
CO 02	Apply theory of elasticity and formulate plane stress and plane strain problems
CO 03	To solve for stresses and deflection of beams under unsymmetrical bending and to locate shear Centre of thin wall beams.
CO 04	o analyse solid mechanics problem using classical methods and energy methods.

UNIT:1 (14 Hours)

Shear center and unsymmetrical bending. Beam columns; Beams on elastic foundations; curved beams, rotating discs and thick cylinders. Virtual work; Minimum potential energy; Hamilton's Principle. Plate theory: Formulation by Hamilton's principle: Bending and buckling of homogenous and Sandwich Plates.

UNIT:2 (14 Hours)

Shell theory: Introduction to theory of surface; Formulation by Hamilton's Principle; membrane, bending and buckling analysis of shells of revolution. Stress-strain relations for linearly elastic solids, Generalized Hooke's law. Analysis of three dimensional stresses and strains. Tensor character of stress. Strain-displacement relations, equilibrium equations, compatibility conditions and Airy's stress function.

UNIT:3 (14 Hours)

Plane stress and plane strain, simple problems in Cartesian and polar co-ordinates. Solution of axisymmetric problems, Bending of beams and plates, Kirkhhof and Mindlin concept. Torsion problem with St.Venant's approach-Prandtl's approach - Torsion of thin walled open and closed sections & thermal stress..

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Advanced Mechanics of Materials - F. B. Seely and J. O. Smith. John Wiley and Sons Inc, 2 nd edition, 1952.
2. Advanced Mechanics of Materials, 4th edition A. P. Boresi and O. M. Sidebottom. John Wiliey and Sons, 1985.
3. Advanced Mechanics of Solids - L. S. Srinath. Tata Mc-Graw Hill Co., 2005

Ref. Books

1. Elementary Mechanics of Solids - P.N. Singh and P.K. Jha. New Age International, 2002.
2. Mechanics of Solids (Vol. 1& 2) - R. Baidyanathan, P.Perumal and S. Lingeswari. Scitch Publications.
3. Timoshenko, S. and Goodier J.N. Theory of Elasticity, McGraw Hill Book Co., Newyork, 1988.
4. J. Chakrabarty, Theory of Plasticity, McGraw-Hill Book Company, New York 1990
5. Irving H.Shames and James,M.Pitarresi, Introduction to Solid Mechanics,Prentice Hall of India Pvt. Ltd., New Delhi -2002.
6.E.P. Popov, Engineering Mechanics of Solids, 2nd Ed., Prentice Hall India, 1998.
7. W.F.Chen and D.J.Han., Plasticity for structural Engineers., Springer-Verlag., NY., 1988.
8. Hoffman and Sachs, *Theory of Plasticity* - McGraw Hill., 2nd ed. 1985
9. Johnson and Mellor, *Engineering Plasticity*- Van-Nostrand., 1st edition, 1983.

MACHINE VIBRATION					
Subject Code		L	T	P	C
MMDPC1030		3	1		4
Course Outcome					
CO1	Relate the causes and effects of vibration in mechanical systems.				
CO2	Develop schematic models for physical systems and formulate governing equations of motion.				
CO3	Able to know the various constraints of vibration system and its analysis.				
CO4	Analyze the vibrations of various generic components, its effect on balancing and the devices for its measurements.				

UNIT:1

(12 Hours)

Review of free and forced vibrations with and without damping. Hamilton's Principle.

Isolation: Theory of oscillation of single degree freedom system with application to Vibration isolation and

vibration measurement. Vibration isolation and transmissibility; Un-damped vibration absorbers.

UNIT:2

(15 Hours)

Multi degree of freedom system:

Generalized coordinates and coordinate coupling; Orthogonality of modes, Free and forced vibration of multi-degree of freedom systems with and without viscous damping; Lagrange's equation; Holzer's method. Solution of Eigen value problem, transfer matrix and modal analysis. Multi-degree freedom system with application to measurement. Multiple degree of freedom systems with applications to dynamic vibration absorbers. Application of matrix to vibrational problems, General theory of small oscillation of conservative systems, principal frequencies and modes. Introduction of Rayleigh and Rayleigh-ritz Methods.

UNIT:3 (13 Hours)

Continuous System: Transverse vibration of a string, longitudinal vibration of a bar, torsional vibration of a shaft, transverse vibration of a beam.

Vibration of membranes and plates, Lap lace Transforms and operational Methods.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Mechanical Vibration : Theory and Applications - F.S. Tse, I.E. Morse and R.T. Hinkle. CBS Publishers, 2002.

2. Theory of Vibration with Application - W.T. Thomson, PHI, 1979.

Ref. Books

1. Principles of Vibration Contro - A. K. Mallick, East-West Press, 1990.

2. Mechanical Vibrations - S. S. Rao. Pearson, 2004.

3. Advanced Theory of Vibration - J.S. Rao. New Age Publication.

4. Introductory course on Theory and Practice of Mechanical Vibration - J.S.Rao and K. Gupta. New Age Publication, 2004.

FATIGUE, CREEP & FRACTURE					
Subject Code		L	T	P	C
MMDPE1041		3	0	0	3

Course Outcome	
CO1	Be familiar with the fatigue development andInfluence of stress concentration under fatigue strength.
CO2	Understand and able to analyse Mechanism of creep and it effects in design components.
CO3	Interface various modes of fracture under different Theories.
CO4	Ability to conduct an experimental analysis on different materials subjected to creep, fatigue and fracture mechanisms.

UNIT:1 (12 Hours)

Fatigue: Types of fatigue loading and failure, Fatigue test, endurance limit; Fatigue under combine stresses; Influence of stress concentration on fatigue strength, Notch sensitivity, Factors influencing fatigue behaviour.

UNIT:2 (12 Hours)

Creep: Creep-stress-time temperature relations, Mechanics of creep in tension, bending, torsion, creep buckling. Members subjected to creep and combined stresses.

UNIT:3 (12 Hours)

Fracture:

Basic modes of fracture, Griffith of brittle fracture, Irwin's theory of fracture inelastic-plastic materials. Theories of linear elastic fracture mechanics, stress intensity factors, fracture toughness testing.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Strength and Resistance of Metals - J. M. Lessels, John Wiley and Sons, Inc., 1954.

2. Mechanical Behaviour of Engineering Materials - Joseph Marin, PHI, 1966.

3. Fatigue Testing and Analysis - Y. Lee, J.Pam, R.B. Hathaway & M.E. Barkey Elsevier Press, 2005.

4. Engineering Fracture Mechanics - S. A. Meguid, Elsevier Press, 1989.

Ref. Books

1. Mechanical Metallurgy - G. E. Dieter, Mc-Graw Hill Book Co., 1961.

2. Mechanical Behaviour of Materials - N. E. Dowling, PHI, 1997.

3. Introduction to Fracture Mechanics - Kare Hellan, Mc-Graw Hill Book Co., 1985.

4. The Practical Use of Fracture Mechanics - David Broek, MN Publishers, 1982.

COMPUTER AIDED DESIGN					
Subject Code		L	T	P	C
MMDPE1042		3	0	0	3
Course Outcome					
CO1	Integrate the role of graphic communication in the engineering design process				
CO2	Generate and interpret engineering technical drawings of parts and assemblies according to engineering design standards				
CO3	Use CAD software to generate a computer model and technical drawing for a simple, well-defined part or assembly.				
CO4	Communicate effectively the geometry and intent of design features.				

UNIT:1 (12 Hours)

Introduction: The design process, elements of CAD; Principles of Software Design: Characteristics of good software, data structures, algorithm design, flow chart, coding, top down programming, modular programming, structural coding, testing of the software.

UNIT:2 (12 Hours)

Computer Graphics: Graphics display, transformations, visualizations, computer animation.3D Modelling and Viewing: Coordinate systems, sketching and sketch planes; Modelling aids and tools; Layers, grids, clipping, arrays, editing. Curves Modelling: Analytical and synthetic curves, curve manipulations. Surface Modelling: Surface representation and surface analysis, analytical and synthetic surfaces, surface manipulations, NURBS.

UNIT:3 (12 Hours)

SOLID MODELING: Geometry and topology, solid entities, solid representation, fundamental of solid modelling, half spaces, boundary representation, constructive solid geometry, sweeps, solid manipulations. Features: Feature entities, feature representation, three dimensional sketching, parametric, relations, constraints, feature manipulation. Mass properties: Geometric and mass properties evaluation, assembly modelling, product data exchange.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Zeid I., “Mastering CAD/CAM”, Tata McGraw Hill. 2007
2. OnwubikoC., “Foundation of Computer Aided Design”, West Publishing Company. 1989

Ref. Books

1. Hsu T. R. and Sinha D. K., “Computer Aided Design: An Integrated Approach”, West Publishing Company. 1991
2. Dimarogonas, A. D., “Computer Aided Machine Design”, Prentice Hall. 1988
3. Mortenson, M. E., “Geometric Modeling”, 3rd Ed., Industrial Press. 2006.

OPTIMUM DESIGN OF MECHANICAL SYSTEMS					
Subject Code		L	T	P	C
MMDPE1043		3	0	0	3
Course Outcome					
CO1	To Understand the concepts of operations research modelling approaches.				
CO2	Formulate and solve engineering and managerial situations as LPP.				
CO3	Formulate and solve non linear programming problem				
CO4	To understand advanced optimization techniques.				

UNIT:1 (12 Hours)

Introduction: Classification of optimization problems, mathematical models in engineering optimization. Concepts in linear optimization: General simplex method, revised simplex method, duality, decomposition principle, integer programming, branch and bound technique and the Gomory algorithm, post optimality analysis.

UNIT:2 (12 Hours)

Non linear programming without constraints: Local and global maxima, minima, Hessian matrix, Fibonacci method, Golden section method, random search method, steepest descent method and conjugate gradient method.

Non linear programming with constraints: Lagrange multipliers, Kuhn - Tucker conditions, quadratic programming.

UNIT:3 (12 Hours)

Wolfe's and Beale's method, sequential linear programming approach, penalty methods. Interior and exterior penalty function method.

Advanced optimization techniques: Concepts of multi - objective optimization, genetic algorithms and simulated annealing.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1.S.S.Rao, Optimization- Theory and Applications, ,Wiley Eastern, New Delhi, 1978
2.J.C.Pant, Introduction to Optimization, Jain Brothers, New Delhi, 1983
3. Kanthi Swaroop, et.at., Operations Research, S. Chand & Co., New Delhi,
4.Kalyanmoy Deb, Optimization for Engineering Design Algorithms and Examples, Prentice Hall of India, New Delhi, 1995
5. Kalyanmoy Deb, Mulitobjective Optimization –An evolutionary Algorithmic Approcach, John Wiley & Sons, New York.

Ref. Books

1.J.S. Arora, Introduction to optimum design, McGraw Hill, New York, 1989
2.R.L. Fox, Optimization Methods for Engineering Design, Addison Wesley, New York, 1971.
3. D.E. Goldberg, Genetic Algorithms in Search, Optimization and Machine, Barnen, Addison Wesley, New York,1989.

ANALYSIS AND DESIGN OF PRESSURE VESSELS AND PIPING					
Subject Code		L	T	P	C
MMDPE1044		3	0	0	3

Course Outcome	
CO1	Understand the concepts and principles applied to members under various loadings and the effects of these loadings.
CO2	Analyze and design structural members subjected to stresses.
CO3	Analyze columns and pressure vessels under various loadings.
CO4	Apply proper techniques and a working knowledge of pipe work design .

UNIT:1 (12 Hours)

Introduction: Methods for determining stresses –Terminology and Ligament Efficiency –Applications.

Stresses in Pressure Vessels: Introduction –Stresses in a circular ring, cylinder –Membrane stress Analysis of Vessel Shell components –Cylindrical shells, torspherical Heads, conical heads –Thermal Stresses –Discontinuity stresses in pressure vessels.

UNIT:2 (12 Hours)

Design of Vessels: Localized stresses and their significance – stress concentration – at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement –pressure vessel Design.

Supports for Vessels: introduction, bracket or lug supports, leg supports, skirt supports, saddle supports.

UNIT:3 (12 Hours)

Buckling and Fracture Analysis in Vessels:Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure.

Buckling: Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

Piping: Introduction – Flow diagram – piping layout and piping stress Analysis.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. John F.Harvey, Theory and Design of Pressure Vessels,CBS Publishers and Distributors, 1987.
2.M.V. Joshi, Process Equipment Design,Macmillan India Ltd.

Ref. Books

1. Henry H.Bedner, Pressure Vessels , Design Hand Book, CBS Publishers and Distributors,
2. Stanley, M.Wales, Chemical process equipment, selection and Design, Butterworths series in Chemical Engineering.
3. William J., Bees, Approximate Methods in the Design and Analysis of Pressure vessels and Piping Pre ASME Pressure Vessels and Piping Conference.

NUMERICAL ANALYSIS					
Subject Code		L	T	P	C
MMDPE1051		3	0	0	3
Course Outcome					
CO1	Solve an algebraic or transcendental equation using an appropriate numerical method				
CO2	Solve a differential equation using an appropriate numerical method				
CO3	Perform an error analysis for a given numerical method				
CO4	Calculate a definite integral using an appropriate numerical method				

UNIT:1 (12 Hours)

Transcendental and Polynomial equations: Initial approximations, First Degree Equation, Iteration Methods Based on Second Degree equation, Multipoint iteration method, Rate of Convergence, Efficiency of a method. System of Linear Algebraic Equations: Effects of Round-off Error, Operations Counts, Standard Methods of Solutions, Convergence analysis Eigen values and Eigenvectors Interpolation: Lagrange Polynomial Interpolation, Cubic Spline Interpolation.

UNIT:2 (12 Hours)

Numerical Differentiation - Finite Differences: Construction of Difference Formulae. Accuracy of Finite Differences, Pade Approximations, Non-Uniform Grids.

Numerical Integration: Trapezoidal and Simpson's Rules, Error Analysis, Integration and Extrapolation, Quadrature.

Numerical Solution Of Ordinary Differential Equations: Initial Value Problems, Numerical Stability, Stability Analysis, Implicit, Runge-Kutta Methods, Multi-Step Methods, System Of First-Order Ordinary Differential Equations, Boundary Value Problems.

UNIT:3 (12 Hours)

Numerical Solution of Partial Differential Equations: Semi-Discretization, von Neumann Stability Analysis, Modified Wave number Analysis, Implicit Time Advancement, Accuracy, Implicit Methods in Higher Dimensions, Approximate Factorization, Stability of the Factored Scheme, Alternating Direction Implicit Methods, Mixed and Fractional Step Methods, Elliptic Partial Differential Equations

Discrete Transform Methods: Discrete Fourier series, Applications, Finite Differenced Elliptic Equations, Fourier Spectral Numerical Differentiation, Discrete Transform and Applications, Numerical Differentiation.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Numerical Methods for scientific & Engg Computation- M. K. Jain, S. R. K. Iyengar & Jain.
2. Numerical Methods for Engineers – S. C. Chapra and R. P. Canale. Mc GrawHill.

Ref. Books

1. Numerical Methods – S. S. Rao.
2. Numerical Methods in Science & Engg: A Practical Approach – S. Rajashekharan. Wheeler Pub.
3. Numerical Recepies – W. H. Press, S. A. Teukolosky, W. T. Vetterling and B. P. Flannery Cambridge University Press.

INSTRUMENTATION AND AUTOMATIC CONTROL SYSTEMS					
Subject Code		L	T	P	C
MMDPE1052		3	0	0	3
Course Outcome					
CO1	An understanding of and an ability to apply analytical and computer-aided methods for solution of electrical circuits.				
CO2	An understanding of basic measuring devices including transformers, transducers, and pressure, flow rate, and temperature measurement devices.				
CO3	Methods for rating instrument devices including dynamic range, resolution, accuracy and precision, bandwidth.				
CO4	An understanding of the elementary concepts and elements of automatic and feedback control system.				

UNIT:1 (12 Hours)

Closed loop & open loop systems; Linear & non-linear systems; Proportional, Derivative & integral controller; Laplace transform method; Transfer function & Block diagrams; Deriving transfer functions of physical systems; Block diagram reduction; Signal flow graphs; Construction of signal flow graphs from block diagram; Mason's gain formula.

First order systems; Second order systems; Higher order systems;

UNIT:2 (12 Hours)

Steady-state error & error constants; Routh stability criterion; Bode plot; Gain margin & Phase margin. Root locus method; Nyquist criterion; Closed loop frequency response; M- circle & N - circle; Lag & lead compensation.

UNIT:3 (12 Hours)

State space analysis - State variables; State - space representation; State equations; Relationship between state equations & transfer functions; Characteristics equation; Eigen values & Eigen vectors; State diagram; Solution of state equation; State transition matrix & its properties; Transfer matrix.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Mechanical Measurements - T.G. Beckwith, N.L. Buck, R.B. Marangoni. Narosa Publishing House 3rd Edition, 1982

2. Measuremets System : Application and Design - Ernest O. Doebelin, Mc-Graw Hill Books Co., 1990, 4th Edition.

3. Modern Control Engineering - K. Ogata, PHI, 3rd Edition, 2000.

Ref. Books

1. Theory and Application of Automatic Controls - B.C.Nakra, New Age International Pvt. Ltd., New Delhi, 1998.

2. Transducers and Instrumentation, PHI, New Delhi,1995.

3. Sensors and Transducers - D. Patranabis, Wheeler Publishing, ND, 1997.

4. Instrumentation-Devices and Systems - C.S.Rangan, G.R.Sarma and V.S.V.Mani, TMH, New Delhi, 1983.

ADVANCED MECHANISMS OF MACHINES					
Subject Code		L	T	P	C
MMDPE1053		3	0	0	3

Course Outcome	
CO1	Classify the steering mechanisms and gyroscopic effects on various dynamic objects.
CO2	Develop a cam profile to meet desired needs within realistic constraints, calculate the inertia forces in reciprocating and rotating masses along with turning moments in flywheels.
CO3	Analyze static and dynamic balancing of rotating and reciprocating masses, classify the various kinds of governors, recognise the effect of controlling force.
CO4	Analyze the effect of vibration in desired systems, determine the natural frequency of a vibration system.

UNIT:1 (14 Hours)

Review of determination of velocity & acceleration of points & links in mechanisms – Analytical & graphical methods; Synthesis of Mechanisms - Function generation; Overlay's method; Cognate linkages; Two position & three position synthesis of 4 - bar linkages & slider crank mechanisms; Coupler curve synthesis; Intermittent rotary motion -Geneva mechanism. Static & Dynamic Force Analysis – Forces, Couples, Conditions of equilibrium – Free body diagram; Analysis of 4 - bar linkages & slider crank mechanisms; Spur, Helical & Bevel ge ar force analysis; Static force analysis with friction.

UNIT:2 (12 Hours)

Dynamic force analysis – Centroid & Centre of mass; Moment of inertia; D' Alembert's principle; Rotation about a fixed centre; Dynamic analysis of 4 - bar mechanism.

Balancing – Primary balancing, Secondary balancing, Balancing of 2 - cylinder & multi - cylinder engines, V -engines.

UNIT:3 (14 Hours)

Gyroscope –Motion of a rigid body in 3 - dimensions; Rigid body in spheric motion; Euller's equation; Euller's modified equation; Simple precession of a symmetrical rotor.

Analysis of Cams –Basic curves; Cam size determination; Cam profile determination - Analytical & graphical methods; Advanced cam curves; Analytical cam design.

Cam Dynamics –Response of undamped cam mechanisms; Follower response - Phase plane method; Numerical method; Jump & Cross-over shock.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Theory of Machines and Mechanisms – J. E. Shigley and Jr. J. J. Uicker. Mc GrawHill Inc.1998.
2. Theory of Mechanisms and Machines – Amitava Ghosh and Mallik. EWP, New Delhi.

Ref. Books

1. Mechanism Synthesis Analysis – A. H. Soni, Mc GrawHill Co, New York.
2. Kinematics Analysis of Mechanisms - J. E. Shigley. Mc GrawHill Co, New York.
3. Mechanics of Machines – V. Ramamurti. Narosa Publishing House.

MATERIALS SELECTION IN MECHANICAL DESIGN					
Subject Code		L	T	P	C
MMDPE1054		3	0	0	3
Course Outcome					
CO1	Understand the principles of materials selection and design.				
CO2	Ability to apply useful tools for design refinement such as value engineering and design for manufacturing and assembly.				
CO3	apply project management tools such as Gantt charts, Pareto charts, critical path analysis, and action items for planning, prioritizing, and scheduling tasks in a design project				
CO4	Ability to apply failure modes and effects analysis (FMEA) to organize and prioritize analysis and testing and to improve the safety and reliability of a design				

UNIT:1 (12 Hours)

Introduction: Materials properties – chemical, physical, mechanical, dimensional; Materials categories; Design process, conceptual design, embodiment design, detail design; Ideology of optimization, materials selection charts.*Performance indices:* Performance, objective function, constraints, performance index; Calculation Model, Measure of Performance, Equations for constrained variables; Design fixedparameters, free parameters.*Optimization of selection without considering shape effects:* Recipe for optimization, Applying performance indices to selection charts; Primary constraints; Reality Check; Case studies – mirrors for large telescopes, table legs, structural materials for buildings, flywheels, springs, elastic hinges and couplings, pressure vessels, Vibration effects, stiff and high damping materials; Thermal effects, insulations, solar heating, heat exchangers.

UNIT:2 (14 Hours)

Manufacturing and process selection: Classification of manufacturing processes, review of shaping, joining and finishing processes, Strategy for processes selecting, translation, screening, ranking; Selection charts, process-material matrix, process-shape matrix, mass bar chart, thickness bar-chart, tolerance and surface-roughness bar-charts; Manufacturing cost.Case studies: forming a fan, fabricating a pressure vessel, economical casting.

Multiple Constraints in Materials Selection – Over constrained Design: Decision matrices, selection stages, coupling equations, value functions; Multiple Selection Stage Method,Active Constraint Method, Coupling Equation Method; CES Software; Fully determined design; Massively over constrained designs; Conflicting objectives, penalty functions and exchange constants; Case studies – shipbuilding, con-rods for high-performance engines, windings for high-field magnets, casing for mini-disk player or cell phone, disk-brake calliper.

UNIT:3 (12 Hours)

Optimization of selection considering shape effects: Shape factors, Microscopic or micro structural shape factors; Limits to shape efficiency, stiffness-limited design, strength-limited design, material indices that include shape, elastic bending of beams and twisting of shafts, failure of beams and shafts, co-selection of material and shape; Case studies – choosing optimal I-beam, spars for man-powered planes, ultra-efficient springs, forks for a racing bicycle.

Designing hybrid materials: Families of configurations of hybrid materials - composites, sandwiches, lattices and segmented; method “A+B+configuration+scale”; Anisotropy; Case studies – metal matrix composites, refrigerator walls, natural materials.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. M. F. Ashby, MATERIALS SELECTION IN MECHANICAL DESIGN, Third Edition

Ref. Books

1. J. E. Gordon, *The New Science of Strong Materials, or Why You Don't Fall Through the Floor*, Princeton University Press, Princeton, NJ.
2. J.E. Gordon, *Structures, or Why Things Don't Fall Down,* Da Capo Press.
3. M. F. Ashby and D. R. H Jones, *Engineering Materials Parts 1, 2, and 3*, Pergamon Press, Oxford, UK.
4. F. A. A. Crane and J. A. Charles, *Selection &Use of Engineering Materials*, Butterworths, London, UK.

MECHANICS OF COMPOSITE MATERIALS					
Subject Code		L	T	P	C
MMDPC2010		3	1		4

Course Outcome	
CO1	To understand the specifics of mechanical behavior of layered composites compared to isotropic materials.
CO2	Apply constitutive equations of composite materials and understand mechanical behaviour.
CO3	To determine stresses and strains in composites with apply failure criteria.
CO4	An ability to use the ideas developed in the analysis of composites towards using composites in aerospace design.

UNIT:1 (14 Hours)

Introduction – Definition & classification of composites; Reinforcing fibers-Types, Characteristics & Selection; Natural fibers, Boron; Carbon; Ceramic; Glass; Armids; Particulate fillers; Matrices-Polymer; Graphite; Ceramic & Metal matrices; Fiber surface treatments; Fillers & additives; Fiber content; Short & continuous fiber reinforced composites. Processing – Pultrusion; Filament winding; Pre-page technology; Injection & compression moulding; Bag moulding; Resin transfer moulding; Other manufacturing processes.

UNIT:2 (15 Hours)

Processing – Pultrusion; Filament winding; Pre-page technology; Injection & compression moulding; Bag moulding; Resin transfer moulding; Other manufacturing processes. Processing of MMC- Diffusion bonding; Stir casting; Squeeze casting.

Mechanics – Rule of mixture; Volume & mass fractions; Density & void content; Stress-strain relations for anisotropic materials; Generallized Hook's law; Stiffenesses, Compliances & engineering constants for orthotropic materials; Stress-strain relations for plane stress in orthotropic materials; Stress-strain relations for a lamina; Characteristics of fiber reinforced lamina.

UNIT:3 (12 Hours)

Analysis – Classical lamination theory; Stress analysis of composite laminates; Failure predictions – Maximum stress theory; Maximum strain theory; Tsai-Hill theory; Modes of failure of composites; First ply failure; Partial ply failure; Total ply failure.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Mechanics of composite materials, R. M. Jones, Mc Graw Hill Book Co.
2. Mechanics of composite materials & structures, M Mukhopadhay, Universities Press.
3. Fiber-Reinforced composite materials, Manufacturing & Design, P. K. Mallick, Marcel Dekken, Inc. New York & Basel.

Ref. Books

1. Mechanics of Laminated Composite Plates and Shells – J. N. Reddy. CRC Press.
2. Stress Analysis of Fiber- Reinforced Composite Materials – M. W. Hyer. WCB McGrawHill.

EXPERIMENTAL STRESS ANALYSIS					
Subject Code		L	T	P	C
MMDPC2020		3	1	0	4
Course Outcome					
CO1	Solve the advanced practical problems related to the theory of elasticity, concepts of stress and strain.				
CO2	Strength and stiffness, deformations and displacements, strain energy, and load carrying capacity.				
CO3	Propose materials and structural elements to the analysis of complex structures.				
CO4	Identify, formulate and solve the structural problems using a range of analytical methods.				

UNIT:1 (12 Hours)

Electrical Wire Resistance Strain Gauges: Strain sensitivity, strain gauge construction, temperature effects in bonded strain gauges. Gauge factor and gauge sensitivities. Determination of actual strain. Measurement of stress by a strain gauge, stress gauge, strain gauge Rosette.

Measuring Circuits: The potentiometer circuit, circuit sensitivity of potentiometer, Wheatstone bridge circuit, Null-balance bridge, strain gauge applications.

UNIT:2 (13 Hours)

Moiré Fringe Method: Moiré method, geometry of moiré fringe, advantages and limitations of moiré method. Photoelasticity: Introduction, basic principle, stress and strain optic law, plane polariscope, circular polariscope, white light illumination.

UNIT:3 (15 Hours)

Analysis Of Photoelastic Data: Materials and properties of material for photoelastic models, stress loci, fractional fringe orders, methods of compensation, calibration techniques, the frozen stress method, Reflection polariscope, separation of principal stresses.

Brittle Coating Method: Brittle coating, calibration of coating, application of failure theory to brittle coating, advantages and limitations.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. J.W. Dally and W.F. Riley, “Experimental stress Analysis”, McGraw Hill, 1991.
2. Durelli, Augusto J., and William Franklin Riley. " Introduction to photomechanics. Prentice-Hall, 1965.
3. L.S.Srinath, M.R.Raghavan, K.Lingaiah, G.Gargesa, B.Pant and K.Ramachandra, “Experimental Stress Analysis, Tata McGraw Hill, 1984.

Ref. Books

1. Experimental Stress Analysis and Motion Measurement – R. C. Dove and P. H. Adams. PHI, 1965.
2. Applied Stress Analysis – A. J. Durelli. PHI, 1970.
3. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, 2009.

MACHINE FAULT DIAGNOSIS AND SIGNAL PROCESSING					
Subject Code		L	T	P	C
MMDPE2031		3	0	0	3
Course Outcome					
CO1	Ability to Understand the solution of aerodynamic flows. Appraise & compare current CFD software. Simplify flow problems and solve them exactly.				
CO2	Able to analyze the concept of discrete representation of flow and heat transfer domain				
CO3	Ability to solve the Error analyze in discretization using FVM/FDM				
CO4	To Understand the both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution				

UNIT:1 (12 Hours)

Introduction. Maintenance Principles. Basics of Machine Vibration. Signal Analysis. Computer based data acquisition. Time domain Signal analysis.

UNIT:2 (12 Hours)

Introduction to MATLAB. Signal Processing Exercises with MATLAB. Fault detection transducers and instrumentation. Vibartion monitoring. In- Situ field balancing of rotors. Condition monitoring of rotating machines. Noise monitoring.

UNIT:3 (12 Hours)

Wear and debris analysis.Thermography. Electrical Motor Current Signature Analysis. Ultrasonics in Condition Monitoring.NDT Techniques in Condition monitoring.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Introduction to Machinery Analysis and Monitoring – J. S. Mitchell. Pennwell Publishers.

Ref. Books

1. Engineering Vibration – D. Inman. Tata Mc GrawHill.

2. Vibration Monitoring and Diagnosis – Ralph A. Collocott. Chapman and Hall. 3. Shock and Vibration Handbook – Harris and Crede. Mc GrawHill.

3. Machinery Condition Monitoring: Principles and Practices, A. R. Mohanty, CRC Press, 2014

MECHATRONICS					
Subject Code		L	T	P	C
MMDPE2032		3	0	0	3

Course Outcome	
CO1	Ability to design and calculate mechanical designs.
CO2	Ability to model and build mechatronic systems and implement these systems.
CO3	Specialized knowledge within either of the profiles: Mechanical engg, Electronic engg or embedded engg.
CO4	Ability to carry out development projects independently and in teams.

UNIT:1 (14 Hours)

1.Introduction: Definition of mechatronics, measurement system, control systems, microprocessor based controllers, mechatronics approach.

2.Sensors and Transducers: Sensors and transducers, performance terminology, photoelectric transducers, flow transducers, optical sensors and transducers, semiconductor lasers, selection of sensors, mechanical / electrical switches, inputting data by switches.

3. Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, electrical actuation systems.

UNIT:2 (12 Hours)

4Signal Conditioning: Signal conditioning, filtering digital signal, multiplexers, data acquisition, digital signal processing, pulse modulation, data presentation systems.

5.Microprocessors and Microcontrollers: Microcomputer structure, microcontrollers, applications, programmable logic controllers.

UNIT:3 (14 Hours)

6.Modeling and System Response: Mathematical models, mechanical, electrical, hydraulic and thermal systems, dynamic response of systems, transfer function and frequency response, closed loop controllers.

7.Design and Mechatronics: Input/output systems, computer based modular design, system validation, remote monitoring and control, designing, possible design solutions, detailed case studies of mechatronic systems used in photocopier, automobile, robots.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Bolton, W., “Mechatronics”, Longman, 1999.
2. Bolton, W., “Mechatronics: A Multidisciplinary Approach”, 4th Ed., Prentice Hall, 2009.
3. Mahalik, N., “Principles, Concept and Applications: Mechatronics”, Tata McGraw, 2003.

Ref. Books

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. G.W. Kurtz, J.K. Schueller, P.W. Claar . II, Machine design for mobile and industrial applications, SAE, 1994..
3. T.O. Boucher, Computer automation in manufacturing - an Introduction, Chappman and Hall, 1996.
4. Mechatronics, Intl. J. published by Pergamon Press

MECHANICAL DRIVES					
Subject Code		L	T	P	C
MMDPE2033		3	0	0	3

Course Outcome	
CO1	Understand the customers' need to design keys, cotters, couplings using theories of failures including springs.
CO2	Analyze and design automobile components behaviour subjected to loads and identify the failure criteria.
CO3	Acquaintance with different types of gear drive designs.
CO4	Ability to justify a design project in a formal report and develop design drawings.

UNIT:1 (14 Hours)

Design of Keys, Shaft and Couplings: Classification of keys and pins, Design of keys and pins, Theories of failure, Design of shafts: based on strength, torsional rigidity and fluctuating load, ASME code for shaft design. Design of Coupling: Types of shaft coupling, design of flange coupling, flexible bush coupling. Design of Mechanical Springs: Types of helical springs, Design of Helical springs, bulking of spring, spring surge, end condition of springs, Design of leaf springs: nipping.

UNIT:2 (14 Hours)

Design of Flywheel: Functions, Coefficient of fluctuation of energy and Coefficient of fluctuation of speed, energy storage in flywheel, stresses in flywheel, design of flywheel.
Design of clutch: Friction clutch, Cone clutch and Centrifugal clutch,
Design of Brake : Block & Band brake, Internal expanding shoe brake.
Design of Gears: Review of kinematics of gears & terminology, interference, tooth profiles, formative number of teeth etc. Design of Spur Gear drive, Helical Gear drive.

UNIT:3 (12 Hours)

Design of Bevel Gear Drive: Types of bevel gear, proportions of bevel gear, force analysis of bevel gear drive, design of bevel gear drive.
Design of Worm Gear Drive: Worm Gearing—AGMA Equation; Worm-Gear force analysis Designing a Worm-Gear Mesh; Buckingham Wear Load.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Machine Design, Maleev & Hartman, CBS publishers.
2. Machine Design, P.H. Black, TMH.
3. Mechanical Engg. Design, Shigley, TMH.

Ref. Books

1. Hand book of Machine Design, Shigley & Mischke, McGraw Hill.
2. Mechanical Engineering Hand book Vol 1 & 2, Kent, John Willey & Sons.
3. Machine Tool Design Data Book, CMTI.

DESIGN DATA HAND BOOKS

1. Design Hand Book by S.M.Jalaluddin ; Anuradha Agencies Publications
2. P.S.G.Design Data Hand Book, PSG College of Tech Coimbatore
3. Machine Design Data Book, K.Lingaiah, Tata Mcgraw Hill

MACHINE TOOL DESIGN					
Subject Code		L	T	P	C
MMDPE2034		3	0	0	3
Course Outcome					
CO1	Interpret the geometrical and dimensional details of a production drawing				
CO2	Design jigs and fixtures for conventional and NC machining				
CO3	Select and design progressive, compound or combination dies for press working operations				
CO4	Design single point and multipoint cutting tools				

UNIT:1 (14 Hours)

Introduction to metal cutting machine tools- criteria for the selection of operating capacity and design parameters, kinematics of machine tools.

Basic principles of machine tool design, estimation of drive power, machine tool drives, electrical, mechanical and fluid drives, stepped and step less speed arrangements and systems.

UNIT:2 (12 Hours)

Design of machine tool spindles and bearings, design of power screws, design of slide ways, selective and pre-selective mechanisms.

Machine tool structures-beds, columns, tables and supports, stock feed mechanism, Measurement and control of machine tools, protective and safety devices, design of precision machine tools.

UNIT:3 (14 Hours)

Micro-feeding mechanisms, concept of modular design and integration of SPM`s, Concepts of aesthetic and ergonomics applied to machine tools.

Acceptance tests standardization of machine tools, machine tool conditioning, latest trends in machine tool design, Introduction to CAD techniques.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. N. K.Mehta , Machine tool design, Tata Mcgraw-hill, New Delhi, 1989.
2. N.Acherkan, Machine tool design, Vol. 3 and 4, Mir publisher, Moscow, 1968.

Ref. Books

1. A.Koenigsburger, Design principles of metal cutting machine tools, Pergamon press, 1964.
2. C.M.T.I. Machine tool design course notes, C.M.T.I. Bangalore.
3. G.Sen and A.Bhattacharya , Principles of machine tools, Vol. 2, NCB, Calcutta, 1973.

FINITE ELEMENT METHOD					
Subject Code		L	T	P	C
MMDPE2041		3	0	0	3

Course Outcome	
CO1	Identify the application and characteristics of FEA elements such as bars, beams, plane and is oparametric elements, and 3-D element
CO2	Develop element characteristic equation procedure and generation of global stiffness equation will be applied.
CO3	Able to apply Suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
CO4	Able to identify how the finite element method expands beyond the structural domain, for problems involving dynamics, heat transfer, and fluid flow.

UNIT:1 (15 Hours)

1. Introduction: Role of the Computer, General Steps of the Finite Element Method, Applications of the Finite Element Method, Advantages of the Finite Element Method.
2. Introduction to the Stiffness (Displacement) Method: Definition of the Stiffness Matrix, Derivation of the Stiffness Matrix for a Spring Element, Example of a Spring Assemblage, Assembling the Total Stiffness Matrix by Superposition (Direct Stiffness Method),Boundary Conditions, Potential Energy Approach to Derive Spring Element Equations.
3. Development of Truss Equations: Derivation of the Stiffness Matrix for a Bar Element in Local Coordinates, Selecting Approximation Functions for Displacements, Transformation of Vectors in Two Dimensions, Global Stiffness Matrix, Computation of Stress for a Bar in the x-y Plane, Solution of a Plane Truss.
4. Energy Approach to Derive Bar Element Equations: Potential Energy Approach to Derive Bar Element Equations, Comparison of Finite Element Solution to Exact Solution for Bar, Galerkin's Residual Method and Its Use to Derive the One-Dimensional Bar Element Equations, Other Residual Methods and Their Application to a One-Dimensional.

UNIT:2 (15 Hours)

5. Development of Beam Equations: Derivation of the Beam Stiffness matrices, Distributed Loading, Potential Energy Approach to Derive Beam Element Equations, Galerkin's Method for Deriving Beam Element Equations.
6. Development of the Plane Stress and Plane Strain Stiffness Equations: Basic Concepts of Plane Stress and Plane Strain, Derivation of the Constant-Strain Triangular Element Stiffness Matrix and Equations, Treatment of Body and Surface Forces.
7. Development of the Linear-Strain Triangle Equations: Derivation of the Linear-Strain Triangular Element Stiffness Matrix and Equations.
8. Axisymmetric Elements: Derivation of the Stiffness Matrix, Solution of an Axisymmetric Pressure Vessel, Applications of Axisymmetric Elements.

UNIT:3 (12 Hours)

9. Isoparametric Formulation: Isoparametric Formulation of the Bar Element Stiffness Matrix, Rectangular Plane Stress Element, Gaussian and Newton-Cotes Quadrature (Numerical Integration), Evaluation of the Stiffness Matrix and Stress Matrix by Gaussian Quadrature.
10. Three-Dimensional Stress Analysis: Three-Dimensional Stress and Strain, Tetrahedral Element.
11. Plate Bending Element: Basic Concepts of Plate Bending, Derivation of a Plate Bending

Element Stiffness Matrix and Equations.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.
Text Books 1. Finite Element Method: Its Basis and Fundamentals. O. C. Zienkiewicz, R. L. Taylor and J. Z. Zhu. Elseiver, 2005. 2. Finite Element Methods – J. N. Reddy. Tata Mc GrawHill. 3. Introduction to the Finite Element Method – C. S. Desai and J. F. Abel. East West Pvt. Ltd., 1972.
Ref. Books 1. Concepts & Applications of finite Element Analysis–R. D. Cook, John Wiley & Sons. 2. The Finite Element Method in Engineering –S.S.Rao.Butterworth-Heinemann, 1999. 3. Finite Element Analysis – H. V. Lakshminarayan, University Press. 4. Finite Element Methods vs. Classical Methods–H.S.Govind Rao,New Age Pub.,2007. 5. Finite Element Analysis – T. Chandrupatla, University Press. 6. Energy & Finite Element Methods in structural Mechanics–Irving H. Shames & Clive Dym, New Age Publications, 2006.

COMPUTER GRAPHICS AND VISUALIZATION					
Subject Code		L	T	P	C
MMDPE2042		3	0	0	3

Course Outcome	
CO1	Able to demonstrate the knowledge and understanding of fundamental principles in computer graphics
CO2	Apply the knowledge to the design of algorithms for graphics applications.
CO3	Enhance his/her skills in graphics and visualization programming through experimental and simulated data .
CO4	Implement a substantial computer graphics system/project in dynamic visualization.

UNIT:1 (14 Hours)

Raster graphics and volume graphics. Video basics. Display devices and interactive devices; 2-D and 3-D graphics primitives. Clipping in 2-D and 3-D; Generation and projection of 3-D wire frame solid models, polygonal models. Space curves and surface models. Intersection of surfaces and blending; hidden line and hidden surface elimination algorithms. Ray-surface intersection and inverse mapping algorithms. Ray tracing for photo realistic rendering. Illumination models. Shading, Transparency, Shadowing and Texture mapping; Representation of colours.

UNIT:2 (13 Hours)

Visualization of experimental and simulated data. Surface construction from scattered data, 3-D data arrays and 2-D cross sections. Elevation maps, topological maps, contour maps and intensity maps; fractals for visualization of complex and large data sets. Algebraic stochastic and Geometrical fractals. Modeling of natural forms and textures using fractals; Visualization of multi variate relations . Flow visualization and hyper streamlines; visualization of Metrological, cosmological, seismic, biological data for scientific decision making.

UNIT:3 (13 Hours)

Animation, Modeling issues in dynamic visualization. Behavioral animation; walk through coordinate transformation and view transformation; virtual reality interfaces. Interactive and immersive systems for prototyping and visualization; Visualization in concurrent engineering. Interactive multimedia technology and standards for VideoGraphics-Audio integration and tele-video conferencing

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. CAD/CAM : Computer-Aided Design and Manufacturing - M. P. Groover and E.W. Zimmer, PHI, 1995

Ref. Books

1. AutoCAD 2002 - New Riders, Techmedia
2. Computer Aided Analysis and Design of Machine Elements - V. D. Rao, M. Ananda Rao and Rama Bhat. New Age International.

BASIC MECHANICAL HANDLING SYSTEMS					
Subject Code		L	T	P	C
MMDPE2043		3	0	0	3

Course Outcome	
CO1	Identify the role that each department plays in achieving the goals of an organization.
CO2	Explain the problems in organizing, planning and controlling the use of men, money, materials and machines for industrial production.
CO3	Apply industrial engineering principles to solve the problems in organizing, planning and controlling the use of men, money, materials and machines for industrial production.
CO4	Design of Mechanical Handling equipments such as Hoists and Cranes.

UNIT:1 (15 Hours)

Elements of Material Handling System:- Importance, terminology, objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and Plant layout, physical facilities and other organizational functions; Classification of Material Handling equipments.

Selection of Material Handling Equipments:- Factors affecting for selection; Material Handling equation; choices of Material Handling equipment; general analysis procedures; basic analytical techniques; the unit load concept; selection of suitable types of systems for applications; activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials.

UNIT:2 (14 Hours)

Conveyors:

Belt Conveyors – characteristics, types, components, basic design considerations; Chain Conveyors – characteristics, types, components, aspects of design; Roller Conveyors-characteristics, types, components, aspect of design; Screw conveyors – characteristics, types, components, aspects of design.

UNIT:3 (13 Hours)

Design of Mechanical Handling Equipments:- **Design of Hoists**:- Drives for hoisting, components, and hoisting mechanisms; rail traveling components and mechanisms; hoisting gear operation during transient motion; selecting the motor rating and determining breaking torque for hoisting mechanisms.

Design of Cranes:- Hand-propelled and electrically driven EOT overhead traveling cranes; Traveling mechanisms of cantilever and monorail cranes; design considerations for structures of rotary Cranes with fixed radius; fixed post and overhead traveling cranes; Stability of stationary Rotary and traveling rotary cranes.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Material Handling Equipments - N. Rudenko. Envee Publishers, ND, 1978.
2. Conveying Machines (Vol I & II) - A.O.Spivakovsky, & V.K. Dyachkav. MIR Publication
3. Mechanical Engg Design - J.E.Shiegley. Mc-Graw Hill Book Co., 1986.
4. Design of Machine Elements - M.F. Spotts and T.E. Shoup. PHI, 1998.

Ref. Books

1. Design of Machine Elements - V. Dobrovolsky, et al., MIR Publishers, 1977.
2. Machine Design - D.N. Reshetov. MIR Publishers, 1978.

ANALYSIS AND SYNTHESIS OF ADVANCED MECHANISM					
Subject Code		L	T	P	C
MMDPE2044		3	0	0	3

Course Outcome	
CO1	Students will have the confidence to analyze Simple and Complex Mechanisms.
CO2	Students will have the ability to apply kinematic theories to real-world problems of mechanism design and synthesis
CO3	Dynamic analysis , accuracy analysis and synthesis of cam profiles.
CO4	Design of gears and gyroscopic elements in the field of mechanical engineering.

UNIT:1 (13 Hours)

Basic concepts of kinematics and mechanisms-type, number and dimensions, kinematic pairs, chains and inversions, accuracy point and error analysis, velocity and acceleration analysis of different complex mechanism(I, II & III), gross motion in the 4-bar mechanisms.

UNIT:2 (15 Hours)

static and dynamic force analysis of mechanisms; Synthesis of coordinated positions, synthesis of mechanism to trace a curve or path generation, synthesis for function generation; Dimensional synthesis, method of approach and optimization of a solution; Equivalent and conjugate linkages, four bar chains, copular curves, Robert's Law chebycheve's polynomials, path curvature Euler -Savary equation, Polode curvature. ; Planer and spatial problems, graphical and analytical methods, finite displacements, analytical design of 4-bar mechanisms for coordinated motion.

UNIT:3 (14 Hours)

Cams: synthesis of cam profiles, advanced cam curves, dynamic analysis, accuracy analysis and design of cams; Gears andgyroscopes: Elements of different secondary space curves, conjugate action, general mechanism, non circular sensors , dynamics of gears, Gyro-dynamics, gyroscopic actions in machines.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. R.S. Hartenberg and J. Denavit, “Kinematic Synthesis of Linkages”, McGraw-Hill, New York, 1980.
2. Robert L. Nortan ,"Design of Machinery', Tata McGraw Hill Edition
3. A. Ghosh & A.K. Mallik, Theory of Mechanism And Machines, Affiliated East-West Press: 1998

Ref. Books

1. Hamilton H. Mabie, "Mechanisms and Dynamics of Machinery", John Wiley and sons New York
2. S. B. Tuttle, "Mechanisms for Engineering Design" John Wiley and sons New York
3. A. Ghosh and A.K. Mallik, “Theory of Machines and Mechanisms”, Affiliated East-West Press, New Delhi, 1988. 10
4. A.G. Erdman and G.N. Sandor, “Mechanism Design – Analysis and Synthesis”, (Vol. 1 and 2), Prentice Hall India, 1988. 5. A.S. Hall, “Kinematics and Linkage Design”, Prentice Hall of India.
6. J.E. Shigley and J.J. Uicker, “Theory of Machines and Mechanisms”, 2nd Edition, McGrawHill, 1995.

BEARING AND LUBRICATION					
Subject Code		L	T	P	C
MMDPE2051		3	0	0	3

Course Outcome	
CO1	Understand the fundamental science, technology and application of interacting lubricated surfaces in relative motion.
CO2	Learn how to use the latest analysis techniques to model lubrication problems in tribology.
CO3	Analyze mathematical approach of hydrodynamic and hydrostatic lubrication.
CO4	Describe the concept of idealized journal bearing and slider bearing under different load carrying conditions.

UNIT:1 (14 Hours)

FRICTION and WEAR: Friction - Laws of friction - Friction classification - Causes of friction, Theories of Dry Friction, Friction Measurement, Stick-Slip Motion and Friction Instabilities, Wear - Wear classification - Wear between solids - Wear between solid and liquid - Factors affecting wear - Measurement of wear, Theories of Wear, Approaches to Friction Control and Wear Prevention, Boundary Lubrication, Bearing Materials and Bearing Construction.

Selection of rolling element bearings: Nominal life, static and dynamic capacity - Equivalent load, probabilities of survival - cubic mean load - bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

UNIT:2 (14 Hours)

Hydrodynamic bearings: Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number - performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings; Raimondi and Boyd solution for hydrodynamic thrust bearings - fixed tilting pads, single and multiple pad bearings - optimum condition with largest minimum film thickness. **Hydrostatic Bearings:** Thrust bearings – pad coefficients - restriction - optimum film thickness - journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.

UNIT:3 (14 Hours)

Dry rubbing Bearings: porous metal bearings and oscillatory journal bearings – qualitative approach only.

Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants - additives - lubrication systems and their selection – selection of pump, filters, piping design - oil changing and oil conservation.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Introduction to Tribology of Bearings - B.C.Majumdar, Wheeler Publication, 1999.
2. Lubrication of bearing by E. I. Radzimogky (John Willey)
3. Lubrication in Practice by W. L. Robertson (CRC)

Ref. Books

1.Friction & Wear of Materials-E. Rabinowicz,John Wiley & Sons Inc.ISBN 0-471-83084-4,1995.
2. Tribology : Friction, Lubrication and Wear - Z. Andras Szeri, ISBN 0070626634, 1980
3. Principles and Applications of tribology - Bharat Bhusan, Hardcover, 1999.
4. Engineering Tribology(Tribology Series,24)-G.W. Stachowiak, A.W.Batchelor, ISBN 0444892354, 1993
5. Engineering Tribology - Prasant Sahoo, PHI Pvt. Ltd.
6. Fundamentals of Tribology - S.K.Basu, S.N.Sengupta, B.B.Ahuja, PHI Pvt. Ltd.
7. Tribology in Industries – S. K. Srivastava. S. Chand and Company Ltd., New Delhi.

ROBOTICS					
Subject Code		L	T	P	C
MMDPE2052		3	0	0	3

Course Outcome

CO1	Classify robots based on joints and arm configurations.
CO2	Compute forward and inverse kinematics of robots and determine trajectory plan.
CO3	Program robot to perform typical tasks including Pick and Place, Stacking and Welding.
CO4	Design and select robots for Industrial and Non-Industrial applications.

UNIT:1 (14 Hours)

Fundamentals of Robotics: Introduction Automation & Robotics robot applications robotic systems, robot anatomy and robot configurations, Joint types used in robots, robot wrists, joint notation schemes, work value for various robot anatomies, robot specifications, introduction to robot arm dynamics.

Robots end-effectors-classification of end-effectors, mechanical grippers, hooking or lifting grippers, grippers for molten metal's, plastics, vacuum cups, magnetic grippers, electrostatic grippers, multiple grippers, internal & external grippers, drive systems for gripers, active & passive grippers.

UNIT:2 (14 Hours)

Robot Kinematics - Forward & reverse kinematics, forward and reverse transformation of two DOF & three DOF 2-D manipulator, homogeneous transformations. Robot drives & control-pneumatic power drives, hydraulic systems, electric drives, robot controllers-servo and non servo systems, motion control of robots, point to point and continuous path control, teaching of robots, robot programming methods. Basic control system models, slew motion, joint-interpolated motion and straight line motion.

Robot Sensors: Scheme of robotic sensors, contact type sensors, force, torque, touch, position, velocity sensors, non-contact type sensors, electro-optical imaging sensors, proximity sensors, range imaging sensors, robot environment and robot input/output interfaces, machine intelligence, safety measures in robots.

UNIT:3 (14 Hours)

Robot cell layouts, multiple robots and machine interface, other considerations in work cell design, work cell control, interlocks, error detection and recovery, work cell controller, robot cycle time analysis.

Quantitative Techniques for economic performance of robots: Robot investment coats, robot operating expenses. General considerations in robot material handling, material transfer applications, pick and place operations, palletizing and related operations, machine loading and unloading, die casting, plastic moulding, forging, machining operations, stamping press operations using robots.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Robotics Technology & Flexible Automation, S. R. Deb, Tata McGraw Hill.
2. Industrial Robotics, M. P. Groover, McGraw Hill.
3. Robotics for Engineers, Y. Koren, McGraw Hill.

Ref. Books

1. Robots & Manufacturing Automation by Asfahal C. Ray, John Wiley.
2. Robotic Engineering, Richard D. Klafter, PHI.
3. Robots & Control, Mittal & Nagrath, Tata McGraw Hill.

DYANAMICS OF ROTORS					
Subject Code		L	T	P	C
MMDPE2053		3	0	0	3
Course Outcome					
CO1	Understand principles of rotor bearing systems.				
CO2	Analyze dynamic behavior of rotor bearing system				
CO3	Predict the response of a rotor bearing system through analytical and computational models.				
CO4	Identify the malfunctions in rotating machinery using vibration measurements				

UNIT:1 (14 Hours)

Rudiments of Rotor Dynamics, Rotor Dynamic considerations in machinery design, critical speeds and unbalance response. Factors affecting them such as gyroscopic action, internal damping, fluid film bearings. Methods for analysis such as Transfer Matrix, FEM etc.

UNIT:2 (12 Hours)

Vibration of Discs, disc gyroscopics, synchronous and non synchronous whirl, analysis of rotors mounted on hydrodynamic bearings, application to two spool and multispool rotors.

UNIT:3 (12 Hours)

Analysis of asymmetric shafts.Parametric excitation and instability due to fluid film forces and hysteresis. Effect of support nonlinearities. Rigid rotor balancing. Torsional vibration. Balancing of rotors. Concepts of condition monitoring.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Rotor Dynamics – J. S. Rao. New Age International Publications, 3rd Edition.

Ref. Books

1. Dynamics of Rotor Bearings Systems – M. J. Goodwin. Unwin Hyman
2. A Matrix Method in Elastomechanics – E. C. Petal and F. A. Leckie. Mc Graw Hill Book Co.
3. Rotor Dynamics – E. K. Kramer. Springer Verlag.

ADVANCED GEAR ENGINEERING					
Subject Code		L	T	P	C
MMDPE2054		3	0	0	3

Course Outcome	
CO1	Understanding Importance of theories of failure and material science
CO2	Able to mechanical components (i.e. bevel and worm gear) available and emphasize the need to continue learning
CO3	Analyze the characteristics of the analysis of gear tooth failures
CO4	Ability to design a component with design of gear trains from the propeller shafts of airplanes for auxiliary systems and optimize material

UNIT:1 (14 Hours)

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.

Spur Gears : Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings. **Helical Gears:**Tooth loads, Principles of Geometry, Design considerations and methodology,Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

UNIT:2 (14 Hours)

Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings. **Gear failures:** Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures

UNIT:3 (14 Hours)

Gear trains: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

Optimal Gear design: Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.

2. Henry E.Merrit,Gear engineering ,Wheeler publishing,Allahabad,1992.

Ref. Books

1. Practical Gear design by Darle W. Dudley, McGraw-Hill book company
2. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949.
3. G.M.Maitha, Hand book of gear design, TaTa Mc.Graw Hill publishing company Ltd., New Delhi,1994.

PROJECT MANAGEMENT AND COSTING					
Subject Code		L	T	P	C
MMDOE3013		3	0	0	3
Pre -Requisite: **Mathematics, Basics of Costing**					
Course Outcome					
CO1	Gain the knowledge and confidence to manage a project from beginning to end				
CO2	Identify the different stages involved in project planning				
CO3	To understand the concept of Project Scheduling and to analysis the Project Feasibility				
CO4	To understand the concept of Break even analysis and overhead allocation Techniques.				

UNIT:1 (10 Hours)

Project Feasibility Analysis: Technical feasibility, commercial and financial viability, Environment Analysis.

Project Engineering: Project Management Techniques : PERT, CPM, Project Scheduling Crashing, PERT / COST, LOB.

UNIT:2 (14 Hours)

Projects Financing alternatives, Sources of finance, their advantages, Choice of Financing mix, Capital budgeting.

Costing: Fixed and variable cost. Break even analysis, Overhead allocation Techniques.

UNIT:3 (16 Hours)

Project Organisation, management and control: Project organisation and control staffing, monitoring: cost, time and control and progress monitoring techniques.

Product and service pricing: Availability and quality based pricing for services.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Prasanna Chandra: Project Engineering and Management, Prentice Hall

Ref. Books

1. Levy and Weist: Management guide to PERT / CPM, Prentice Hall

RESEARCH METHODOLOGY					
Subject Code		L	T	P	C
MMDOE3011		3	0	0	3

Pre -Requisite: **Communication skills, Statistical mathematics**

Course Outcome

CO1	To develop understanding of the basic framework of research process.
CO2	To understand various research designs and techniques.
CO3	To identify various sources of information for literature review and data collection.
CO4	To develop an understanding of the ethical dimensions of conducting applied research.

UNIT:1 (14 Hours)

Introduction to RM: Meaning and significance of research. Importance of scientific research in decision making. Types of research and research process. Identification of research problem and formulation of hypothesis. Research Designs. Measurement and Data Collection. Primary data, Secondary data, Design of questionnaire ; Sampling fundamentals and sample designs. Measurement and Scaling Techniques, Data Processing

UNIT:2 (14 Hours)

Data Analysis – I: Hypothesis testing; Z-test, t-test, F-test, Chi-square test. Analysis of variance. Non-parametric Test – Sign Test, Run test, Krushall – Wallis test

UNIT:3 (12 Hours)

Data Analysis – II: Factor analysis, Multiple Regressions Analysis. Discriminant Analysis, Use of SPS Package.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Research Methodology, Chawla and Sondhi, Vikas

Ref. Books

1. Research methodology by C.R. KOTHARI
2. Research Methodology, Paneersevam, PHI

HUMAN RESOURCE MANAGEMENT					
Subject Code		L	T	P	C
MMDOE3012		3	0	0	3

Pre -Requisite: **Organizational behavior**

Course Outcome	
CO1	To discuss strategically plan for the human resources needed to meet organizational goals and objectives.
CO2	To define the process of job analysis and discuss its importance as a foundation for human resource management practice
CO3	To evaluate and critique an organization's selection process.
CO4	To explain and apply the legal principles that apply to a wide range of workplace issues

UNIT:1 (14 Hours)

Human Resource Development Strategies, Design And Experience

Human Resource Development: HRD-An Overview, Line Managers and HRD, Task Analysis, Motivational Aspects of HRD, Developmental Supervision, Counselling and Mentoring , HRD for Health and Family Welfare in Select HRD Culture and Climate, HRD for Workers, HRD/OD Approach to IR Corporate Business.

UNIT:2 (12 Hours)

Basics of Human Resource Planning

Macro Level Scenario of Human Resource Planning, Concepts and Process of Human Resource Planning, Methods and Techniques-Demand Forecasting, Methods and Techniques-Supply Forecasting, Job Evaluation: Concepts, Scope and Limitations, Selection and Recruitment, Induction and Placement, Performance and Potential Appraisal, Transfer, Promotion and Reward Policies, Training and Retraining.

UNIT:3 (14 Hours)

Wage and Salary Administration & Labour Legislation

Wage Concepts and Definition of Wages Under Various Labour Legislation, Norms for Wage Determination, Law relating to Payment of Wages and Bonus, Pay Packet Composition, Design of Performance-linked Reward System,

Philosophy of Labour Laws, Labour Laws, Industrial Relations and Human Resource Management, Indian Constitution and Labour Legislations

Time Management: Importance of Time factor, Time waster, Prioritizing Work Scheduling, Functions of the Time Office, Flexible Work arrangements.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books

1. Beardwell and Len Holder, Human Resource Management Macmillan India Ltd.,
2. Graham H.T., & R.Bennet, Human Resource Management – Pitman, London

Ref. Books

1. Performance Appraisal, Theory and Practice – AIMA VIKAS Management Series,
2. C.B. Manmoria, Personnel Management – Himalayan Publishing Co., New Delhi.
3. Pattanayak: Human Resource Management, PHI,
4. Nair,N.G. & Latha Nair:Personnel Management & Industrial Relations–S.Chand & Co.