ADHIYAMAAN COLLEGE OF ENGINEERING

[An Autonomous Institution Affiliated to Anna University, Chennai]
[Accredited by NAAC]
Dr.M.G.R NAGAR, HOSUR, KRISHNAGIRI (DT) – 635 130, TAMILNADU, INDIA
REGULATIONS 2018
CHOICE BASED CREDIT SYSTEM

M.E- ENGINEERING DESIGN

VISION

To develop competent and creative world class Mechanical Engineers who use their talents to achieve the excellence.

MISSION

- To provide the students qualitative technical knowledge
- To provide nurture creativity and critical thinking by applying global competency factors in Mechanical Engineering through effective teaching-learning processes
- To keep the students abreast of the latest technology to cope up with ever changing requirements of industries.

The Programme defines Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes as follows:

I. PROGRAMME EDUCATIONAL OBJECTIVES [PEOs]

PEO 1 Graduates of M.E. Engineering Design should have a comprehensive background of mathematics, science, and basics of mechanical engineering to solve applications related mechanical engineering and multidisciplinary areas.

PEO 2 Graduates of M.E. Engineering Design need to develop expertise and acumen in core areas like design, thermal and manufacturing engineering to the satisfaction of employers and blossom into entrepreneurs, scientists and technocrats with ethical values.

PEO 3 Engineering Design program orients its graduates towards professional growth either through employment or higher studies or research and contemporary areas of socio-technological issues like energy crisis, pollution and industrial relations.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

II. PROGRAM OUTCOMES [POs]

PO1: An ability to apply knowledge of mathematics, science and engineering to real world applications.

PO2: An ability to identify, formulate, analyse and solve complex mechanical engineering problems.

PO3: An ability to design mechanical engineering components, processes and create products or systems within economic, environmental, ethical and manufacturability constraints.

PO4: An ability to visualize and work in the laboratory so as to interpret and analyze data to facilitate report.

PO5: An ability to demonstrate skills to use modern engineering tools, various mechanical software and equipments to analyze problems.

PO6: An ability to understand the professional responsibility to access societal, health, safety and legal issues in this technological world.

PO7: An ability to perceive the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge needed for sustainable development.

PO8: An ability to apprehend code of conduct and ethical responsibilities.

PO9: An ability to work as an individual, as a member or a leader in diverse teams and in multi-disciplinary task.

PO10: An ability to communicate effectively through verbal, written and graphical forms.

PO11: An ability to understand engineering economics and management principles to handle projects effectively.

PO12: An ability to develop confidence for self education and lifelong learning.

III. PROGRAM SPECIFIC OUTCOMES [PSOs]

PSO1: An ability to solicit the knowledge of mathematics, science and mechanical fundamental in the realm of Design, Production and Thermal fluid sciences to solve engineering problems utilizing sophisticated technology.

PSO2: An ability to clutch societal realization to promulgate the organization through entrepreneurship for the advanced technophile world.

PSO3: An ability to develop and implement new ideas on product design with the help of modern computer aided tools for ensuring best manufacturing practices.

Mapping of PEO with PO and PSO

PEOs	POs												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I	3	3	2		1						1	2		3	
II		1	3	2	3	1	2	1			1	1	2		1
III			1		2	3	3	2	2		3	1			2

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Mapping of CO with PO and PSO

		COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR 1	SEM 1	Advanced Numerical Methods	√	√											√		
		Concepts of Engineering Design	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Computer Application in Design	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Finite Element Analysis	√	√	√	√	√					√			√		√
		Optimization Techniques in Design	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		CAE Laboratory-I	√	√		√								√	√		√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	SEM 2	Tribology in Design	√	√	√										√	√	√
		Vibration Analysis and Control	√	√	√										√	√	√
		Integrated Mechanical Design	√	√	√	√	√	√	√			√	√	√	√	√	√
		Mechanisms Design and Simulation	√	√	√	√						√			√		√
		CAE Laboratory-II	√	√	√	√	√					√		√	√		√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
YEAR 2	SEM 3	Project Work (Phase – I)	√	√	√		√	√			√	√		√	√		√
		Internship	√	√		√						√		√	√		√
		COURSE TITLE	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	SEM 4	Project Work (Phase-II)	√	√	√	√	√					√	√		√		√

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

ADHIYAMAAN COLLEGE OF ENGINEERING

[An Autonomous Institution Affiliated to Anna University, Chennai]
[Accredited by NAAC]
REGULATIONS 2018
CHOICE BASED CREDIT SYSTEM
M.E- ENGINEERING DESIGN
CURRICULA AND SYLLABI FOR SEMESTERS I TO IV

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	118EDT01	Advanced Numerical Methods	FC	3	1	0	5	4
2.	118EDT02	Concepts of Engineering Design	PC	3	0	0	4	3
3.	118EDT03	Computer Application in Design	PC	3	0	0	4	3
4.	118EDT04	Finite Element Analysis	PC	3	1	0	5	4
5.	118EDT05	Optimization Techniques in Design	PC	3	1	0	5	4
6.	PE1	PROFESSIONAL ELECTIVE 1	PE	3	0	0	4	3
PRACTICALS								
7.	118EDP07	CAE Laboratory-I	PC	0	0	2	3	1
			Total	18	3	2	30	22

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	218EDT01	Tribology in Design	PC	3	1	0	5	4
2.	218EDT02	Vibration Analysis and Control	PC	3	1	0	5	4
3.	218EDT03	Integrated Mechanical Design	PC	3	0	0	4	3
4.	218EDT04	Mechanisms Design and Simulation	PC	3	1	0	5	4
5.	PE2	PROFESSIONAL ELECTIVE 2	PE	3	0	0	4	3
6.	PE3	PROFESSIONAL ELECTIVE 3	PE	3	0	0	4	3
PRACTICALS								
7.	218EDP07	CAE Laboratory-II	PC	0	0	2	3	1
			Total	18	3	2	30	22

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	PE4	PROFESSIONAL ELECTIVE 4	PE	3	0	0	4	3
2.	PE5	PROFESSIONAL ELECTIVE 5	PE	3	0	0	4	3
PRACTICALS								
3.	318EDP01	Project Work (Phase – I)	EEC	0	0	8	8	4
4.	318EDP02	Internship	EEC	0	0	6	6	3
			Total	6	0	14	22	13

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICAL								
1.	418EDP01	Project Work (Phase-II)	EEC	0	0	30	30	15
			Total	0	0	30	30	15

LIST OF ELECTIVES

SEMESTER I, PROFESSIONAL ELECTIVE 1

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	118EDE01	Design of Hydraulic and Pneumatic Systems	PE	3	0	0	4	3
2.	118EDE02	Additive Manufacturing	PE	3	0	0	4	3
3.	118EDE03	Smart Materials and Structures	PE	3	0	0	4	3
4.	118EDE04	Composite Materials and Mechanics	PE	3	0	0	4	3
5.	118EDE05	Advanced Mechanics of Materials	PE	3	0	0	4	3

SEMESTER II, PROFESSIONAL ELECTIVE 2 & 3

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	218EDE01	Integrated Product and Process Development	PE	3	0	0	4	3
2.	218EDE02	Integrated Manufacturing Systems	PE	3	0	0	4	3
3.	218EDE03	Concepts of Design for Manufacture and Assembly	PE	3	0	0	4	3
4.	218EDE04	Engineering Fracture Mechanics	PE	3	0	0	4	3
5.	218EDE05	Design of Automotive System	PE	3	0	0	4	3
6.	218EDE06	Mechatronics System in Design	PE	3	0	0	4	3
7.	218EDE07	Nanomaterial & Nanotechnology	PE	3	0	0	4	3
8.	218EDE08	Plates and Shell	PE	3	0	0	4	3

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

SEMESTER III, PROFESSIONAL ELECTIVE 4 & 5

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	318EDE01	Micro Electro Mechanical Systems	PE	3	0	0	4	3
2.	318EDE02	Engineering Materials and their Applications	PE	3	0	0	4	3
3.	318EDE03	Product Life Cycle Management	PE	3	0	0	4	3
4.	318EDE04	Design of Materials Handling Systems	PE	3	0	0	4	3
5.	318EDE05	Vibration Control & Condition Monitoring	PE	3	0	0	4	3
6.	318EDE06	Design and Optimization of Thermal Energy System	PE	3	0	0	4	3
7.	318EDE07	Surface Engineering	PE	3	0	0	4	3
8.	318EDE08	Industrial Robotics & Experts System	PE	3	0	0	4	3
9.	318EDE09	Mechanical Behavior of Engineering Materials	PE	3	0	0	4	3
10.	318EDE10	Design of Pressure Vessels & Piping	PE	3	0	0	4	3
11.	318EDE11	Applied Engineering Acoustics	PE	3	0	0	4	3
12.	318EDE12	Computational Fluid Dynamics	PE	3	0	0	4	3
13.	318EDE13	Research Methodology and IPR	PE	3	0	0	4	3

Minimum number of Credits to be earned

Semester	I	II	III	IV	TOTAL
Credits	22	22	13	15	72

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

GROUPING OF SUBJECTS

FUNDAMENTAL COURSE (FC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	118EDT01	Advanced Numerical Methods	HS	3	1	0	4	4

PROFESSIONAL CORE (PC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	118EDT02	Concepts of Engineering Design	PC	3	0	0	4	3
2.	118EDT03	Computer Application in Design	PC	3	0	0	4	3
3.	118EDT04	Finite Element Analysis	PC	3	1	0	5	4
4.	118EDT05	Optimization Techniques in Design	PC	3	1	0	5	4
5.	118EDP07	CAE Laboratory-I	PC	0	0	2	3	1
6.	218EDT01	Tribology in Design	PC	3	1	0	5	4
7.	218EDT02	Vibration Analysis and Control	PC	3	1	0	5	4
8.	218EDT03	Integrated Mechanical Design	PC	3	0	0	4	3
9.	218EDT04	Mechanisms Design and Simulation	PC	3	1	0	5	4
10.	218EDP07	CAE Laboratory-II	PC	0	0	2	3	1

PROFESSIONAL ELECTIVES (PE)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	118EDE01	Design of Hydraulic and Pneumatic Systems	PE	3	0	0	4	3
2.	118EDE02	Additive Manufacturing	PE	3	0	0	4	3
3.	118EDE03	Smart Materials and Structures	PE	3	0	0	4	3
4.	118EDE04	Composite Materials and Mechanics	PE	3	0	0	4	3
5.	118EDE05	Advanced Mechanics of Materials	PE	3	0	0	4	3
6.	218EDE01	Integrated Product and Process Development	PE	3	0	0	4	3
7.	218EDE02	Integrated Manufacturing Systems	PE	3	0	0	4	3
8.	218EDE03	Concepts of Design for Manufacture and Assembly	PE	3	0	0	4	3
9.	218EDE04	Engineering Fracture Mechanics	PE	3	0	0	4	3

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

10.	218EDE05	Design of Automotive System	PE	3	0	0	4	3
11.	218EDE06	Mechatronics System in Design	PE	3	0	0	4	3
12.	218EDE07	Nanomaterial & Nanotechnology	PE	3	0	0	4	3
13.	218EDE08	Plates and Shell	PE	3	0	0	4	3
14.	318EDE01	Micro Electro Mechanical Systems	PE	3	0	0	4	3
15.	318EDE02	Engineering Materials and their Applications	PE	3	0	0	4	3
16.	318EDE03	Product Life Cycle Management	PE	3	0	0	4	3
17.	318EDE04	Design of Materials Handling Systems	PE	3	0	0	4	3
18.	318EDE05	Vibration Control & Condition Monitoring	PE	3	0	0	4	3
19.	318EDE06	Design and Optimization of Thermal Energy System	PE	3	0	0	4	3
20.	318EDE07	Surface Engineering	PE	3	0	0	4	3
21.	318EDE08	Industrial Robotics & Experts System	PE	3	0	0	4	3
22.	318EDE09	Mechanical Behavior of Engineering Materials	PE	3	0	0	4	3
23.	318EDE10	Design of Pressure Vessels & Piping	PE	3	0	0	4	3
24.	318EDE11	Applied Engineering Acoustics	PE	3	0	0	4	3
25.	318EDE12	Computational Fluid Dynamics	PE	3	0	0	4	3
26.	318EDE13	Research Methodology and IPR	PE	3	0	0	4	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	318EDP01	Project Work (Phase – I)	EEC	0	0	8	8	4
2.	318EDP02	Internship	EEC	0	0	6	6	3
3.	418EDP01	Project Work (Phase-II)	EEC	0	0	30	30	15

SUMMARY

S.No.	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL	Percentage %
		I	II	III	IV		
1.	FC	4				4	5.56%
2.	PC	15	16			31	43.06%
3.	PE	3	6	6		15	20.83%
4.	EEC			7	15	22	30.56%
	Total	22	22	13	15	72	

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

118EDT01 **ADVANCED NUMERICAL METHODS** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To solve equations using direct and iterative methods.
- To learn Eigen value problems.
- To introduce the concept of calculus of variations.
- To learn numerical methods to solve partial differential equations – Elliptic.
- To learn numerical methods to solve partial differential equations – Parabolic.

UNIT I SIMULTANEOUS EQUATIONS AND NUM ERICAL INTEGRATION 9

Solution of system of equations, Direct methods: Gauss elimination method, Choleski method, Iterative methods: Relaxation method. System of non-linear equations – Newton Raphson method – Newton-Cotes integration formulae - Trapezoidal rule, Simpson's rule, Gaussian quadrature.

UNIT II BOUNDARY VALUE & EIGENVALUE PROBLEMS 9

Shooting method, solution through a set of equations, derivative boundary conditions, Characteristic value problems and solution using characteristic polynomial method, Jacobi method, power method and Inverse of a matrix by power method.

UNIT III CALCULUS OF VARIATIONS 9

Variation and its properties – Euler's equation – Functional dependent of first and higher order derivatives – Functionals dependent of functions of several independent variables – Rayleigh Ritz method – Galerkin method.

UNIT IV NUMERICAL SOLUTIONS PARTIAL DIFFERENTIAL EQUATIONS 9

Laplace equations, representations as a difference equation, Iterative methods for Laplace's equations. Poisson equation, derivative boundary conditions, irregular and non-rectangular grids. Matrix patterns, Sparseness, ADI methods

UNIT V PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS 9

Explicit method, Crank-Nicholson method, derivative boundary condition, stability and convergence criteria. Parabolic equations in two or more dimensions, applications to heat flow problems.

TOTAL HOURS:60 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to

CO1: Apply numerical methods such as direct, iterative to solve system of equations and to solve integrals.
CO2: Solve the boundary value problems and Eigen value problems.
CO3: Compute maxima and minima of a functional dependent of functions using different methods.
CO4: Solve Elliptic type of partial differential equations using iterative methods.
CO5: Evaluate numerically the solutions of parabolic equations using initial and boundary conditions.

REFERENCE BOOKS

1. Richard L.Burden, J.Dougles Faires and Annette M. Burden, "Numerical Analysis", Tenth Edition, Cengage, 2016. www.cengage.com/international.
2. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. Elsgolc, L.E., "Calculus of Variations", Dover Pub., 2007.

4. Ward Cheney and David Kincaid, “Numerical Mathematics and Computing”, Brooks/Cole Publishing company, Fourth Edition, 1999.
5. Sankara Rao, K., “Introduction to Partial Differential Equations”, Prentice Hall of India Pvt. Ltd., New Delhi, 2012.
6. Jain M K, Iyengar S R K, and Jain R K, “Computational Methods For Partial Differential Equations”, New age International (P) Ltd, 1994.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply numerical methods such as direct, iterative to solve system of equations and to solve integrals.	3	3											3		
Co2	Solve the boundary value problems and Eigen value problems.	3	3											3		
Co3	Compute maxima and minima of a functional dependent of functions using different methods.	3	3											3		
Co4	Solve Elliptic type of partial differential equations using iterative methods.	3	3											3		
Co5	Evaluate numerically the solutions of parabolic equations using initial and boundary conditions.	3	3											3		

118EDT02 CONCEPTS OF ENGINEERING DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce basic concepts in design process.
- To provide knowledge on tools in engineering design.
- To learn material selection and materials in designing to machine members.
- To impart basic knowledge in material processing for designing machine members.
- To identify legal, ethical environmental and safety issue in design and quality Engineering.

UNIT I THE DESIGN PROCESS **8**

The Design Process - Need identification – Design requirements – Product Life Cycle – Morphology of Design steps of Product Design – Conceptual Design, Embodiment Design, Detailed Design – Concurrent Engineering – CAD & CAM, Human factors in Design.

UNIT II TOOLS IN ENGINEERING DESIGN **9**

Creativity and Problem solving, Decision Theory, Modeling – Role of models in Engineering Design, Mathematical Modeling, Geometric modeling, Finite Element Modeling, Rapid Prototyping – Simulation Finite Difference method, Monte Carlo method – Optimization – Search Methods, Geometric programming, Structural and Shape optimization.

UNIT III MATERIAL SELECTION AND MATERIALS IN DESIGN **9**

Classification and Properties of Engineering materials, Material Standards and specifications – Methods of material selection – Ashby Chart and method of weight factors, Derivation of material indices, Use of material selection Chart, Pugh selection method, Selection with computed aided databases – Design for brittle fracture, Design for fatigue failure, Design for corrosion resistance, Designing with plastics.

UNIT IV MATERIAL PROCESSING AND DESIGN 9

Classification of manufacturing processes and their role in design, Factors determining the process selection, Use of process selection chart and computerized database – Design for manufacturing, Design for forging and sheet metal forming, Design for casting, Design for machining, welding and assembly, Design for residual stresses and heat treatment

UNIT V LEGAL, ETHICAL ENVIRONMENTAL AND SAFETY ISSUES IN DESIGN AND QUALITY ENGINEERING 10

Origin of laws, Contracts, Liability, Tort Law, Product Liability , Design aspects of product liability, Codes of ethics, Solving ethical conflicts, Design for environment – Life Cycle assessment, Material recycling and remanufacture, Design for safety – Potential Dangers and Guidelines for design for safety, Design for reliability failure mode effect analysis, Robust Design.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Student will be able to

CO1: Perform design process for developing new machine members.
CO2: Notice tools in engineering design
CO3: Find the solution in materials selection and materials in designing a new machine member.
CO4: Conduct designing machine members using materials processing.
CO5: Apply knowledge to select material basing on legal, ethical environmental and safety issues in design and quality engineering.

TEXT BOOKS

1. Dieter George E, "Engineering Design – A Materials and Processing Approach", McGraw Hill, International Edition, Singapore 2012.
2. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw Hill, International Edition, 6th Edition, 2011.

REFERENCE BOOKS

1. Gerhard Pahl and Beitz W, "Engineering Design: A Systematic Approach", Springer, Verlag, London, 3rd Edition, 2007.
2. Suh. N. P., "The Principles of Design", Oxford University Press, New York, 1990.
3. Ray M.S., "Elements of Engineering Design: An Integrated Approach", Prentice Hall Inc. 1985.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Perform design process for developing new machine members.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co2	Notice tools in engineering design	2	2	2	2	2	2	1	1	2	1	1	1	3	2	2
Co3	Find the solution in materials selection and materials in designing a new machine member.	2	2	2	2	2	2	1	1	2	1	1	1	2	2	2
Co4	Conduct designing machine members using materials processing.	3	3	3	3	3	2	1	1	2	1	1	1	3	2	2
Co5	Apply knowledge to select material basing on legal, ethical environmental and safety issues in design and quality engineering.	2	2	2	2	2	2	1	1	2	1	1	1	2	2	2

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

118EDT03 **COMPUTER APPLICATION IN DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know about the application of computer graphics in design.
- To comprehend with the concepts of geometrical modeling and reverse engineering of components.
- To study about computer tools in mould design, jigs and fixtures design.
- To impart knowledge on design productivity using computers.
- To gain knowledge about managing product design data using computer.

PREREQUISITE: Fundamentals of Computer and Programming, Design of Machine Elements, Design of Transmission Systems.

UNIT I INTRODUCTION TO COMPUTER APPLICATIONS IN NEW PRODUCT DESIGN 9

Concept design, Parametric sketching, Constraints, Computer graphics, Principles- 2D transformation, scaling, rotation, windowing, view ports, clipping, data exchange formats.

UNIT II COMPUTERS IN DESIGN 9

Solid modeling of Mechanical components, Associative features, Sheet metal components, Nesting and development, Plastic parts with draft and shrinkage allowance, Reverse engineering of components, Assembly of parts, Tolerance analysis, Mass property calculations.

UNIT III COMPUTERS IN TOOLING DESIGN 9

Mould design, Jigs and fixtures design, Check for interferences, Mechanism design and analysis, Rapid tooling.

UNIT IV COMPUTERS IN DESIGN PRODUCTIVITY 9

Customizing various software by using visual basic, pro/program, script, LISP etc to write applications like design of shafts, gears etc.,

UNIT V MANAGING PRODUCT DESIGN DATA 9

Version control, Library creation, Catalog making, Standardization for design, Collaborative design among peer groups, Design optimization for geometry, Design check, approval and validation.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Students will be able to

CO1: Familiarized with the computer graphics application in design.
CO2: Perform design of machine tools using computers
CO3: Find the solution in programming the tool design
CO4: Apply computer knowledge in development of product design
CO5: Manage design data for producing new tools.

TEXT BOOKS

1. William M. Newman and Robert F Sproull, “Principles of Interactive Computer Graphics” McGraw Hill Book Co., Singapore, 2nd Edition, 1989.
2. Ibrahim Zeid, Sivasubramanian, “CAD/CAM – Theory and Practice”, McGraw Hill International Edition, 2nd Edition, 2010.

REFERENCE BOOKS

1. P N Rao, “CAD/CAM: Principles and Applications” Tata McGraw Hill, 3rd Edition, 2010.
2. Donald D. Hearn and M Pauline Baker, “Computer Graphics”, Prentice Hall Inc, 2004.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

3. Schlechtendahl E. G, “CAD – Data transfer for Solid Models”, Springer, Verlag, Berlin, 1989.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Familiarized with the computer graphics application in design.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co2	Perform design of machine tools using computers	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co3	Find the solution in programming the tool design	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co4	Apply computer knowledge in development of product design	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co5	Manage design data for producing new tools.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3

118EDT04 **FINITE ELEMENT ANALYSIS** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To formulate and analysis of 1D analysis arising in engineering design.
- To formulate and analysis of 2D, 3D analysis arising in engineering design.
- To know about the isoparametric formulation of triangular and rectangular elements.
- To provide further advanced FEA knowledge and techniques for solving Dynamic analysis
- To analyze the thermal and fluid flow problems by FEA.

PREREQUISITE - Knowledge of Numerical Methods and Strength of Materials are required.

UNIT I ONE DIMENSIONAL ANALYSIS 12

Relevance of finite element analysis in design, Modeling and discretization, Interpolation, elements, nodes and Degrees of Freedom, Applications of FEA, Variational methods, Potential energy method – Weighted residual methods, Galerkin method, One Dimensional Elements and Computational Procedures: Bar element, Beam element, Truss element, Shape functions, Element matrices and vectors - Assembly of elements – Boundary conditions - Solution of equations, Mechanical loads and stresses, Example problems.

UNIT II TWO AND THREE DIMENSIONAL ANALYSIS 12

Basic Boundary Value Problems in two-dimensions – Triangular, quadrilateral, higher order elements, Poisson’s and Laplace’s Equation, Weak Formulation, Introduction to Theory of Elasticity – Plane Stress – Plane Strain and Axisymmetric Formulation, Principle of virtual work – Element matrices and vectors, Three dimensional stress and strain – Tetrahedral Element – Hexahedral Element, Finite Element formulation, Example problems.

UNIT III ISOPARAMETRIC FORMULATION 12

Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Isoparametric Elements, Bilinear Isoparametric quadrilateral elements – shape function, Jacobian matrix, strain displacement matrix, stress-strain relationship matrix, force vector, Isoparametric Formulation - triangular element – rectangular elements – Serendipity elements, Numerical Integration - Gauss quadrature – Stress calculations, Examples problems.

UNIT IV DYNAMIC ANALYSIS 12

Introduction, Equations of motion, Axial vibration of rod, Transverse Vibration of beam, Formulation of element stiffness, Mass and force matrices, Lumped and consistent mass matrices, Natural frequencies, Eigen Values and Eigen Vectors, Mode shapes, Vector iteration methods, Transient vibration, Example problems.

UNIT V THERMAL AND FLUID FLOW ANALYSIS 12

Steady state heat transfer, Heat transfer with convection, One Dimensional Finite Element Formulation, Two Dimensional Finite Element Formulation, Basic differential equations of fluid flow, One Dimensional Finite Element Formulation, Two Dimensional Finite Element Formulation, Example problems.

TOTAL HOURS:60 PERIODS

COURSE OUTCOMES

CO1: Students will capable of formulate and analysis of 1D Problems.
CO2: Students will capable of formulate and analysis of 2D and 3D Problems.
CO3: Students will have the ability to solve isoparametric problems using FEA.
CO4: Students will able to solve dynamic analysis problem using FEA
CO5: Students will have the ability to apply finite element to formulate and solve thermal and fluid flow problems.

TEXT BOOKS

1. Daryl L Logan, "A First course in the finite element method", Cengage learning, 6th Edition, 2017.
2. Seshu P, "A Text book on Finite Element Analysis", Prentice Hall of India, New Jersey, 2003.

REFERENCE BOOKS

1. S.S.Rao, "The Finite Element Method in Engineering", Butterworth-Heinemann, 5th Edition, 2010.
2. *Robert D. Cook*, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", Wiley Student Edition, 4th Edition, 2008.
3. J. N.Reddy, "An Introduction to the Finite Element Method", McGraw Hill International, 2005.
4. David V Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Int. Ed., New Delhi, 2004.
5. Chandrupatla T R and Belegundu A D, "Introduction to Finite Elements in Engineering", Third Edition, Prentice Hall, 2002.
6. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1996.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Students will capable of formulate and analysis of 1D Problems.	1	2	2	1	1					1			2		1
Co2	Students will capable of formulate and analysis of 2D and 3D Problems.	1	2	2	1	1					1			2		1
Co3	Students will have the ability to solve isoparametric problems using FEA.	1	2	2	1	1					1			2		1
Co4	Students will able to solve dynamic analysis problem using FEA	1	2	2	1	1					1			2		1
Co5	Students will have the ability to apply finite element to formulate and solve thermal and fluid flow problems.	2	1	2	1	2								3		2

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

118EDT05 **OPTIMIZATION TECHNIQUES IN DESIGN** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

- To impart knowledge on various categories of existing engineering problems and solutions to such problems through different optimization techniques and approaches.
- To learn the engineering optimization fundamentals and applications.
- To understand the different optimization techniques and approaches for various categories of existing engineering problems and to formulate the optimization problems.
- To know about the design concepts for manufacturing industries.
- To study about the computational procedure in dynamic programming.

PREREQUISITE: Knowledge of Design of Machine Elements is required.

UNIT I ENGINEERING DESIGN PRACTICE 12

Evolution of Design Technology, Introduction to Design and the Design Process, Design versus Analysis, Role of Computers in Design Cycle, Impact of CAE on Design, Numerical Modeling with FEA and Correlation with Physical Tests.

Applications of Optimization in Engineering Design: Automotive, Aerospace and General Industry Applications, Optimization of Metallic and Composite Structures, Minimization and Maximization Problems, Multidisciplinary Design Optimization (MDO) and Multi Objective Optimization (MOO).

UNIT II OPTIMUM DESIGN PROBLEM FORMULATION 12

Types of Optimization Problems, The Mathematics of Optimization, Design Variables and Design Constraints, Feasible and Infeasible Designs, Equality and Inequality Constraints, Discrete and Continuous Optimization, Linear and Non Linear Optimization.

Optimization Theory, Fundamental Concepts, Global and Local Minimum, Gradient Vector and Hessian Matrix, Concept of Necessary and Sufficient Conditions, Constrained and Unconstrained Problems, Lagrange Multipliers and Kuhn Tucker Conditions

UNIT III SENSITIVITY ANALYSIS, OPTIMIZATION DISCIPLINES 12

Sensitivity Analysis, Linear and Non Linear Approximations. Gradient Based Optimization Methods, Dual and Direct.

Optimization Disciplines: Conceptual Design Optimization and Design Fine Tuning, Combined Optimization, Optimization of Multiple Static and Dynamic Loads, Transient Simulations, Equivalent Static Load Methods, Internal and External Responses, Design Variables in Each Discipline.

UNIT IV MANUFACTURABILITY IN OPTIMIZATION PROBLEMS 12

Design For Manufacturing, Manufacturing Methods and Rules, Applying Manufacturing Constraints to Optimization Problems.

Design Interpretation: Unbound Problems, Over Constrained Problems, Problems with numerical of Multiple Solutions, Active and Inactive Constraints, Constraint Violations and Constraint Screening, Design Move Limits, Local and Global Optimum.

UNIT V DYNAMIC PROGRAMMING 12

Introduction, Multistage decision processes, Principle of optimality, Computational Procedure in dynamic programming, Initial value problem, Examples.

TOTAL HOURS:60 PERIODS

COURSE OUTCOMES

CO1: Students will be familiarized with different approaches of optimizing an engineering problem or a function which is essentially required in industries today.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

CO2: Students acquire knowledge to optimize an existing design with single or multiple objective functions.

CO3: Students will get familiarized with the different approaches of optimizing disciplines in engineering problem or a function.

CO4: Students will able to solve the optimization problems in manufacturability using various optimization methods.

CO5: Students will able to write the procedure for dynamic programming using computational process.

TEXT BOOKS

1. Rao S.S, "Engineering Optimization: Theory and Practice", Newage Publisher, 3rd Edition, 2013.
2. Jasbir Arora, "Introduction to Optimum Design", McGraw Hill, 2011.

REFERENCE BOOKS

1. Fox R.L, Addison, "Optimization methods for Engg. Design", Wesley, 2004.
2. Mital K. V. and C. Mohan, "Optimization methods in Operations Research and Systems Analysis", New age International Publishers, 1996.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Students will be familiarized with different approaches of optimizing an engineering problem or a function which is essentially required in industries today.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co2	Students acquire knowledge to optimize an existing design with single or multiple objective functions.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co3	Students will get familiarized with the different approaches of optimizing disciplines in engineering problem or a function.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co4	Students will able to solve the optimization problems in manufacturability using various optimization methods.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co5	Students will able to write the procedure for dynamic programming using computational process.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3

118EDP07 **CAE LABORATORY - 1** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To know about design concepts, to use the Finite Element Method software correctly and efficiently.
- To know about the types of element used, type of analysis done, interpretation of results, method of solving and analyzing a given problem.
- To acquire the basic skills in using professional level finite element software, applied to structural, heat transfer and fluid flow components at various loading conditions.
- To analyze a physical problem, develop experimental procedures for accurately investigating the problem, and effectively perform and document findings.
- To simulate simple mechanisms using simulation software.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

Simulation of mechanisms using simulation software like MATLAB/ADAMS etc. **15**

Simulation of mechanism: Simple pendulum, Four bar mechanism, Slider crank mechanism, Cam and Follower mechanism, Spur gear drive, Piston and Cylinder.

Analysis of mechanical machine components using analysis software like ANSYS/ NASTRAN etc. **30**

Static Structural analysis: Truss, Bar, Beam, Axisymmetric analysis.

Dynamic analysis: Modal, Harmonic, Transient analysis, Buckling analysis, Non linear analysis Thermal analysis: Conduction heat transfer, Heat transfer with Conduction and Convection, Transient heat conduction analysis.

Coupled field analysis, Contact analysis, Fluid flow analysis and Design optimization.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Student will be able to

CO1: Select the method, meshing, analysis and optimize the given problem for structural and thermal applications.

CO2: Conduct structural analyses and selected other analysis like normal modes/natural frequency analysis, harmonic analysis, steady-state heat conduction analysis

CO3: Use professional level finite element software to solve engineering problems in solid mechanics and heat transfer

CO4: Simulate simple kinematic mechanisms using simulation software.

CO5: Recognize sources of errors in FEA.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Select the method, meshing, analysis and optimize the given problem for structural and thermal applications.		2		1								1	1		1
Co2	Conduct structural analyses and selected other analysis like normal modes/natural frequency analysis, harmonic analysis, steady-state heat conduction analysis	2	1		1								1			2
Co3	Use professional level finite element software to solve engineering problems in solid mechanics and heat transfer	2	2		2								1			3
Co4	Simulate simple kinematic mechanisms using simulation software.		1		2								2			2
Co5	Recognize sources of errors in FEA.	1	1		1									1		1

118EDE01 **DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To have knowledge on how to use and application of hydraulics and pneumatics as fluid power in Industry.
- To learn the various control valves and actuation systems.
- To comprehend the design concepts of hydraulic system for automation.
- To analyse the pneumatic circuit for energy efficiency.
- To study installation, maintenance and special circuits.

PREREQUISITE: Knowledge of Applied Hydraulics and Pneumatics is required.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS 9

Hydraulic Power Generators, Selection and specification of pumps, Pump characteristics, Linear and Rotary Actuators – selection, specification and characteristics.

UNIT II CONTROL AND REGULATION ELEMENTS 9

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT III HYDRAULIC CIRCUITS 9

Reciprocation, quick return, sequencing, synchronizing circuits, accumulator circuits, industrial circuits, press circuits, hydraulic milling machine, grinding, planning, copying, forklift, earth mover circuits, design and selection of components, safety and emergency mandrels.

UNIT IV PNEUMATIC SYSTEMS AND CIRCUITS 10

Pneumatic fundamentals, control elements, position and pressure sensing, logic circuits, switching circuits, fringe conditions modules and these integration - sequential circuits - cascade methods, mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS 8

Pneumatic equipments, selection of components, design calculations, application -fault finding - hydro pneumatic circuits, use of microprocessors for sequencing, PLC, Low cost automation - Robotic circuits.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

CO1: The students will have fundamental knowledge on fluid power control.
CO2: The students will be able to select various control valves and use them in hydraulic and pneumatic circuit development.
CO3: The students will be able to design hydraulic circuits for automation.
CO4: The students will be able to analyse the pneumatic circuit for energy efficiency.
CO5: The students know installation, maintenance of power systems.

TEXT BOOKS

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 2014, 7th Edition.
2. Dudley A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 1987.

REFERENCE BOOKS

1. Jagadeesha T and Thammaiah Gowda, “Fluid Power: Generation, Transmission and Control”, Wiley, 2016.
2. Shanmuga Sundaram K, “Hydraulic and Pneumatic controls: Understanding made easy”, S.Chand & Co. Book Publishers, New Delhi, 2009.
3. Andrew Parr, “Hydraulics and Pneumatics” (HB), Jaico Publishing House, 2005.
4. Majumdar S R, “Oil Hydraulic Systems: Principles and Maintenance”, McGraw Hill Education, 28th Edition, 2017.
5. Bolton. W., “Pneumatic and Hydraulic Systems”, Butterworth –Heinemann, 1998.
6. Majumdar S R, “Pneumatic Systems: Principles and Maintenance”, McGraw Hill Education, 1996.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will have fundamental knowledge on fluid power control.	1	1	1										1	1	1
Co2	The students will be able to select various control valves and use them in hydraulic and pneumatic circuit development.	2	2	3										2	2	2
Co3	The students will be able to design hydraulic circuits for automation.	1	3	2										1	2	2
Co4	The students will be able to analyse the pneumatic circuit for energy efficiency.	2	1	1										2	1	1
Co5	The students know installation, maintenance of power systems.	1	2	2										1	2	1

118EDE02 **ADDITIVE MANUFACTURING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know about the concepts of the rapid prototyping methods.
- To know the principle and process details of stereo lithography system.
- To comprehend the concepts and process details of fusion deposition modeling.
- To gain the knowledge on laminated object manufacturing.
- To know about rapid tooling techniques and its advantages.

PREREQUISITE: Knowledge of Manufacturing Technology - I is required.

UNIT I INTRODUCTION OF RAPID PROTOTYPING 8

Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry and classification of RP systems

UNIT II STEREO LITHOGRAPHY SYSTEMS AND SELECTIVE LASER SINTERING 9

Stereo lithography Systems, Principle, Process parameters, Process details, Data preparation, Data files and Machine details, Applications. Selective Laser Sintering, Types of machines, Principle of operation, Process parameters, Data preparation for SLS, Applications.

UNIT III FUSION DEPOSITION MODELING & SOLID GROUND CURING 9

Fusion Deposition Modeling: Principle, Process parameters, Path generation, Applications. Solid Ground Curing: Principle of operation, Machine details, Applications.

UNIT IV LAMINATED OBJECT MANUFACTURING, CONCEPT MODELERS & LENS 9

Laminated Object Manufacturing, Principle of operation, LOM materials, Process details, Applications. Concept Modelers, Principle, Thermo jet printer, Sander's model market, 3-D printer, GenisysXs printer, JP 5system, Object Quadra System, Laser Engineered Net Shaping (LENS), principle, applications.

UNIT V RAPID TOOLING 10

Indirect Rapid Tooling, Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Direct Rapid Tooling, Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, ProMetal, Sand casting tooling, Laminate tooling, soft tooling vs hard tooling, Case Studies: Automotive and Aerospace Industries

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

CO1: The students will able to gain knowledge about the various rapid prototyping technologies.

CO2: The students will able to gain knowledge about stereo lithography process and selective laser sintering.

CO3: The students will have sound knowledge on processes like fusion deposition modeling and solid ground curing.

CO4: The students will have sound knowledge on processes includes laminated object manufacturing concept modeler and laser engineered net shaping.

CO5: The students can enhance the knowledge in rapid tooling and different softwares used for rapid prototyping like solid view.

TEXT BOOKS

1. Pham. D. T. & Dimov. S. S., "Rapid Manufacturing", Verlag, London, 2012.
2. Paul. F. Jacobs, "Stereo lithography and other RP & M Technologies", SME, New York, 2010.

REFERENCE BOOKS

1. Hari Prasad & K.S. Badrinarayanan, "Rapid Prototyping and Tooling", SIP Pageturners, 2013.
2. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, "Rapid Prototyping Principles and Applications", World Scientific Publishing Company, 2010.
3. Serope Kalpakjian and Steven R Schmid, "Manufacturing Engineering and Technology", Prentice Hall, 6th Edition, 2009.
4. Frank W Lioli, "Rapid Prototyping and Engineering Applications", CRC Press, 2008.
5. Terry Wohlers, "Wohlers Report 2006", Wohlers Associates, 2006.
6. N. Hopkinson, RJM Hague, P.M.Dickens, "Rapid Manufacturing: An Industrial Revolution for the Digital Age", Wiley, 2005.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will able to gain knowledge about the various rapid prototyping technologies.	2		2									1	2		1
Co2	The students will able to gain knowledge about stereo lithography process and selective laser sintering.	1		2										1		1
Co3	The students will have sound knowledge on processes like fusion deposition modeling and solid ground curing.	1		1										1		2
Co4	The students will have sound knowledge on processes includes laminated object manufacturing concept modeler and laser engineered net shaping.						3							1		1
Co5	The students can enhance the knowledge in rapid tooling and different softwares used for rapid prototyping like solid view.	1		1			2							1		1

118EDE03 **SMART MATERIALS AND STRUCTURES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To study about the fundamentals of smart materials, devices and electronics, in particular those related to the development of smart structures and products.
- To know about the usage of various shape memory alloys in industrial application.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

- To gain knowledge about the characteristics and applications of vibrations absorbers.
- To study about the construction of various electro- mechanical system used for advanced engineering application and analysis.
- To study about the sensors and actuators in MEMS application.

PREREQUISITE: Knowledge of Engineering Materials and Metallurgy, Dynamics of Machinery are required.

UNIT I SMART STRUCTURES 10

Types of Smart Structures, Potential Feasibility of Smart Structures, Key Elements of Smart Structures, Applications of Smart Structures. Piezoelectric materials, Properties, piezoelectric Constitutive Relations, Depoling and Cohesive Field, field strain relation. Hysteresis, Creep and Strain Rate effects, Inchworm Linear Motor. Beam Modeling: Beam Modeling with induced strain Rate effects, Inchworm Linear Motor Beam Modeling with induced strain. Actuation-single Actuators, dual Actuators, Pure Extension, Pure Bending harmonic excitation, Bernoulli-Euler beam Model, problems, Piezoelectrical Applications.

UNIT II SHAPE MEMORY ALLOY 9

Experimental Phenomenology, Shape Memory Effect, Phase Transformation, Tanaka's Constitutive Model, testing of SMA Wires, Vibration Control through SMA, Multiplexing. Applications of SMA and Problems.

ER and MR Fluids: Mechanisms and properties, Fluid Composition and behavior, The Bingham Plastic and Related Models, Pre-Yield Response. Post-Yield flow applications in Clutches, Dampers and Others.

UNIT III VIBRATION ABSORBERS 10

Series and Parallel Damped Vibrations (Overview), Active Vibration Absorbers, Fiber Optics, Physical Phenomena, Characteristics, Sensors, Fiber Optics in Crack Detection, applications. Control of Structures: Modeling, Control Strategies and Limitations, Active Structures in Practice.

UNIT IV MEMS 8

Mechanical Properties of MEMS Materials, Scaling of Mechanical Systems, Fundamentals of theory, The Intrinsic Characteristics of MEMS, Miniaturization, Microelectronics Integration.

UNIT V DEVICES 8

Sensors and Actuators, Conductivity of Semiconductors, Crystal Planes and Orientation, (Stress and Strain Relations, Flexural Beam Bending Analysis Under Simple Loading Conditions), Polymers in MEMS, Optical MEMS Applications.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Student will be able to

CO1: Describe the behavior and applicability of various smart materials.
CO2: Analyse the different Shape memory alloys and their experimental phenomenon.
CO3: Characterize the different vibration absorber.
CO4: Design, analysis and testing of MEMS for different applications.
CO5: Describe the polymer and optical MEMS

TEXT BOOKS

1. M. V. Gandhi and B. S. Thompson, "Smart Materials and Structures", Chapman and Hall, London; New York, 2016.

2. A. V. Srinivasan, “Smart Structures: Analysis and Design”, Cambridge University Press, Cambridge, New York, 2010.
3. B. Culshaw, “Smart Structures and Materials”, Artech House, Boston, 1996.

REFERENCE BOOKS

1. A. J. Moulson and J. M. Herbert, “Electroceramics: Materials, Properties, Applications”, John Wiley & Sons, 2003.
2. G. Engdahl, “Handbook of Giant Magnetostrictive Materials”, Academic Press, San Diego, California, London, 2000.
3. K. Otsuka and C. M. Wayman, “Shape Memory Materials”, Cambridge University Press, Cambridge; New York, 1999.
4. K. Uchino, “Piezoelectric Actuators and Ultrasonic Motors”, Kluwer Academic Publishers, Boston, 1997.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Describe the behavior and applicability of various smart materials.	3	1	1										1		1
Co2	Analyse the different Shape memory alloys and their experimental phenomenon.		1	1	2											
Co3	Characterize the different vibration absorber.					3	1						1	2		1
Co4	Design, analysis and testing of MEMS for different applications.	1				1	1						1	1		1
Co5	Describe the polymer and optical MEMS	1				1	1						1	1		1

118EDE04 COMPOSITE MATERIALS AND MECHANICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To comprehend with general characteristics of composite materials.
- To study about manufacturing process of composite materials.
- To analyze mechanics of composite materials.
- To perform various tests on composite materials to know its effect.
- To develop the equations based on laminates.

PREREQUISITE: Knowledge of Composite Materials is required.

UNIT I INTRODUCTION OF COMPOSITE MATERIALS **9**

Definition, Need, General Characteristics, Applications, Fibers – Glass, Carbon, Ceramic and Aramid fibers, Matrices – Polymer, Graphite, Ceramic and Metal Matrices, Fiber surface treatments, Fillers and Additives.

UNIT II MANUFACTURING OF COMPOSITES **9**

Bag Moulding, Compression Moulding, Pultrusion, Filament Winding, Other Manufacturing Processes, Processing of MMC, Diffusion bonding, Stir casting, Squeeze casting, Quality Inspection methods.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT III MECHANICS OF COMPOSITES 9

Rule of mixture, volume and mass fractions, density, void content, Evaluation of four elastic moduli based on strength of materials approach and Semi-Empirical model, Longitudinal Young's modulus, transverse Young's modulus, major Poisson's ratio, In-plane shear modulus, Ultimate strengths of a unidirectional lamina, Characteristics of Fiber-reinforced lamina, laminates, Lamination theory, Interlaminar stresses

UNIT IV PROPERTIES OF COMPOSITES 9

Static Mechanical Properties, Fatigue and Impact Properties, Environmental effects, Long term properties, Fracture Behavior and Damage Tolerance

UNIT V LAMINA CONSTITUTIVE EQUATIONS 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

CO1: The students will have ability to identify the properties of composite materials.
CO2: The students will have knowledge of manufacturing composite materials by using various methods.
CO3: The students can analyse the mechanism of composite materials.
CO4: The students can perform various tests on composite materials.
CO5: The students can be able to develop the equations based on laminates and to determine lamina stress within laminates.

TEXT BOOKS

1. Robert M Jones, "Mechanics of composite materials (Materials science and Engineering Series)", Taylor and Francis, Second Edition, 2015.
2. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 3rd Edition, 2007.

REFERENCE BOOKS

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", 4th Edition, John Wiley and Sons, New York, 2017.
2. Ronald Gibson, "Principles of Composite Material Mechanics", 4th Edition, Tata McGraw Hill, 2016.
3. Autar K. Kaw, "Mechanics of Composite Materials" CRC Press, NY, 2nd Edition, 2006.
4. Halpin J.C, "Primer on Composite Materials, Analysis", Techomic Publishing Co, 2006.
5. Mallick P K and Newman S, "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 2006.
6. Chawla K.K., "Composite Materials", Springer – Verlag, 1998.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will have ability to identify the properties of composite materials.	1	1	1										1	1	1
Co2	The students will have knowledge of manufacturing composite materials by using various methods.	2	3	3										2	3	2
Co3	The students can analyse the mechanism of composite materials.	1	2	2										1	3	1
Co4	The students can perform various tests on composite materials.	2	1	1										2	2	2
Co5	The students can be able to develop the equations based on laminates and to determine lamina stress within laminates.	1	2	2										3	1	1

118EDE05 ADVANCED MECHANICS OF MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To comprehend the basic concepts of mechanics of materials.
- To cognize the stresses and deflection in unsymmetrical beams.
- To interpret the stresses and strains associated with thick-wall cylindrical pressure vessels and rotating disks.
- To interpret the stresses and strains in noncircular section.
- To interpret the stresses and strains in flat plates.

PREREQUISITE: Knowledge of Strength of Materials is required.

UNIT I ELASTICITY **9**

Stress and Strain relation, General equation of elasticity in cartesian, polar and spherical coordinates, Differential equation of equilibrium, Compact ability, Boundary conditions, Representations of three dimensional stress of a tension, Generalized Hooke's law, St.Vennant's principle, Plane strain, plane stress, Airy's stress function, Shear Centre, Location of shear centre for various sections, shear flow.

UNIT II UNSYMMETRICAL BENDING **9**

Stresses and deflection in beams subjected to unsymmetrical loading – Kern of a section, Curved flexural members, circumferential and radial stresses, Deflection and radial curved beam with re-strained ends, Closed ring subjected to concentrated load & uniform load, Chain link & Crane hooks.

UNIT III THICK CYLINDERS AND ROTATING DISCS **9**

Thick walled cylinder subjected to internal and external pressures, Shrink fit joints, Stresses due to rotation, Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness, Allowable speed, Rotating shafts and cylinders.

UNIT IV TORSION OF NON CIRCULAR SECTIONS **9**

Torsion of rectangular cross section, St.Vennant Theory, Elastic membrane analogy, Prandtl's stress function, Torsional stresses in hollow thin walled tubes.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT V STRESSES IN FLAT PLATES 9

Stresses in circular and rectangular plates due to various types of loading and end conditions, Buckling of plates, Theory of contact stresses – methods of computing contact stresses, Deflection of bodies in point and line contact – applications.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Students will be able to

CO1: Comprehend the basic concepts of mechanics of materials.
CO2: Cognize the stresses and deflection in unsymmetrical beams.
CO3: Interpret the stresses and strains associated with thick-wall cylindrical pressure vessels and rotating disks, non circular rotating shafts.
CO4: Interpret the stresses and strains in noncircular cross section members.
CO5: Interpret the stresses and strains in flat plates.

TEXT BOOKS

1. Antony E. Armenakas, "Advanced Mechanics of Materials and Applied Elasticity", Taylor & Francis, 2013.
2. Arthur P.Boresi and Richard J.Schmidt, "Advanced Mechanics of Materials", John Willey & Sons Inc., 6th Edition, 2009.

REFERENCE BOOKS

1. Srinath.L.S., "Advanced Mechanics of Solids", Tata McGraw Hill Publishing Company Ltd., 3rd Edition, 2010.
2. Robert D.Cook, Wareen.C.Yound, "Advanced Mechanics of Materials", Macmillon Publishers Company, 2nd Edition, 1999.
3. Krishna Raju, N. and Gururaja.D.R., "Advanced Mechanics of Solids and Structures", Narosa Publishing House, 1997.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Comprehend the basic concepts of mechanics of materials.	2	1	1										3	2	1
Co2	Cognize the stresses and deflection in unsymmetrical beams.	3	2	2										1	1	2
Co3	Interpret the stresses and strains associated with thick-wall cylindrical pressure vessels and rotating disks, non circular rotating shafts.	1	1	1										2	2	1
Co4	Interpret the stresses and strains in noncircular cross section members.	2	3	2										1	1	2
Co5	Interpret the stresses and strains in flat plates.	1	1	2										1	2	1

218EDT01 TRIBOLOGY IN DESIGN L T P C
3 1 0 4

COURSE OBJECTIVES:

- To understand the principles for selecting compatible materials for minimizing friction and wear in machinery.
- To understand the principles of hydrodynamic and hydrostatic lubrication and their design and applications.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

- To understand the principles of bearing selection and bearing arrangement in machines.
- To understand the factors influencing the design and selection of Porous bearings.
- To learn about space and automotive tribology.

UNIT I INTRODUCTION TO TRIBOLOGY 12

Introduction, Friction, Wear, Wear Characterization, Regimes of lubrication Classification of contacts, lubrication theories, Effect of pressure and temperature on viscosity. Newton's Law of viscous forces, Flow through stationary parallel plates. Hagen's Poiseuille's theory, viscometers. Numerical problems, Concept of lightly loaded bearings, Petroff's equation, Numerical problems.

UNIT II HYDRODYNAMIC LUBRICATION 12

Pressure development mechanism. Converging and diverging films and pressure induced flow. Reynold's equation in two dimensions with assumptions. Introduction to idealized slide bearing with fixed shoe and Pivoted shoes. Expression for load carrying capacity. Location of center of pressure, effect of end leakage on performance, Numerical problems

Journal Bearings: Introduction to idealized full journal bearings. Load carrying capacity of idealized full journal bearings, Sommerfeld number and its significance, short and partial bearings, Comparison between lightly loaded and heavily loaded bearings, effects of end leakage on performance, Numerical problems.

UNIT III HYDROSTATIC BEARINGS 12

Hydrostatic thrust bearings, hydrostatic circular pad, annular pad, rectangular pad bearings, types of flow restrictors, expression for discharge, load carrying capacity and condition for minimum power loss, numerical problems, and hydrostatic journal bearings. **EHL Contacts:** Introduction to Elasto - hydrodynamic lubricated bearings. Introduction to 'EHL' constant. Grubin type solution.

UNIT IV ANTIFRICTION BEARINGS 12

Advantages, selection, nominal life, static and dynamic load bearing capacity, probability of survival, equivalent load, cubic mean load, bearing Mountings.

Porous Bearings: Introduction to porous and gas lubricated bearings. Governing differential equation for gas lubricated bearings, Equations for porous bearings and working principal, Fretting phenomenon and its stages.

UNIT V SPACE AND AUTOMOTIVE TRIBOLOGY 12

Introduction - Mechanism, components, liquid and solid lubricants, accelerated testing and life testing of space mechanism. Principles of Aerospace eccentric bearing test mechanism. Engine Tribology - importance, engine bearings, wheel bearings, tire. Mechanics of load transfer - contact area and normal pressure distribution, brakes, effects of service on engine oil properties. Tribology in manufacturing - macro and micro tribology of MEMS materials. Technologies for machinery diagnosis and prognosis.

TOTAL HOURS:60 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Select compatible materials for minimizing friction and wear in machinery.

CO2: Design or choose efficient tribological systems such as rolling element bearings, hydrodynamic bearings, and dry sliding bearings, for the needs of a specific application.

CO3: Design bearings under Hydrostatic condition.

CO4: Explain the concepts advanced bearings like porous bearings and gas lubricated bearings.

CO5: Performs space and automotive tribology related study.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

TEXT BOOKS

1. Majumdar.B.C, “Introduction to Tribology of Bearing”, Wheeler Publishing, New Delhi, 2001.
2. Radzimovsky, “Lubrication of Bearings – Theoretical Principles and Design”, Oxford Press Company, 2000.

REFERENCE BOOKS

1. Dudley D.Fulier, "Theory and Practice of Lubrication for Engineers", New York Company, 1998
2. Moore "Principles and Applications of Tribology", Pergamon Press, 1975.
3. Oscar Pinkus, BenoSternlicht, “Theory of Hydrodynamic Lubrication”, McGraw-Hill, 1961.
4. G W Stachowiak, A W Batchelor, “Engineering Tribology”, Elsevier Publication 1993.
5. F. M. Stansfield, “Hydrostatic Bearings for Machine Tools and Similar Applications”, Machinery Publishing, 1970.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Select compatible materials for minimizing friction and wear in machinery.	3	1	1										1	2	1
Co2	Design or choose efficient tribological systems such as rolling element bearings, hydrodynamic bearings, and dry sliding bearings, for the needs of a specific application.	2	2	1										2	2	1
Co3	Design bearings under Hydrostatic condition.	1	1	2										1	1	2
Co4	Explain the concepts advanced bearings like porous bearings and gas lubricated bearings.	2	2	2										2	1	2
Co5	Performs space and automotive tribology related study.	3	2	2										1	1	2

218EDT02 VIBRATION ANALYSIS AND CONTROL

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operates in vibratory conditions.
- To obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF).
- To write the differential equation of motion of vibratory systems.
- To make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.
- To understand working principles of vibration measurement devices.

UNIT I FUNDAMENTALS OF VIBRATION **12**

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review Of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers - Response To Arbitrary and non- harmonic Excitations – Transient Vibration –Impulse loads- Critical Speed Of Shaft-Rotor systems.

UNIT II TWO DEGREE FREEDOM SYSTEM **12**

Introduction-Free Vibration Of Undamped And Damped - Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM 12

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method -Geared Systems-Eigen Values & Eigen vectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams

UNIT IV VIBRATION CONTROL 12

Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods- -Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber-Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control

UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 12

Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. -Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes

TOTAL HOURS:60 PERIODS

COURSE OUTCOMES

The student will have an ability to

CO1: Analyze the mathematical model of a linear vibratory system to determine its response.
CO2: Obtain linear mathematical models of real life engineering systems.
CO3: Use Lagrange's equations for linear and nonlinear vibratory systems.
CO4: Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.
CO5: Conduct test by using different vibration measuring device.

TEXT BOOKS

1. Rao, S.S.," Mechanical Vibrations," Prentice Hall, 2011.
2. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.

REFERENCE BOOKS

1. V. P. Singh, "Mechanical Vibrations Mechanical Engineering; a Modern Approach", Dhanpat Rai Publication, 2009.
2. S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw –Hill Publishing Com. Ltd New Delhi, 2007.
3. S Graham Kelly, "Schaum's Outline of Mechanical Vibrations", McGraw Hill Education, 1996.
4. Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Analyze the mathematical model of a linear vibratory system to determine its response.	1	1	2										1	1	1
Co2	Obtain linear mathematical models of real life engineering systems.	2	1	2										3	2	2

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

Co3	Use Lagrange's equations for linear and nonlinear vibratory systems.	3	1	1										2	1	3
Co4	Determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.	1	1	2										1	2	1
Co5	Conduct test by using different vibration measuring device.	2	1	2										2	1	2

218EDT03 INTEGRATED MECHANICAL DESIGN

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamentals of design procedure of shafts and phase of design.
- To understand the design procedure for developing the shafts.
- To understand the design procedure for developing gears and gear boxes.
- To understand the design procedure for developing brakes and clutches.
- To understand the fundamentals and design procedure of different machine elements for mechanical design.

UNIT I FUNDAMENTALS OF DESIGN **9**

Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration –BIS, ISO, DIN, BS, ASTM Standards. Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress - Theories of Failure – Ductile vs. brittle component design.

UNIT II DESIGN OF SHAFTS **9**

Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity

UNIT III DESIGN OF GEARS AND GEAR BOXES **9**

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads – Component design of spur, helical, bevel and worm gears – Design for sub assembly – Integrated design of speed reducers and multi-speed gear boxes – application of software packages.

UNIT IV BRAKES & CLUTCHES **9**

Dynamics and thermal aspects of brakes and clutches – Integrated design of brakes and clutches for machine tools, automobiles and mechanical handling equipments.

UNIT V INTEGRATED DESIGN **9**

Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators, Escalators, Gear Box, Valve gear Mechanisms, Machine Tools

TOTAL HOURS:45 PERIODS

(Use of Approved Data Book Is Permitted)

COURSE OUTCOMES

The student will have an ability to

CO1: Design components based on process and function tolerances.
CO2: Design shafts for different applications.
CO3: Design different types of gears and gear boxes.
CO4: Solve the problems in brakes and clutches.
CO5: Understand the basics procedure of design of machine in engineering field.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

TEXT BOOKS

1. Norton L. R., "Machine Design – An Integrated Approach", Pearson Education, 2005.
2. Shigley, J.E., "Mechanical Engineering Design", McGraw Hill, 1986.

REFERENCE BOOKS

1. Prasad. L. V., "Machine Design", Tata McGraw Hill, New Delhi, 1992.
2. Maitra G.M., "Hand Book of Gear Design", Tata McGraw Hill, 1985.
3. Alexandrov, M., "Materials Handling Equipments", MIR Publishers, 1981.
4. Newcomb, T.P. and Spur, R.T., "Automobile Brakes and Braking Systems", Chapman and Hall, 2nd Edition, 1975.
5. Boltzharol, A., "Materials Handling Handbook", The Ronald Press Company, 1958.

APPROVED DATA BOOKS

1. P.S.G. Tech., "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.
2. Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol. 1 & 2, Suma Publishers, Bangalore, 1983.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Design components based on process and function tolerances.	1	2	2	1	1					1			2		1
Co2	Design shafts for different applications.	1	2	2	1	1					1			1		1
Co3	Design different types of gears and gear boxes.	1	1	2	1	1					1			2		1
Co4	Solve the problems in brakes and clutches.	1	3	1	1	1					1			2		1
Co5	Understand the basics procedure of design of machine in engineering field.	1	1		1	1	1	1				1	1	1	1	

218EDT04 MECHANISMS DESIGN AND SIMULATION

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To learn the basic concepts of mechanism and analysis of kinematic structures.
- To learn the analytical methods for velocity and acceleration analysis of mechanism.
- To learn the various path curvature theory.
- To understand the synthesis of four bar mechanism.
- To learn the concept of coupler curve for cam mechanism.

UNIT I INTRODUCTION **12**

Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms – mobility analysis – formation of one D.O.F. multi loop kinematic chains, Network formula – Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms-Equivalent mechanisms.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT II KINEMATIC ANALYSIS 12

Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism-Denavit-Hartenberg Parameters – Forward and inverse kinematics of robot manipulators.

UNIT III PATH CURVATURE THEORY, COUPLER CURVE 12

Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cuspcrunode coupler driven six-bar mechanisms-straight line mechanisms

UNIT IV SYNTHESIS OF FOUR BAR MECHANISMS 12

Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein's Equation-Bloch's Synthesis.

UNIT V SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS 12

Cognate Lingages-parallel motion Linkages. Design of six bar mechanisms-single dwell-double dwell-double stroke. Geared five bar mechanism-multi-dwell. Cam Mechanisms- determination of optimum size of cams. Mechanism defects. Study and use of Mechanism using Simulation Soft-ware packages. Students should design and fabricate a mechanism model as term project.

TOTAL HOURS:60 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Use the concept of analysis for different kinematic mechanism.
CO2: Use the position analysis method to determine the velocity and acceleration.
CO3: Formulate the coupler curve for straight line and six bar mechanism.
CO4: Perform the dimensional synthesis of four bar mechanism.
CO5: Synthesis the coupler curve for cam mechanism.

TEXT BOOKS

1. Robert L.Norton., "Design of Machinery",Tata McGraw Hill, 2005.
2. Sandor G.N., and Erdman A.G., "Advanced Mechanism Design Analysis and Synthesis", Prentice Hall, 1984.

REFERENCE BOOKS

1. Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2005.
2. Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanism and Machines", EWLP, Delhi, 1999.
3. Kenneth J, Waldron, Gary L. Kinzel, "Kinematics, Dynamics and Design of Machinery", John Wiley-sons, 1999.
4. Ramamurti, V., "Mechanics of Machines", Narosa, 2005.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use the concept of analysis for different kinematic mechanism.	1	2	2										1		1

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Co2	Use the position analysis method to determine the velocity and acceleration.	1	2	2									1		1
Co3	Formulate the coupler curve for straight line and six bar mechanism.	1	2	2	1								1		1
Co4	Perform the dimensional synthesis of four bar mechanism.	1	2	2	1								1		1
Co5	Synthesis the coupler curve for cam mechanism.	1	2	1	1						1		2		1

218EDP07 **CAE LABORATORY – II** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To understand and practice the drawings of machine components and simple assemblies using modeling packages.
- To provide the fundamental concepts of the theory of the finite element method through software.
- To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.
- To understand the concepts of Structural and thermal stress analysis on components.
- To gain knowledge about the Failure analysis of various joints.

Modeling and Assembling of mechanical machine components using modeling software **15**

Modeling and Assembling of Machine Vice, Tailstock, Connecting rod, Shaper tool head assembly etc.

Analysis of mechanical machine components using analysis software **30**

Stress analysis in Curved beam.
Single edge notched beam in four point bending.
Torsion of Prismatic bar with rectangular cross section.
Contact Stress Analysis of Circular Disc under diametrical compression.
Vibration Characteristics of a Spring Mass Damper System.
Buckling, Bending and Modal analysis of stiffened Panels.
Design Optimization problems (shape and weight optimization).
Thermal Stress Analysis a thick walled cylinder filled with a fluid at high temperature.
FE Modeling and Failure Analysis of welded joints, bolted joints and adhesive bonded joints.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will have ability to

CO1: Model and assemble the drawings of any mechanical products using modeling software.
CO2: Select the method, meshing, analysis and optimize the real time problems using finite element analysis software.
CO3: Evaluate and interpret FEA analysis results for design and evaluation purposes
CO4: Develop a basic understanding of the limitations of the FE method and understand the possible error sources in its use.
CO5: Use analysis software for the application and use of the FE method for heat transfer and structural problems.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Model and assemble the drawings of any mechanical products using modeling software.	1	1	2	1	2					1			2		2
Co2	Select the method, meshing, analysis and optimize the real time problems using finite element analysis software.	1	1	2	1	2					1			2		2
Co3	Evaluate and interpret FEA analysis results for design and evaluation purposes	1	1	2	1	2					1			2		2
Co4	Develop a basic understanding of the limitations of the FE method and understand the possible error sources in its use.	1	1		1								1	1		1
Co5	Use analysis software for the application and use of the FE method for heat transfer and structural problems.	1	1	2	1	1					1			1		1

218EDE01 INTEGRATED PRODUCT & PROCESS DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the generic development process and concept development.
- To study about the product planning and its phases.
- To know about the product specifications.
- To apply the knowledge on concept selection for a product.
- To gain knowledge on product architecture to apply on real time situations.

PREREQUISITE: Knowledge of CAD/CAM/CIM is required.

UNIT I INTRODUCTION **9**

Characteristics of Successful Product Development, Who Designs and Develops Products, Duration and Costs of Product Development, Challenges of Product Development, Development Processes and Organizations, A Generic Development Process, Concept Development: The Front-End Process, Adapting the Genetic Product Development Process- Product Development Process Flows-The AMF Development Process-Product Development Organizations.

UNIT II PRODUCT PLANNING **9**

Product Planning Process- Identifying Opportunities- Evaluating and Prioritizing Projects- Allocating Resources and Timing- Pre-Project Planning-Reflect on the Results and the Process-Identifying Customer Needs- Raw Data from Customers- Interpreting Raw Data in Terms of Customer Needs-Organizing the Needs into a Hierarchy-Establishing the Relative Importance of the Needs-Reflecting on the Results and the Process

UNIT III PRODUCT SPECIFICATIONS **9**

What Are Specifications -When Are Specifications Established-Establishing Target Specifications-Setting the Final Specifications-Concept Generation-The Activity of Concept Generation-Clarify the Problem- Search Externally-Search Internally-Explore Systematically- Reflect on the Results and the Process.

UNIT IV CONCEPT SELECTION **9**

Concept Selection- Overview of Methodology-Concept Screening-Concept Testing-Define the Purpose of the Concept Test- Choose a Survey Population- Choose a Survey Format- Communicate the Concept-

Measure Customer Response-Interpret the Results- Reflect on the Results and the Process

UNIT V PRODUCT ARCHITECTURE 9

Product Architecture-Implications of the Architecture-Establishing the Architecture-Delayed Differentiation-Platform Planning-Related System, Level Design Issues

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

CO1: The students will have the knowledge about the product development process and challenges in product development.
CO2: The student will be able to implement the projects and execute them.
CO3: The students will have an ability to gain knowledge on writing about the product specifications.
CO4: The students will be able to know about concept selection process and concept testing.
CO5: The students will have an ability to gain knowledge on product level design issues.

TEXT BOOKS

1. Karl T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw –Hill International Edns., Fifth Edition, 2017.
2. Kevin Otto, Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", 1 Edition, Pearson, 2nd Indian Reprint 2004.

REFERENCE BOOKS

1. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992,ISBN, 1-55623-603-4
2. Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41639-5
3. Concurrent Engg. /Integrated Product Development. Kemnneth Crow, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	The students will have the knowledge about the product development process and challenges in product development.	1	1			1	1						1	1		1
Co2	The student will be able to implement the projects and execute them.		1			2							3	1		2
Co3	The students will have an ability to gain knowledge on writing about the product specifications.				1								1	1		1
Co4	The students will be able to know about concept selection process and concept testing.				2								1	1		1
Co5	The students will have an ability to gain knowledge on product level design issues.					1							1	1		1

218EDE02 INTEGRATED MANUFACTURING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the important features of production systems.
- To gain knowledge on group technology, computer aided process planning and integrated manufacturing systems in modern manufacturing.
- To gain the knowledge on Computer Aided Planning and Control.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

- To gain the knowledge of computer monitoring systems in production.
- To know the concepts of integrated manufacturing system.

PREREQUISITE: Knowledge of CAD/CAM/CIM is required.

UNIT I INTRODUCTION 8

Objectives of a manufacturing system-identifying business opportunities and problems- classification of production systems-linking manufacturing strategy and systems analysis of manufacturing operations.

UNIT II GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9

Introduction-part families-parts classification and coding - group technology machine cells-benefits of group technology. Process planning function CAPP – Computer generated time standards.

UNIT III COMPUTER AIDED PLANNING AND CONTROL 9

Production planning and control-cost planning and control-inventory management- Material requirements planning (MRP)-shop floor control-Factory data collection system-Automatic identification system-barcode technology- automated data collection system.

UNIT IV COMPUTER MONITORING 9

Types of production monitoring systems-structure model of manufacturing process, process control & strategies- direct digital control-supervisory computer control computer in QC - contact inspection methods non-contact inspection method – computer aided testing - integration of CAQC with CAD/CAM.

UNIT V INTEGRATED MANUFACTURING SYSTEM 10

Definition - application - features - types of manufacturing systems- machine tools materials handling system- computer control system - DNC systems manufacturing cell. Flexible Manufacturing Systems (FMS) - the FMS concept transfer systems - head changing FMS - variable mission manufacturing system - CAD/CAM system - human labor in the manufacturing system-computer integrated manufacturing system benefits. Rapid prototyping - Artificial Intelligence and Expert system in CIM.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES:

Students will be able to

CO1: Get good exposure on manufacturing systems.
CO2: Get good exposure on CAPP systems for rotational and prismatic parts and GT.
CO3: Understand the effect of manufacturing automation strategies and derive production metrics with computer monitoring and control of manufacturing.
CO4: Understand the production monitoring system.
CO5: Understand the applications of FMS and Rapid prototyping concepts.

TEXT BOOKS

1. Mikell P Groover, "Automation, Production System and Computer Integrated Manufacturing", Pearson/Prentice-Hall of India, 2012.
2. James A Rehg and Henry W Kroebber, “Computer Integrated Manufacturing”, Pearson/Prentice-Hall of India, 2005.

REFERENCE BOOKS

1. Yorem Koren, "Computer Integrated Manufacturing Systems", McGraw Hill, 2010.
2. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi, 1998.

3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1st Edition, 1986.
4. R.W. Yeomans, A. Choudry and P.J.W. Ten Hagen, "Design rules for a CIM system", North Holland Amsterdam, 1986.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Get good exposure on manufacturing systems.	2			1	1								2		1
Co2	Get good exposure on CAPP systems for rotational and prismatic parts and GT.	1											1	2		1
Co3	Understand the effect of manufacturing automation strategies and derive production metrics with computer monitoring and control of manufacturing.	1			2	1			1				1	1		1
Co4	Understand the production monitoring system.								1					1		1
Co5	Understand the applications of FMS and Rapid prototyping concepts.	1			1	1							1	1		1

218EDE03 DESIGN FOR MANUFACTURE AND ASSEMBLY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To aquire knowledge on process capability and tolerances, form design.
- To know about the factors influencing form design.
- To gain the knowledge on component design for machining consideration, casting consideration in component design and design for the environment.
- To gain the knowledge on group technology concepts.
- To know about the environmental objectives and global issues.

PREREQUISITE: Knowledge of Machine drawing is required.

UNIT I PROCESS CAPABILITY AND TOLERANCES 8

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, Evaluation method, Process capability - Feature tolerances, Geometric tolerances. Worst case method - Assembly limits, Datum features, Tolerance stacks**.**

UNIT II FACTORS INFLUENCING FORM DESIGN 9

Influence of materials on form design - form design of grey iron, malleable iron, steel and aluminium castings - form design of welded members, forgings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 10

Design features to facilitate machining – drills, milling cutters, keyways, Doweling procedures, Counter sunk screws - Reduction of machined area, simplification by separation, simplification by amalgamation. Design for machinability - Design for economy, Design for clampability, Design for accessibility, Design for assembly.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT IV COMPONENT DESIGN - CASTING CONSIDERATION 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - Group technology, Computer Applications for DFMA.

UNIT V DESIGN FOR THE ENVIRONMENT 9

Introduction – Environmental objectives, Global issues, Regional and local issues. Basic DFE methods – Design guide lines, Example application. Lifecycle assessment – Basic method, AT&T's environmentally responsible product assessment. Weighted sum assessment method – Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage. Design for disassembly, Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Understand the complex interrelationships between design and manufacturing.

CO2: Explore and understand basic manufacturing processes and the design for manufacturing (DFM) implications of design choices for specific manufacturing processes.

CO3: Understand the role of components design with machining consideration.

CO4: Understand approaches and practices related to CAD model building and model checking for specific manufacturing processes such as models for sheet metal and models for casts and molds.

CO5: Know about the environmental issues with case study.

TEXT BOOKS

1. Peck, Harry, "Designing for Manufacture", Pitman Publications, 2010.
2. James Bralla, "Design for Manufacturability Handbook", Second Edition, McGraw-Hill, New York, 1999.

REFERENCE BOOKS

1. George E Dieter, "Engineering Design- Material and processing approach", McGraw Hill Intl., 2nd Edition, 2013.
2. Matousek, "Engineering Design- A Systematic Approach", Blackie & Son Ltd, London, 2013.
3. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication, New Delhi, 2011.
4. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Second Edition, Marcel Dekker Inc., London, 2010.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the complex interrelationships between design and manufacturing.	2	1	2			1							2		1
Co2	Explore and understand basic manufacturing processes and the design for manufacturing (DFM) implications of design choices for specific manufacturing processes.	2		1	1									2		
Co3	Understand the role of components design with machining consideration.	1	1	1	1								1	1		1
Co4	Understand approaches and practices related to CAD model building and model checking for specific manufacturing processes such as models for sheet metal and models for casts and molds.	1		2			1							1		

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Co5	Know about the environmental issues with case study.	1		1									1	1		

218EDE04 **ENGINEERING FRACTURE MECHANICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of solid mechanics.
- To get knowledge on stationary crack, crack growth and fatigue crack growth.
- To analyze dynamic energy balance.
- To understand the concepts of fatigue crack growth curve.
- To analyze crack Growth for cyclic loading and crack initiation under large scale.

PREREQUISITE: Knowledge of Engineering Materials and Metallurgy is required.

UNIT I ELEMENTS OF SOLID MECHANICS **9**

The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - Limit analysis.

UNIT II STATIONARY CRACK UNDER STATIC LOADING **9**

Two dimensional elastic fields - Analytical solutions yielding near a crack front - Irwin's approximation - Plastic zone size - Dugdale model - J integral and its relation to crack opening displacement.

UNIT III ENERGY BALANCE AND CRACK GROWTH **9**

Griffith analysis - Linear Fracture Mechanics-Crack opening displacement - Dynamic energy balance – R Curves - Crack arrest.

UNIT IV FATIGUE CRACK GROWTH CURVE **9**

Empirical relation describing crack growth by fatigue - Life calculations for a given load amplitude - Effects of changing the load spectrum - Effects of Environment.

UNIT V APPLICATION OF FRACTURE MECHANICS **9**

Crack Initiation under large scale yielding – Thickness as a design parameter – Mixed mode fractures - Crack instability in thermal and residual stress fields - Numerical methods

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Calculate the stress-strain and load-displacement fields around a crack tip.
CO2: It helps the engineers to get familiarized with the design of components that contain crack under static load condition.
CO3: It helps the engineers to get familiarized with the design of components that contain crack and its growth under fatigue load condition.
CO4: Design materials and structures using fracture mechanics approaches.
CO5: Know different application of fracture mechanics.

TEXT BOOKS

1. David Broek, "Elementary Engineering Fracture Mechanics ", 4th Edition, Kluwer Academic Publishers, 2005.
2. George E.Dieter,"Mechanical Metallurgy", 3rd Edition, Tata McGraw Hill, 1986.
3. Preshant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, 2009.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

REFERENCE BOOKS

1. Anderson T L, “Fracture Mechanics: Fundamentals and Applications”, CRC Press, 4th Edition, 2017.
2. Janssen M, Zuidema J, Wanhill R J H, “Fracture Mechanics”, VSSD, 2nd Edition, 2006.
3. Sanfard R J, “Principles of Fracture Mechanics”, Pearson Education Inc., Upper Saddle River, 2003.
4. Kare Hellan, "Introduction of Fracture Mechanics", McGraw-Hill Book Company, 2000.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Calculate the stress-strain and load-displacement fields around a crack tip.		2		1								1	1		1
Co2	It helps the engineers to get familiarized with the design of components that contain crack under static load condition.	2	1	2	1								1	2		2
Co3	It helps the engineers to get familiarized with the design of components that contain crack and its growth under fatigue load condition.	1	2		1	1					1			2		
Co4	Design materials and structures using fracture mechanics approaches.	1	1		1	2					1			1		2
Co5	Know different application of fracture mechanics.	1	2	1		1								1		1

218EDE05 DESIGN OF AUTOMOTIVE SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study about the design and loading conditions on automobile components.
- To gain knowledge about the design of clutch with different parameters.
- To enable the student to comprehend the purpose and usage of transmission system in automobiles.
- To design the suspension and steering system.
- To study the design principles of brakes at various pressure & torques.

PREREQUISITE: Knowledge of Design of Transmission system is required.

UNIT I INTRODUCTION **9**

General Layout of Automobile, Types of Chassis, Material, Performance of Automobiles. Design Conditions, Loading Conditions, Forced Vibrations of Spring Mass with Random Disturbance, Fatigue Resistance Analysis Procedure.

UNIT II CLUTCHES **9**

Design of Clutches, Calculation of Critical Parameters of Clutches, Design Calculation of Standard Elements of Friction Clutches, Torsional Vibration Dampers, Clutch Control Drives.

UNIT III TRANSMISSION **9**

Transmission Systems, Parameters, Differential, Axle Shafts, Gear Box. Transfer Case, Auxiliary Gear Box, Gear Shift Mechanisms, Planetary Gears. Kinematics of Universal Joints, Design of Universal Joint and Propeller Shaft.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT IV SUSPENSION AND STEERING SYSTEM 9

Oscillation and Smoothness of Ride, Elastic Characteristics of Ride, Elastic Elements of Suspension, Shock Absorbers. Fundamentals of Designing and Calculating Steering Control Linkage, Steering Gears, Hydraulic Booster.

UNIT V BRAKES 9

Pressure Distribution in Brakes, Braking Torque, Internally Expanding Brakes, Design of Drum and Disk Brakes, Fundamentals of Designing Brake Force Regulators, Antilocking System.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will have an ability to

CO1: Design the various automobile components.
CO2: Design of clutch with different parameters.
CO3: Design the various transmission components
CO4: Design the suspension and steering system.
CO5: Design the brakes at various pressure & torques.

TEXT BOOKS

1. Heinz Heisier, "Vehicle and Engine technology", SAE, New York, Second Edition, 1999.
2. Lukin P Gasparyants G and Rodionov V, "Automobile Chassis Design and Calculations", Second Edition, Mir Publishers, 1989.

REFERENCE BOOKS

1. Jack Erjavec, “Automotive Technology – A System Approach”, Thomson Delmar Learning, 6th Edition, 2014.
2. Horst Bauer, “Diesel-Engine Management – Systems and Components”, Robert Bosch, 4th Edition, 2006.
3. John Fenton, “Handbook of automotive body and systems design”, Professional Engineering Publishing, 2001.
4. Schwaller AE, "Motor Automotive Technology" 3rd Editions, Delman Publishers, New York, 1999.
5. Gillespie T D, "Fundamentals of Vehicle Dynamics" SAE Inc., New York, 2nd Edition, 2021.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Design the various automobile components.	1	1	3										2		2
Co2	Design of clutch with different parameters.	1	1	2										2		2
Co3	Design the various transmission components	1	1	2										2		1
Co4	Design the suspension and steering system.	1	1	2										2		2
Co5	Design the brakes at various pressure & torques.	1	1	2										2		1

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

218EDE06 **MECHATRONICS SYSTEM IN DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the functions of Mechatronics system.
- To select appropriate sensors for an engineering application.
- To study about application of microprocessors and microcontrollers programs.
- To study programmable logic controllers and their applications.
- To study about different possible design solutions for a Mechatronic system.

PREREQUISITE: Knowledge of Mechatronics is required.

UNIT I INTRODUCTION **9**

Introduction to Mechatronics – Systems, Key Elements, Mechatronics Design Process, Measurement Systems, Control Systems, Traditional design and Mechatronics Design.

UNIT II SENSORS AND TRANSDUCERS **9**

Sensors and Transducers **-** Types**,** Performance Terminology, Displacement, Position and Proximity, Velocity and Motion, Fluid pressure, Temperature sensors, Light sensors, Selection of sensors, Signal processing.

UNIT III MICROPROCESSORS AND MICRO CONTROLLERS **9**

Microprocessors and Micro Controllers – Architecture, Pin Configuration and Instruction Set, Programming of Microprocessors Using 8085 Instructions. Interfacing input and output devices - Interfacing D/A converters and A/D converters, Applications, Temperature Control, Stepper motor control, Traffic light controller.

UNIT IV PROGRAMMABLE LOGIC CONTR-OLLERS **9**

Basic structure - Input / Output processing, Programming, Mnemonics, Timers, Internal Relays and Counters. Data handling - Analog input / output, Selection of PLC.

UNIT V DESIGN OF MECHATRONICS SYSTEMS **9**

Design of Mechatronics System – Future Trends, Possible Design Solutions. Case studies of Mechatronics Systems - Automatic Washing Machine, Auto Focusing in Digital Cameras, Thermal Cycle Fatigue of Ceramic Plate with mechatronics approach, Time Delay Blower**.**

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will have the ability to

CO1: Understand the functions of Mechatronics system.
CO2: Select appropriate sensors for an engineering application.
CO3: Write microcontroller programs.
CO4: Learn Programmable Logic Controllers and their applications.
CO5: Design solutions for a Mechatronic system.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

TEXT BOOKS

1. Michael B.Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 5th Edition, 2019.
2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, A J., "Mechatronics: Electronics in Products and Processes ", Chapman and Hall, 2018.

REFERENCE BOOKS

1. Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", 5th Edition, Prentice Hall, 2002.
2. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", IEEE Inc, New York, 1996.
3. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 2009.
4. Bolton.W, "Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering", Pearson Education Press, 6th Editions, 2018.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the functions of Mechatronics system.	3	2	3			2	1						3	1	
Co2	Select appropriate sensors for an engineering application.	3	2	3			2	1						3	1	
Co3	Write microcontroller programs.	3	2	1			2	1						3		
Co4	Learn Programmable Logic Controllers and their applications.	3	2	2											1	2
Co5	Design solutions for a Mechatronic system.		3	2										3		2

218EDE07 **NANOMATERIAL AND NANOTECHNOLOGY** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

To understand the

- Basic knowledge on Nanoscience and Technology.
- Various process techniques available for the processing of nanostructured materials.
- Exotic properties of nanostructured materials at their nanoscale lengths.
- Magnetic behavior of nanomaterials and its applications.
- Physical properties of nano structured materials.

PREREQUISITE: Knowledge of Engineering Physics and Engineering Materials & Metallurgy are required.

UNIT I INTRODUCTION **9**

Introduction to nanoscale materials - atomic & molecular size. Scientific revolutions-nanotechnology application area. Scope of nanoscience and technology.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT II NANOSTRUCTURES AND DIMENSIONS 9

Classification of nanostructures-zero, one, two and three dimensional nanostructures. Size Dependency in Nanostructures-quantum size effects in nanostructures. Chemistry of tailored nano shapes.

UNIT III NANOMATERIAL SYNTHESIS 9

Synthesis of nanomaterials-top down and bottom up approach. Method of nanomaterials preparation – wet chemical synthesis-mechanical grinding-gas phase synthesis.

UNIT IV NANOMATERIAL PROPERTIES 9

Surface to volume ratio. Surface properties of nanoparticles. Mechanical, optical, electronic, magnetic, thermal and chemical properties of nanomaterials. Size dependent properties-size dependent absorption spectra. Shape impact.

UNIT V PHYSICAL PROPERTIES OF NANOSTRUCTURED MATERIALS 9

Quantum dots-optical properties and applications. Carbon nano tubes-physical properties and applications. Magnetic behavior of nanomaterials. Electronic transport in quantum wires. Surface chemistry of tailored monolayer.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will have the ability to

CO1: Understand the importance of reduction in materials dimensionality, and its relationship with materials properties.
CO2: Know about the nano structures and dimensions.
CO3: Synthesis different nanomaterials.
CO4: Understand the properties of nanostructured materials.
CO5: Learn deeply about the physical properties and magnetic behaviour of nanomaterials.

TEXT BOOKS

1. Charles P. Poole, Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2015.
2. Mick Wilson, Kamali Kannargare., Geoff Smith, "Nano technology: Basic Science and Emerging technologies", Overseas Press, 2014.

REFERENCE BOOKS

1. Mark A. Ratner, Daniel Ratner, "Nanotechnology: A gentle introduction to the next Big Idea", Prentice Hall P7R:1st Edition, 2014.
2. T. Pradeep, "Nano the Essential Nanoscience and Nanotechnology", Tata McGraw Hill, 2012.
3. J. Dutta, H. Hoffmann, "Nanomaterials", Topnano-21, 2010.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the importance of reduction in materials dimensionality, and its relationship with materials properties.	2												2		1
Co2	Know about the nano structures and dimensions.		1	1		1	1						1			
Co3	Synthesis different nanomaterials.	2			1								1	1		1
Co4	Understand the properties of nanostructured materials.	1	1			1	1						1	1		1

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Co5	Learn deeply about the physical properties and magnetic behaviour of nanomaterials.												1	1		1

218EDE08 **PLATES AND SHELLS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart basic knowledge on equations of elasticity, stresses and energy principles.
- To enable the student analyse the stress and moment resultants of different geometry under various types of loads.
- To understand the buckling analysis of rectangular plate under various boundary conditions.
- To impart the knowledge of dynamic behaviour of rectangular plates.
- To enable the student analyse and design thin shell structures including spherical and cylindrical shells.

UNIT I GENERAL INTRODUCTION 7

Review of equations of elasticity- kinematics, compatibility equations, stress measures- equations of motions- constitutive relations- transformation of stresses, strains and stiffness-energy principles and variational methods in elasticity- virtual work-external and internal virtual work variational operator-functionals- Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential- applications

UNIT II CLASSICAL THEORY OF PLATES 10

Plates as structural elements- stress and moment resultants- assumptions made in the classical theory-displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory.

UNIT III BUCKLING ANALYSIS OF RECTANGULAR PLATES 10

Buckling of simply supported plates under compressive forces- governing equations- the Navier solution- biaxial compression of a plate- uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions-general formulation.

UNIT IV VIBRATION OF PLATES 9

Governing equations for natural flexural vibrations of rectangular plates- natural vibrations of plates simply supported on all edges- vibration of plates with two parallel sides simply supported- Levy's solution- vibration of plates with different boundary conditions- Rayleigh-Ritz method- Natural vibration of plates with general boundary conditions- transient analysis of rectangular plates.

UNIT V ANALYSIS OF THIN ELASTIC SHELLS OF REVOLUTION 9

Classification of shell surfaces- geometric properties of shells of revolution- general strain displacement relations for shells of revolution- stress resultants- equations of motion of thin shells analytical solution for thin cylindrical shells- membrane theory- flexure under axisymmetric loads shells with double curvature- geometric considerations- equations of equilibrium- bending of spherical shells- vibration of cylindrical shells.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will able to

CO1: Use the different energy equation and stress equation for analysis of plates.
CO2: Analyse the plates with varying load conditions using classical theory.
CO3: Perform the buckling analysis of rectangular plate under different load conditions.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

CO4: Design the rectangular plates under the transient analysis condition.
CO5: Analyse the stress resultants of thin spherical and cylindrical shell structures.

TEXT BOOKS

1. Timoshenko, S. and Krieger S.W., "Theory of Plates and Shells", McGraw Hill Book Company, New York, 2010.
2. Reddy,J.N., "Theory and Analysis of Elastic Plates & Shells", C.R.C. Press, NY, USA, 2nd Edition, 2006.

REFERENCE BOOKS

1. K. Baskar and T.K. Varadan, "Plates- Theories and Applications", Ane Books Pvt. Ltd., New Delhi, 2013.
2. Ramasamy, G.S., "Design and Construction of Concrete Shells Roofs", CBS Publishers, 2005.
3. Dr.N.Subramanian, "Principles of Space Structures", Wheeler Publishing Co., 1999.
4. Szilard, R., "Theory and Analysis of Plates", Prentice Hall Inc., 1995.
5. Wilhelm Flügge, "Stresses in Shells", Springer – Verlag, 1962.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use the different energy equation and stress equation for analysis of plates.	2	2	2		1		2			1			3		2
Co2	Analyse the plates with varying load conditions using classical theory.	3	3	2		2		2			1			2	1	
Co3	Perform the buckling analysis of rectangular plate under different load conditions.	3	3	1		1								2	2	1
Co4	Design the rectangular plates under the transient analysis condition.	3	2	1							1					1
Co5	Analyse the stress resultants of thin spherical and cylindrical shell structures.	3	2	1										3		

318EDE01 MICRO ELECTRO MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know about the basic concept of MEMS and microsystems.
- To learn about various material and fabrication process used in MEMS.
- To judge about the mechanics involved in microsystems.
- To know about various manufacturing methods and packing techniques.
- To familiar with microsystem design and application of MEMS in industry.

UNIT I INTRODUCTION **9**

Overview, Microsystems and microelectronics, Working principle of Microsystems, micro actuation techniques-micro sensors-types, microactuators-types, micropump- micromotors-micro-valves-microgrippers, scaling laws-scaling in geomentry, scaling in rigid body dynamics, scaling in electrostatic forces, scaling in electricity, scaling in fluid mechanics, scaling in heat transfer.

UNIT II MATERIALS AND FABRICATION PROCESS **9**

Substrates and wafer-single crystal silicon wafer formation, ideal substrates - mechanical properties, silicon compounds - Sio_2, SiC, Si_3N_4 and polycrystalline silicon, Silicon piezoresistors - Gallium arsenide, Quartz-piezoelectric crystals, polymers for MEMS -conductive polymers, Photolithography, Ion

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

implantation, Diffusion, Oxidation, CVD, Physical vapor deposition, Deposition by epitaxy, etching process.

UNIT III MICROMECHANICS 9

Introduction-static bending of thin plates-circular plates with edge fixed, rectangular plate with all edges fixed and square plate with all edges fixed, Mechanical vibration-resonant vibration, micro accelerometers-design theory and damping coefficients, thermo mechanics, thermal stresses, fracture mechanics, stress intensity factors, fracture toughness and interfacial fracture mechanics.

UNIT IV MICRO SYSTEM MANUFACTURING AND PACKAGING 9

Clean room technology, Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA-Micro system packaging-materials-die level-device level-system, level-packaging techniques-die preparation, surface bonding, wire bonding, sealing.

UNIT V MICRO SYSTEM DESIGN 9

Design considerations-process design, mask layout design, mechanical design-applications of micro system in automotive industry, bio medical, aero space-telecommunications.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Have basic foundation education in MEMS.
CO2: Become familiar with micro fabrication techniques.
CO3: Become fluent with design, analysis and testing of MEMS.
CO4: Select the most suitable manufacturing process and strategies for micro fabrication.
CO5: Assess whether using a MEMS based solution is relevant and best approach.

TEXT BOOKS

1. Chang Liu, “Foundation of MEMS”, Pearson Edition, 2012.
2. Nitaigour Premchand Mahalik, “MEMS”, Tata McGraw Hill Companies, 2009.

REFERENCE BOOKS

1. James J Allen, Dekker, “Mechanical Engineering”, CRC Press, 2005.
2. Marc F Madou, “Fundamentals of Micro Fabrication”, CRC Press, 2002.
3. Mohamed Gad-el-Hak, “The MEMS Hand book”, CRC press, 2002.
4. Francis E.H Tay and W.O Choong, “Microfludics and BioMEMS Applications”, Springer, 2002.
5. Julian W. Gardner, Vijay K.Varadan, Osama O.Awadel Karim, “Microsensors MEMS and Smart Devices”, John Wiley & sons Ltd., 2001.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Have basic foundation education in MEMS.	3	3		2		1			2			1	2		1
Co2	Become familiar with micro fabrication techniques.	2	2										1		3	
Co3	Become fluent with design, analysis and testing of MEMS.	2	1		3		1			2					3	
Co4	Select the most suitable manufacturing process and strategies for micro fabrication.	3	3											2		1
Co5	Assess whether using a MEMS based solution is relevant and best approach.	2	3		2		2			2					1	

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

318EDE02 ENGINEERING MATERIALS AND THEIR APPLICATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know the mechanical behaviour of both metallic and non-metallic materials under different loading and temperature conditions.
- To study about the behavior of materials under dynamic loads condition.
- To gain knowledge on selection of materials for different applications.
- To know about the modern metallic materials used for various applications.
- To gain knowledge on polymers, its properties and its applications.

UNIT I BASIC CONCEPTS OF MATERIAL BEHAVIOR 12

Elasticity in metals and polymers– Strengthening mechanisms, work hardening, solid solution, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity. Griffith's theory– Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism.

UNIT II BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES 10

Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law- Safe life, Stress-life, strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT III SELECTION OF MATERIALS 8

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 materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT IV MODERN METALLIC MATERIALS 8

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT V NON METALLIC MATERIALS 7

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – Structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, processing and applications.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Familiarize the researchers in the area of material behaviour under different loading conditions.
CO2: Analyze material behavior under dynamic loads and perform failure analysis.
CO3: Select materials for the design of engineering structures.
CO4: Know about the modern metallic materials used for different applications.
CO5: Know about the polymers, its processing methods and its applications.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

TEXT BOOKS

1. George E.Dieter, "Mechanical Metallurgy", McGraw Hill, 3rd Edition, 2017.
2. Thomas H. Courtney, "Mechanical Behavior of Materials", 2nd Edition, McGraw Hill, 2000.

REFERENCE BOOKS

1. Flinn, R.A., and Trojan, P.K., "Engineering Materials and their Applications", 4th Edition Jaico, 1999.
2. Metals Hand book, Vol.10, "Failure Analysis and Prevention", 10th Edition, Jaico, 1999.
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., "Selection and use of Engineering Materials", 34th Edition, Butterworth-Heiremann, 1997.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Familiarize the researchers in the area of material behaviour under different loading conditions.	2				1	1						3	1		1
Co2	Analyze material behavior under dynamic loads and perform failure analysis.	1		1	1	1							1	1		
Co3	Select materials for the design of engineering structures.		1	2	1	1								1		
Co4	Know about the modern metallic materials used for different applications.		1	1									1	1		
Co5	Know about the polymers, its processing methods and its applications.		2		1	1							1	1		

318EDE03 PRODUCT LIFE CYCLE MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know about the importance of product life cycle.
- To know the concept of product development process and to study the methodology of product design.
- To gain knowledge on product modeling and know the types of analysis tools.
- To implement the PDM technology for industries.
- To develop advanced knowledge based product and processes models.

UNIT I INTRODUCTION AND PRODUCT LIFE CYCLE ENVIRONMENT 9

Background, Overview, Need, Benefits, Concept of Product Life Cycle. Components / Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement.
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 II PRODUCT DEVELOPMENT PROCESS & METHODOLOGIES 9

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. Design for Manufacturing, Design for Assembly. Design for Six Sigma.

UNIT III PRODUCT MODELLING AND TYPES OF ANALYSIS TOOLS 9

Product Modeling - 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.

Design for manufacturing - machining - casting and metal forming - optimum design - Design for assembly and disassembly - probabilistic design concepts - FMEA - QFD - Taguchi Method for design of experiments -Design for product life cycle. Estimation of Manufacturing costs, Reducing the component costs and assembly costs, Minimize system complexity.

UNIT IV PRODUCT DATA MANAGEMENT (PDM) TECHNOLOGY 9

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 and implementation.

UNIT V RECENT ADVANCES 9

Intelligent Information Systems - Knowledge based product and process models - Applications of soft computing in product development process - Advanced database design for integrated manufacturing.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Compare product data, information, structures and PLM concepts.

CO2: Apply PLM systems in organization verticals including production, after sales, sales and marketing, and subcontracting.

CO3: Measure benefits of PLM implementation in daily operations, material costs, productivity of labor and quality costs.

CO4: Apply PLM concepts for service industry and E-Business.

CO5: Know about the applications of soft corrupting.

TEXT BOOKS

1. Grieves, Michael. “Product Lifecycle Management”, McGraw-Hill, 2006.
2. Antti Saaksvuori, Anselmi Immonen, “Product Life Cycle Management”, Springer, 2nd Edition, 2013.

REFERENCE BOOKS

1. Stark, John. “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 3rd Edition, 2015.
2. Karl T Ulrich and Steven D. Eppinger, “Product Design & Development”, McGraw Hill International Edns, 2008.
3. Burden, Rodger, “PDM: Product Data Management”, Resource Pub, 2003.
4. Crnkovic, Ivica; Asklund, Ulf & Dahlqvist, Annita Persson. “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
5. Clement, Jerry; Coldrick, Andy; & Sari, John, “Manufacturing Data Structures”, John Wiley & Sons, 1995.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Compare product data, information, structures and PLM concepts.	1		2	1	2	1							1		

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Co2	Apply PLM systems in organization verticals including production, after sales, sales and marketing, and subcontracting.		1		1											1
Co3	Measure benefits of PLM implementation in daily operations, material costs, productivity of labor and quality costs.			1										1		2
Co4	Apply PLM concepts for service industry and E-Business.		1			1								1		1
Co5	Know about the applications of soft corrupting.	1				2										1

318EDE04 DESIGN OF MATERIALS HANDLING SYSTEMS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To get comprehensive insight on design of hoists, hoisting gear, conveyors and elevators.
- To know about the principles involved in design of different material handling techniques.
- To know the proper selection, use and care through work area hazard assessments and training.
- To learn how to use catalogues and standards material handling equipments.
- To gain knowledge on design of conveyors and elevators.

UNIT I MATERIALS HANDLING EQUIPMENT 6

Types of material handling equipments, Selection of material handling equipments and applications of material handling equipments.

UNIT II DESIGN OF HOISTS 10

Design of hoisting elements - Welded and roller chains, Hemp and wire ropes, Design of ropes, pulleys, Pulley systems, Sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks - Crane grabs, Lifting magnets, Grabbing attachments. Design of arresting gear. Brakes - shoe, band and cone types.

UNIT III DRIVES OF HOISTING GEAR 10

Hand and power drives - Traveling gear, Rail traveling mechanism, Cantilever and monorail cranes, slewing. Jib and luffing gear - Cogwheel drive, Selecting the motor ratings.

UNIT IV CONVEYORS 10

Types – Description, Design and applications of Belt conveyors, Apron conveyors and Escalators, Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT V ELEVATORS 9

Bucket elevators – Design, loading and bucket arrangements. Cage elevators - Shaft way, Guides, Counter weights, Hoisting machine, Safety devices, Design of form lift trucks.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students will be able to

CO1: Comprehend the concepts and benefits of better material handling systems.
CO2: Familiarize about the proper selection, use and care through work area hazard assessments and training.
CO3: Familiarize on the technique to select suitable material handling equipment and design them based on the need.
CO4: Design material handling equipments such as drives of hoisting gears.
CO5: Design material handling equipments such as conveyors, elevators for different applications.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

TEXT BOOKS

1. Spivakovsy, A.O. and Dyachkov, V.K, "Conveying Machines", Volumes I and II, MIR Publishers, 1985.
2. Rudenko, N, "Materials handling equipment", ELnvee Publishers, 1970.

REFERENCE BOOKS

1. Alan Mulemann, John Oakland, Keith Locker, "Production and Operations Management" Macmillan India Ltd, 2015.
2. Datta A.K, "Materials Management: Procedures, Text and Cases", Prentice Hall of India, 2008.
3. Everett E. Adam Jr & Ronald J. Ebert, "Production and Operations Management", Prentice Hall of India, 2003 (Digitized 2008).
4. Alexandrov, M., 'Materials Handling Equipments', MIR Publishers, 1981.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Comprehend the concepts and benefits of better material handling systems.	1	1	1	1	1	2	1	1	2	1	1	1	2	2	2
Co2	Familiarize about the proper selection, use and care through work area hazard assessments and training.	2	2	2	2	2	2	1	1	2	1	1	1	2	2	2
Co3	Familiarize on the technique to select suitable material handling equipment and design them based on the need.	3	3	3	3	3	2	1	1	2	1	1	1	2	2	2
Co4	Design material handling equipments such as drives of hoisting gears.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3
Co5	Design material handling equipments such as conveyors, elevators for different applications.	3	3	3	3	3	2	1	1	2	1	1	1	3	3	3

318EDE05 VIBRATION CONTROL AND CONDITION MONITORING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on fundamentals of various degrees of freedom vibration systems.
- To learn about various vibration reduction techniques.
- To familiarize about the concept of active vibration control.
- To learn condition based maintenance principles and applications.
- To gain knowledge on dynamic balancing and alignment of machinery.

UNIT I INTRODUCTION **9**

Fundamentals of single degree of freedom systems, Two degree of freedom systems, Multi degree of freedom, Continuous systems, Determination of natural frequencies and Mode shapes, Numerical methods in vibration analysis.

UNIT II VIBRATION CONTROL **9**

Introduction, Reduction of vibration at source, Control of vibration, Structural design, Material selection, Located additions, Artificial damping, Resilient isolation, Vibration isolation, Vibration absorbers.

UNIT III ACTIVE VIBRATION CONTROL **9**

Introductions, Concepts and Applications, Smart materials, Types and characteristics smart structures, characteristic active vibration in smart structures.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT IV CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS 9

Introduction, Condition monitoring methods, Design of information system, Selecting methods of monitoring, Machine condition monitoring and diagnosis, Vibration severity criteria, Machine maintenance techniques, Machine condition monitoring techniques, Vibration monitoring techniques, Instrumentation systems, Choice of monitoring parameter.

UNIT V DYNAMIC BALANCING AND ALIGNMENT OF MACHINERY 9

Introduction, Dynamic balancing of rotors, Field balancing in one plane two planes and in several planes, Machinery alignment, Rough alignment methods, Face peripheral dial indicator method, Reverse indicator method.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

CO1: Students will have the knowledge about the fundamentals of various degrees of freedom.
CO2: Students are able to find solution to reduce the vibration at source.
CO3: Students are able to perform modern treatment of vibrations, the control strategies using active and passive control methods.
CO4: Students are able to provide valuable information on machine condition monitoring for achieving precise operation, and improving machinery performance.
CO5: Students are capable to do dynamic balancing and alignment of machinery.

TEXT BOOKS

1. Rao, S.S. "Mechanical Vibration' 6th Edition, Pearson Education, Inc., 2017.
2. Rao, J.S. "Vibratory Conditional Monitoring of Machines" CRC Press, 2000.

REFERENCE BOOKS

1. Daniel. J. Inman, "Vibration and Control", John Willey & Sons Inc, 2006
2. Preumont, A. "Vibration Control of Active Structures: An Introduction", 2nd Edition, Kluwer Academic Publishers, 2002.
3. Daniel J. Inman "Vibration with Control" 2nd Edition, John Wiley & Sons, 2017
4. Denys J. Mead "Passive Vibration Control" Wiley, 1999.
5. GergelyTakács Boris Rohaľ-Ilkiv "Model Predictive Vibration Control: Efficient Constrained MPC Vibration Control for Lightly Damped Mechanical Structures", Springer Verlag London Limited, 2012.
6. Malcolm J. Crocker, "Handbook of Noise and Vibration Control" John Wiley &Sons, Inc., 2002.
7. B.K.N. Rao., "Handbook of Condition Monitoring", Published by Elsevier Science, 1996.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Students will have the knowledge about the fundamentals of various degrees of freedom.	3	3	3										1	2	2
Co2	Students are able to find solution to reduce the vibration at source.	2	2	2										2	2	2
Co3	Students are able to perform modern treatment of vibrations, the control strategies using active and passive control methods.	2	1	1										1	1	1
Co4	Students are able to provide valuable information on machine condition monitoring for achieving precise operation, and improving machinery performance.	1	2	1										2	2	2

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

Co5	Students are capable to do dynamic balancing and alignment of machinery.	1	1	1										2	2	1

318EDE06 DESIGN AND OPTIMIZATION OF THERMAL ENERGY SYSTEM

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To know about the ways and means of flow distribution and stress analysis, constructional details of Heat Exchangers, Design aspects of heat exchangers, condensers, evaporators and cooling towers.
- To study about the different modes of mathematical models.
- To gain knowledge on modeling of heat exchanger, evaporator and condenser.
- To study about the systems optimization.
- To gain knowledge on dynamic behavior of thermal system.

UNIT I INTRODUCTION **9**

Design Principles, Workable systems, Optimal systems, Matching of system components, Economic analysis, Depreciation, Gradient present worth factor.

UNIT II MATHEMATICAL MODELLING **9**

Equation fitting, Nomography, Empirical equation, Regression analysis, Different modes of mathematical models, Selection, Computer programmes for models.

UNIT III MODELLING THERMAL EQUIPMENTS **9**

Modelling heat exchangers, Evaporators, Condensers, Absorption and Rectification Columns, Compressor, Pumps, Simulation studies, Information flow diagram, Solution procedures.

UNIT IV SYSTEMS OPTIMIZATION **9**

Objective function formulation, Constraint equations, Mathematical formulation, Calculas method, Dynamic programming, Geometric programming, Linear programming methods, Solution procedures.

UNIT V DYNAMIC BEHAVIOUR OF THERMAL SYSTEM **9**

Steady state simulation, Laplace transformation, Feedback control loops, Stability analysis, Non-linearties.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Apply basic principles underlying heat exchanger.
CO2: Apply mathematical modeling and optimization in design of thermal systems.
CO3: Develop representational models of real processes and systems.
CO4: Develop the optimization method.
CO5: Analyze dynamic behavior of thermal systems.

TEXT BOOKS

1. Kapur J N, "Mathematical Modelling", New Age International Publishers, New Delhi, 2005.
2. Stoecker W F, "Design of Thermal Systems" McGraw Hill, 1981.

REFERENCE BOOKS

1. Faye C McQuiston, Jerald D Parker, Jeffrey D Spitcer, "Heating, Ventilating and Air conditioning, Analysis and Design", John Wiley and Sons, USA, 2005.
2. Hodge B K, “Analysis and Design of Energy System”, Prentice Hall, 1999.
3. Jaluria Y, “Design and Optimization of Thermal System”, McGraw Hill, 1998.

4. Stoecker W F, "Refrigeration and Air-Conditioning" TMH, 1985.
5. Fanger P O, "Thermal Comport" McGraw Hill, USA 1973.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Apply basic principles underlying heat exchanger.	3	3	1							2			3		
Co2	Apply mathematical modeling and optimization in design of thermal systems.	3	3	1							2			3		
Co3	Develop representational models of real processes and systems.	3	3	1							2			3		
Co4	Develop the optimization method.	3	3	1							2			3		
Co5	Analyze dynamic behavior of thermal systems.	3	3	1							2			3		

318EDE07 **SURFACE ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on surface interaction and friction that will come in handy to solve the industrial problems.
- To know about the basic concepts of wear and its laws.
- To study about the influence and evaluation of corrosion on materials.
- To know about the basic principles of Laser Technology and Plasma Coating Technology
- To study the tribology properties of materials.

UNIT I FRICTION **7**

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non-metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II WEAR **6**

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals International standards in friction and wear measurements.

UNIT III CORROSION **10**

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion –stress corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.

UNIT IV SURFACE TREATMENTS **12**

Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT V ENGINEERING MATERIALS 10

Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology Nano Tribology.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The students can able to

CO1: Know the importance of surface topography in friction materials.
CO2: Aware of the need of wear measurements and standards.
CO3: Know the various types of corrosion and how to prevent it.
CO4: Compare different methods of surface treatment and coating techniques.
CO5: Apply the engineering materials and alloys in various applications.

TEXT BOOKS

1. G.W.Stachowiak & A.W. Batchelor, "Engineering Tribology", Butterworth Heinemann, UK, Elsevier, 4th Edition, 2013.
2. S.K.Basu, S.N.Sengupta & B.B.Ahuja, "Fundamentals of Tribology", Prentice Hall of India Pvt Ltd, New Delhi, 2010.

REFERENCE BOOKS

1. Rabinowicz.E, "Friction and Wear of materials", John Willey &Sons, UK, 2nd Edition, 1995.
2. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.
3. Fontana G., "Corrosion Engineering", McGraw Hill, 1985.
4. Halling, J. (Editor), "Principles of Tribology ", Macmillian, 1984.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Know the importance of surface topography in friction materials.	1											1	2		1
Co2	Aware of the need of wear measurements and standards.			2			1									
Co3	Know the various types of corrosion and how to prevent it.		1			1							1			1
Co4	Compare different methods of surface treatment and coating techniques.			1			1							2		1
Co5	Apply the engineering materials and alloys in various applications.		1		1								1			2

318EDE08 INDUSTRIAL ROBOTICS AND EXPERTS SYSTEM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know the importance of robots in modern industries and lifestyle.
- To analyze various robot kinematics, motion and control.
- To study vision and sensing characteristics of robot.
- To designing of various robot components, robot shell and robot programming.
- To gain knowledge on artificial intelligence and expert systems.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT I INTRODUCTION AND ROBOT KINEMATICS 9

Definition need and scope of Industrial robots, Robot anatomy, Work volume, Precision movement, Classifications of Robots, 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 9

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 SENSORS 9

Transducers and Sensors, Sensors in Robot, Tactile sensor, Proximity and range sensors, Sensing joint forces, Robotic vision system, Image Gribbing, Image processing and analysis, Image segmentation, Pattern recognition, Training of vision system.

UNIT IV ROBOT CELL DESIGN AND APPLICATION 9

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, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 9

Methods of Robot Programming, Characteristics of task level languages lead through programming methods, Motion interpolation, Artificial intelligence, Basics, Goals of artificial intelligence, AI techniques, Problem representation in AI, Problem reduction and solution techniques, Application of Artificial Intelligence in Robots.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will able to

CO1: Design robotics and write program for controlling the robotics.
CO2: Analysis the robotic kinematics.
CO3: Know about the robot vision system and pattern recognition.
CO4: Design robot work cell for different industrial applications.
CO5: Apply artificial intelligence and expect systems in robotics.

TEXT BOOKS

1. Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987 (Digitized 2007).
2. John J Craig, “Introduction to Robotics – Mechanics and Control”, Pearson, 3rd Edition, 2012.

REFERENCE BOOKS

1. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 2012.
2. Kozyrey, Yu. "Industrial Robots", MIR Publishers Moscow, third Edition, 2008.
3. Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 2001.
4. Timothy Jordanides et al, "Expert Systems and Robotics ", Springer -Verlag, New York, May 1991.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Design robotics and write program for controlling the robotics.	2		1	1	2	1						1	2		2

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

Co2	Analysis the robotic kinematics.		1	2	1									1		1
Co3	Know about the robot vision system and pattern recognition.			1			1							1		
Co4	Design robot work cell for different industrial applications.			2	1									1		1
Co5	Apply artificial intelligence and expect systems in robotics.	1	1				1							1		1

318EDE09 MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To differentiate the macro-mechanics and micro-mechanisms of elastic and plastic deformation, creep, fracture, and fatigue failure, as applied to metals, ceramics, composites, thin film and biological materials.
- To gain more knowledge on various strengthening mechanisms.
- To get thorough introduction to the principles of fracture mechanics.
- To know practical examples of the application of fracture mechanics to design and life prediction methods and reporting.
- To know the basics of fractography as a diagnostic tool for structural failures.

UNIT I DISLOCATION THEORY **9**

Dislocation, Definition types, Deformation by slip – dislocation movement – slip system – critical resolved shear stress for slip Twinning systems – stacking faults – deformation bands and kink bands, Burger's circuits – cross slip – dislocation reaction – partial dislocations – sessile dislocation stress fields and energies of dislocation – forces on dislocations – forces between dislocations – dislocation climb – intersection of dislocation-jogs – dislocations sources – multiplication of dislocations – dislocation pile-ups, Effect of temperature, strain and strain rate on plastic behavior, super plasticity

UNIT II STRENGTHENING MECHANISMS **9**

Theory of work hardening cold worked structure – grain boundary strengthening yield point phenomena – strain-aging solid solution strengthening, Precipitation hardening dispersion strengthening, Bauschinger effect – preferred orientation (Texture) fiber strengthening - poly phase strengthening.

UNIT III FRACTURE AND FRACTURE MECHANICS **9**

Types of fracture in metals, Theoretical cohesive strength of metals, Griffith theory of brittle fracture, Theory of Brittle fracture – theory of ductile fracture – theory of ductile to brittle fracture – significance of transition temperature curves Metallurgical factors affecting transition temperature. Notch effects. Introduction to fracture mechanics, Strain – energy release rate - stress intensity, Factor and fracture toughness. Elementary discussions on linear elastic and Elastic – plastic fracture mechanics - crack opening displacement, Experimental determination of KIC and critical COD and J integral R curve, Toughness of materials.

UNIT IV FATIGUE **9**

Fatigue testing - factors affecting fatigue - structural changes accompanying fatigue - formation of fatigue cracks and fatigue failure, Cumulative damage - Low cyclic fatigue, Application of fracture mechanics to fatigue crack propagation, Effect of temperature on fatigue - statistical analysis of fatigue data

UNIT V CREEP **9**

Introduction to creep – creep curve, creep mechanisms, variables affecting creep, presentation and practical application of creep data, accelerated creep testing, and time – temperature parameters for conversion of creep data, development of creep resistant alloys, creep testing- high temperature material problem, stress rupture test, parametric approaches in presenting creep data, Larsen Miller parameter, Manson Hafred parameter.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Student will be able to

CO1: Know about the mechanism of plastic deformation and origin of materials strength.
CO2: Suggest the ways by which engineering materials may be intrinsically strengthened.
CO3: Identify ductile-brittle transition temperature and select materials accordingly.
CO4: Know about high temperature mechanical behavior of materials and be able to select the materials for high temperature applications.
CO5: Know about the creep mechanism, variables affecting creep while selecting materials for various applications.

TEXT BOOKS

1. Meyers M.A. Chawla. K.K. "Mechanical Behaviour of Materials", Cambridge University Press, 2009.
2. Courtney T. H. "Mechanical Behavior of Materials", 4th Edition, McGraw Hill. 2005.

REFERENCE BOOKS

1. Dieter G. E. "Mechanical Metallurgy", 3rd Edition, McGraw Hill Books. 2017.
2. Hertzberg. R.W. "Deformation and Fracture Mechanics of Engineering Materials", John Wiley. 2013.
3. Smallman R.E. "Modern Physical Metallurgy", Butterworths, 8th Edition, 2013.
4. Rose. R.M. Shepard L.A. Wulff. J. "Structure and Properties of Materials", Vol. 3, Mechanical Behavior, 4th edition, John Wiley, 1984.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Know about the mechanism of plastic deformation and origin of materials strength.	2		2	1		1						2	2		1
Co2	Suggest the ways by which engineering materials may be intrinsically strengthened.	1		1		1							1			1
Co3	Identify ductile-brittle transition temperature and select materials accordingly.			1		1								1		1
Co4	Know about high temperature mechanical behavior of materials and be able to select the materials for high temperature applications.	1		1									1	1		
Co5	Know about the creep mechanism, variables affecting creep while selecting materials for various applications.	1			1	1							1	1		2

318EDE10 DESIGN OF PRESSURE VESSELS AND PIPING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To gain mathematical knowledge to design pressure vessels and piping.
- To gain knowledge on stress analysis in pressure vessels and piping.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

- To design pressure vessels for different applications.
- To know about buckling and fracture analysis in pressure vessels.
- To know about piping layout and piping stress analysis.

UNIT I INTRODUCTION 6

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

UNIT II STRESSES IN PRESSURE VESSELS 10

Introduction, Stresses in a circular ring, cylinder, Membrane stress analysis of Vessel Shell components, Cylindrical shells, Spherical Shells, Conical heads, Thermal Stresses, Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS 10

Design of Tall cylindrical self supporting process columns – Supports for short vertical vessels – Stress concentration – at a variable, Thickness transition section in a cylindrical vessel about a circular hole, Elliptical openings, Theory of reinforcement – Pressure vessel design.

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 10

Buckling phenomenon, Elastic buckling of circular ring and cylinders under external pressure – Collapse of thick walled cylinders or tubes under external pressure, Effect of supports on Elastic, buckling of Cylinders, Buckling under combined external pressure and axial loading.

UNIT V PIPING 9

Introduction, Flow diagram, Piping layout and piping stress analysis.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Know about the fundamentals involved in the design of pressure vessels.
CO2: Apply the mathematical fundamental for the design of pressure vessels and piping.
CO3: Design and analyze pressure vessels and piping.
CO4: Perform buckling and fracture analysis in pressure vessels.
CO5: Apply the knowledge of piping layout and piping stress analysis while designing piping for different applications.

TEXT BOOKS

1. Dennis Moss and Micheal M Basic, “Pressure vessel design manual”, Butterworth – Heinemann, 4th Edition, 2013.
2. John F. Harvey, “Theory and Design of Pressure Vessels”, CBS Publishers and Distributors, 2001.

REFERENCE BOOKS

1. Philip Ellenberger, “Piping and Pipeline Calculations Manual: Construction, Design Fabrication and Examination”, 2nd Edition, Butterworth – Heinemann, 2014.
2. Brownell, L. E., and Young, E. H., “Process Equipment Design”, John Wiley and Sons, 2009.
3. Sam kannapan, “Introduction to pipe stress analysis”, ABI Enterprises, 2008.
4. Stanley, M. Wales, “Chemical process equipment, selection and Design”. Buterworths series in Chemical Engineering, 2005.
5. William. J. Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.
6. Henry H. Bedner, “Pressure Vessels”, Design Hand Book, CBS publishers and Distributors, 2nd Revised Edition, 1990.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Know about the fundamentals involved in the design of pressure vessels.	2	3	2										3		
Co2	Apply the mathematical fundamental for the design of pressure vessels and piping.	2	3	1		2	2				1	1		2		
Co3	Design and analyze pressure vessels and piping.	2	2	1				2						2		1
Co4	Perform buckling and fracture analysis in pressure vessels.		3												2	2
Co5	Apply the knowledge of piping layout and piping stress analysis while designing piping for different applications.	3		2											3	

318EDE11 APPLIED ENGINEERING ACOUSTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To know about the principles of acoustics.
- To have a deep understanding of the responsibility of engineers to the community in terms of providing a safe healthy environment.
- To gain knowledge on propagation of sound through different mediums.
- To identify noise source types and of how sound propagates outdoors.
- To familiarize with the concepts of noise control techniques used in industry level.

UNIT I BASIC CONCEPTS OF ACOUSTICS 9

Scope of Acoustics - Sound pressure - Sound intensity - Sound power level - Wave motion - Alteration of wave paths -Measurement of sound waves - sound spectra - Sound fields - Interference - Standing waves - Acoustic energy density and intensity - Specific acoustic impedance.

UNIT II CHARACTERISTICS OF SOUND 9

The one dimensional wave equation - Solution of 1D wave equation - Velocity in gaseo medium - Velocity of plane progressive sound wave through a thin solid rod - Velocity of plane wave in a bulk of solid - Transverse wave propagation along a string stretched under tension - Wave equation in two dimension

UNIT III TRANSMISSION PHENOMENA 9

Changes in media - Transmission from one fluid medium to another, normal incidence, oblique incidence - Reflection at the surface of a solid, normal incidence, oblique incidence - Standing wave pattern - Transmission through three media.

UNIT IV AN INTRODUCTION TO THE ASSESSMENT AND MEASUREMENT OF SOUND 9

Introduction - The decibel scale for the measurement of sound power - Sound level meter - Weighted sound pressure level - Equal Loudness contours - Perceived noisiness - Loudness, Loudness level, perceived noise, perceived noise level - Equivalent sound level - Identified level - Frequency and Amplitude measurement.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT V BASIC CONCEPTS OF NOISE CONTROL 9

Noise Control at source, path, receiver - Noise control by acoustical treatment - Machinery noise - Types of machinery involved - Determination of sound power and sound power level - Noise reduction procedures - Acoustic enclosures.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Students will be able to

CO1: Understand the basic knowledge required to measure, assess the sound.
CO2: Analyze and solve noise and vibration problems in industrial situations.
CO3: Gain some hands-on experience on the characteristics of sound waves.
CO4: Familiarize with the effects of sound and vibration on humans and how to mediate these effects and of how sound propagates and is controlled.
CO5: Describe the measures available to control noise and vibration problems.

TEXT BOOKS

1. Joshua E Greenspon, "Structural Acoustic" CRC Press, 1st Edition, 2016.
2. Alan B Coppens, James V Sanders, "Fundamentals of Acoustics "- John Wiley and Sons Inc., 4th Edition, 2000.

REFERENCE BOOKS

1. David A Bies and Colin H Hansen, "Engineering Noise Control - Theory and Practice", CRC Press, 5th Edition, 2018.
2. Colin H Hansen, Xiaojun Qiu and Scott Snyder, "Active Control of Noise and Vibration Volume I & II", CRC Press, 2nd Edition, 2012.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Understand the basic knowledge required to measure, assess the sound.	3	3		2		2							3		
Co2	Analyze and solve noise and vibration problems in industrial situations.	2	2		3		3							2		
Co3	Gain some hands-on experience on the characteristics of sound waves.	2	2					1							2	1
Co4	Familiarize with the effects of sound and vibration on humans and how to mediate these effects and of how sound propagates and is controlled.	1	2		1									1	3	1
Co5	Describe the measures available to control noise and vibration problems.		3	1												1

318EDE12 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce governing equations of viscous fluid flows.
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer.
- To enable the students to understand the various discretization methods, solution procedure and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.
- To gain knowledge on prediction of fluid flow and heat transfer for turbulence models.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD 9

Classification, Initial and Boundary conditions, Initial and Boundary value problems, Finite difference method, Central, Forward, Backward difference, Uniform and non- uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II CONDUCTION HEAT TRANSFER 9

Steady one-dimensional conduction, Two and Three-dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT III INCOMPRESSIBLE FLUID FLOW 9

Governing Equations, Stream Function - Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and spalding, Computation of Boundary layer flow, Finite difference approach.

UNIT IV CONVECTION HEAT TRANSFER AND FEM 9

Steady One-Dimensional and Two-Dimensional Convection - Diffusion, Unsteady one- dimensional convection - Diffusion, Unsteady two-dimensional convection - Diffusion - Introduction to finite element method - Solution of steady heat conduction by FEM - Incompressible flow - Simulation by FEM.

UNIT V TURBULENCE MODELS 9

Algebraic Models - One equation model, K - Ɛ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Simplify a real fluid-flow system into a simplified model problem, to select the proper governing equations for the physics involved in the system, to solve for the flow, to investigate the fluid-flow behavior, and to understand the results.

CO2: Use modern tools to build flow geometries for conduction heat transfer.

CO3: Generate an adequate mesh for an accurate solution, select appropriate solvers to obtain a flow solution, and visualize the resulting flow field.

CO4: Analyze a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses, etc., using flow visualization and analysis tools.

CO5: Analyze problems in turbulence and predict fluid flow and heat transfer.

TEXT BOOKS

1. Chung T.J, “Computational Fluid Dynamics”, Cambridge University Press, 2nd Edition, 2014.
2. Versteeg H K, “An Introduction to Computational Fluid Dynamics”, PHI Publications, 2nd Edition, 2007.

REFERENCE BOOKS

1. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer ", 3rd Edition, 2012.
2. Anil W Date, “Introduction to Computational Fluid Dynamics”, Cambridge University Press, 1st Edition, 2009.
3. Prodip Niyogi, Chakrabarthy S.K., Laha M.K., “Introduction to Computational Fluid Dynamics”, Pearson 1st Edition, 2005.
4. Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 2004.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

5. Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.
6. Bose, T.X., "Numerical Fluid Dynamics", Narosa Publishing House, 1997.
7. Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics 2", Specific Techniques for different flow categories, Springer, 2nd Edition, 1996.
8. John D Anderson Jr, "Computational Fluid Dynamics", McGraw Hill Education, 6th Edition, 1995.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Simplify a real fluid-flow system into a simplified model problem, to select the proper governing equations for the physics involved in the system, to solve for the flow, to investigate the fluid-flow behavior, and to understand the results.	3	3			1					2			3		1
Co2	Use modern tools to build flow geometries for conduction heat transfer.	3	3			1					2			3		1
Co3	Generate an adequate mesh for an accurate solution, select appropriate solvers to obtain a flow solution, and visualize the resulting flow field.	3	3			1					2			3		1
Co4	Analyze a flow field to determine various quantities of interest, such as flow rates, heat fluxes, pressure drops, losses, etc., using flow visualization and analysis tools.	3	3			1					2			3		1
Co5	Analyze problems in turbulence and predict fluid flow and heat transfer.	3	3			1					2			3		1

318EDE13 RESEARCH METHODOLOGY AND IPR **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To know how to identify and to solve the research problem.
- To develop the skills of research related activities.
- To learn about the procedure for applying patents.
- To analyse the structure of patents.
- To know about the advances and practical applications of patents by taking case studies.

UNIT I INTRODUCTION TO RESEARCH METHODOLOGY **9**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT II RESEARCH SKILLS **9**

Effective literature studies approach, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT III NATURE OF INTELLECTUAL PROPERTY RIGHTS **9**

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

UNIT IV PATENT RIGHTS **9**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V NEW DEVELOPMENTS IN IPR **9**

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

The student will be able to

CO1: Determine research problem formulation.

CO2: Equip research related skills like writing a research paper, report preparation and format of research proposal.

CO3: Analyse the process of patenting and its procedure.

CO4: Know about the scope of patent rights and applications of technology transfer.

CO5: Gather information about recent developments about IPR.

TEXT BOOKS

1. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", SAGE Publication, 3rd Edition, 2011.
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.
3. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age International, 2nd Edition, 2004.

REFERENCE BOOKS

1. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Law & Business, 3rd Edition, 2016.
2. Debora J Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta Academic, 1996.
4. William Henry Mayall, "Industrial Design for Engineers", McGraw Hill, 1992.
5. Benjamin W Niebel, "Product Design and Process Engineering", McGraw Hill, 1st Edition, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Determine research problem formulation.	1		1	1	1	1	1					2	1	2	
Co2	Equip research related skills like writing a research paper, report preparation and format of research proposal.			1			1	1	1				1	1	1	
Co3	Analyse the process of patenting and its procedure.			1	1		1	1	2	1	1		3	1	2	
Co4	Know about the scope of patent rights and applications of technology transfer.		1	2			1	1					1	1	1	
Co5	Gather information about recent developments about IPR.		1		1	1					1		1	1	1	

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

318EDP01 **PROJECT WORK (PHASE – I)** **L T P C**
0 0 8 4

COURSE OBJECTIVES:

- To strengthens the students to carry out the project on their own and to implement their innovative ideas.
- To deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation or an analysis.
- To use their engineering education and communication skills for success in life.
- To involve in management or entrepreneurship, including transitioning technologies to the world.
- To develop new knowledge and products that will promote sustainable economic and environmental developments to improve the quality of life.

GUIDELINES

1. The project work is to enable the individual student to work on a project involving theoretical and experimental studies related to the branch of study.
2. Every project work shall have a guide who is the member of the faculty of the institution.
3. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement and methodology. The final report shall be typewritten form as specified in the guidelines.

EVALUATION

1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.
4. Final review will be done by the committee that consists of minimum of three members one of which should be the guide. (If possible include one external expert examiner within the college)

TOTAL HOURS:150 PERIODS

COURSE OUTCOMES

The students will have

CO1: Clear idea of their area of project work.
CO2: The knowledge to carryout the phase II work in systematic way.
CO3: Ability to compile relevant data, interpret & analyze it and test the hypotheses wherever applicable.
CO4: Ability to plan a research design including the sampling, observational, statistical and operational designs keeping in mind the ethical aspects of research.
CO5: Ability to arrive at logical conclusions and propose suitable recommendations on the research problem.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Clear idea of their area of project work.	1	1	1		1	1			1	1		1	1		1
Co2	The knowledge to carryout the phase II work in systematic way.	1		1		1	1						1	1		1
Co3	Ability to compile relevant data, interpret & analyze it and test the hypotheses wherever applicable.															1

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

Co4	Ability to plan a research design including the sampling, observational, statistical and operational designs keeping in mind the ethical aspects of research.	2	1			2								2		1
Co5	Ability to arrive at logical conclusions and propose suitable recommendations on the research problem.					1							1	1		1

318EDP02 **INTERNSHIP** **L T P C**
0 0 6 3

COURSE OBJECTIVES:

- To make the students to get practical exposure and learn about various activities happening in the industries.
- To make the students to learn about effective communication, presentation skills and report preparation.
- To prepare the students with key knowledge and skills in applied design, analysis, manufacture, test, and assembly of mechanical systems.
- To prepare the students who can communicate effectively and who can contribute as members of a team.
- To prepare the students with a broad knowledge of mechanical engineering technology practices applicable to many different industry types.

GUIDELINES

1. It is mandatory that each student should undergo internship / in-plant training in reputed industries for the duration of 2-3 weeks after second semester end examination. Then the student has to submit a hard copy of the training report not less than 10 pages. Also he / she has to give presentation on the training report for about 30 minutes.
2. Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

EVALUATION

1. The training report will be evaluated by the faculty in-charge.
2. There is internal assessment and end examination.

TOTAL HOURS:30 PERIODS

COURSE OUTCOMES

The student will have

CO1: Practical knowledge about various activities like processes, design, quality control, etc that are taking place in industries.

CO2: The skills about effective communication, presentation and report preparation.

CO3: Gain more experience in accomplishing a long-term project, and managing the progress throughout the year.

CO4: Gain more experience in working in a professional team, with colleagues who have different views, talents, and backgrounds.

CO5: Gain more experience at identifying the necessary technical and non-technical methods needed to solve an industrial problem.

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous),
Dr. M.G.R. Nagar, HOSUR - 635130

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Practical knowledge about various activities like processes, design, quality control, etc that are taking place in industries.		2		1								1	1		1
Co2	The skills about effective communication, presentation and report preparation.	2	1		1									1		2
Co3	Gain more experience in accomplishing a long-term project, and managing the progress throughout the year.	2	2		2									1		3
Co4	Gain more experience in working in a professional team, with colleagues who have different views, talents, and backgrounds.		1		2									2		2
Co5	Gain more experience at identifying the necessary technical and non-technical methods needed to solve an industrial problem.	1			1						1		1	2		1

418EDP01 **PROJECT WORK (PHASE – II)** **L T P C**
0 0 30 15

COURSE OBJECTIVES:

The objectives of the project are

- To get an opportunity to synthesize knowledge from various areas of learning, and critically and creatively apply it to real life situations.
- To acquire skills like collaboration, communication and independent learning, prepares them for lifelong learning and the challenges ahead.
- To deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation or an analysis.
- To use the engineering technical skills and modern engineering tools necessary for practical applications.
- To document and present one's own research work, with strict requirements on structure, format, and language usage for publication.

GUIDELINES

1. The project work is to enable the individual student on a project involving theoretical and experimental studies related to the branch of study.
2. Every project work shall have a guide who is the member of the faculty of the institution.
3. They should publish the papers in the journals / conferences.
4. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. The final report shall be typewritten form as specified in the guidelines.

EVALUATION

1. The progress of the project is evaluated by a review committee consisting of a minimum of three members.
2. The review committee may be constituted by the Head of the Department.
3. The continuous assessment shall be made by conducting three reviews.
4. Final review will be done by the committee that consists of minimum of three members one of which should be the guide. (If possible include one external expert examiner within the college)

TOTAL HOURS:90 PERIODS

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130

COURSE OUTCOMES

The students will be able to

CO1: Use the engineering technical skills and modern engineering tools necessary for practical applications.

CO2: Use design principles and develop conceptual, engineering design and fabrication of various components.

CO3: Take up any challenging practical problems and find solution by formulating proper methodology by attending different conferences.

CO4: Create the document for research article with correct format and structure.

CO5: Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries.

Course Outcome		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Co1	Use the engineering technical skills and modern engineering tools necessary for practical applications.	1	1		1	1					1			1		1
Co2	Use design principles and develop conceptual, engineering design and fabrication of various components.	1	1	2		1					1			2		2
Co3	Take up any challenging practical problems and find solution by formulating proper methodology by attending different conferences.	1	1	1										1		1
Co4	Create the document for research article with correct format and structure.	1				1					2			1		
Co5	Gain Practical knowledge about various activities like processes, design, quality control that are taking place in industries.	1	1	1	1	1						1		1		

G RANGANATH

Digitally signed by G RANGANATH
DN: C=IN, O=PERSONAL, T=5743, OID.2.5.4.65=477ffb4dbbd048fca3ebc0819eac5932, Phone=52395e01ffcfdff2072ee2031119111d02facc9c55479d3d2d69ce80f3fdcbd3, PostalCode=635109, S=Tamil Nadu, SERIALNUMBER=fd0cabc4c841372f49b7553888e0d3fd2a47f2cf77abb2bc845fe5200c1fb253, CN=G RANGANATH
Reason: I am the author of this document
Location:
Date: 2023-01-12 15:01:47

PRINCIPAL
Adhiyamaan College of Engineering (Autonomous)
Dr. M.G.R. Nagar, HOSUR - 635130