NANDHA ENGINEERING COLLEGE

(Autonomous)

Affiliated to Anna University Chennai ✤ Approved by AICTE ✤ Accredited by NBA-NewDelhi

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1.1.2 Details of Courses where syllabus revision was carried out in

M.E - Engineering Design

Course Code	Course Name	% of Change
17EDB01	Mechanical Vibrations	25
17EDX02	Composite Materials and Mechanics	60
17EDX23	Micro Electro Mechanical Systems	20
	Average	**35.00 %**

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REGULATIONS -2017
M.E. ENGINEERING DESIGN
CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABI

SEMESTER - I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1	17EDA01	Advanced Numerical Methods	FC	NIL	4	3	2	0	4
2	17EDA02	Concepts of Engineering Design	FC	NIL	3	3	0	0	3
3	17EDB01	Mechanical Vibrations	PC	NIL	4	4	0	0	4
4	17EDB02	Failure Analysis and Design	PC	NIL	3	3	0	0	3
5	17EDB03	Computer Applications in Design	PC	NIL	3	3	0	0	3
6	17EDB04	Design for Manufacture, Assembly and Environments	PC	NIL	3	3	0	0	3
PRACTICALS									
7	17EDP01	Computer Aided Modeling Lab	PC	NIL	4	0	0	4	2
				TOTAL	24	19	2	4	22

SEMESTER: II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1	17EDB05	Advanced Finite Element Analysis	PC	17EDA01	4	4	0	0	4
2	17EDB06	Mechanisms Design and Simulation	PC	NIL	4	4	0	0	4
3	17EDB07	Integrated Mechanical Design	PC	17EDA01	4	4	0	0	4
4	E01	Elective I	PE	Ref. PE	3	3	0	0	3
5	E02	Elective II	PE	Ref. PE	3	3	0	0	3
6	E03	Elective III	PE/OE	Ref. PE	3	3	0	0	3
PRACTICALS									
7	17EDP02	Analysis and Simulation Lab	PC	17EDP01	4	0	0	4	2
8	17EDE01	Technical Seminar	EEC	NIL	2	0	0	2	1
				TOTAL	27	21	0	6	24

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SEMESTER: III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1	E 04	Elective IV	PE	Ref. PE	3	3	0	0	3
2	E 05	Elective V	PE	Ref. PE	3	3	0	0	3
3	E 06	Elective VI	PE	Ref. PE	3	3	0	0	3
PRACTICALS									
4	17EDE02	Project Work Phase - I	EEC	NIL	12	0	0	12	6
5	17EDE03	Industrial Training	EEC	NIL	4	0	0	4	1
				TOTAL	**25**	**9**	**0**	**16**	**16**

SEMESTER: IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1	17EDE04	Project Work Phase - II	EEC	17EDE02	24	0	0	24	12
				TOTAL	**24**	**0**	**0**	**24**	**12**

Total credits to be earned for the award of degree = 22+24+16+12 = 74

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FOUNDATION COURSES (FC)

SL. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	17EDA01	Advanced Numerical Methods	NIL	4	3	2	0	4	I
2	17EDA02	Concepts of Engineering Design	NIL	3	3	0	0	3	I

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	17EDB01	Mechanical Vibrations	NIL	4	4	0	0	4	I
2	17EDB02	Failure Analysis and Design	NIL	3	3	0	0	3	I
3	17EDB03	Computer Applications in Design	NIL	3	3	0	0	3	I
4	17EDB04	Design for Manufacture, Assembly and Environments	NIL	3	3	0	0	3	I
5	17EDP01	Computer Aided Modeling Lab	NIL	4	0	0	4	2	I
6	17EDB05	Advanced Finite Element Analysis	17EDA01	4	4	0	0	4	II
7	17EDB06	Mechanisms Design and simulation	NIL	4	4	0	0	4	II
8	17EDB07	Integrated Mechanical Design	17EDA01	4	4	0	0	4	II
9	17EDP02	Analysis and Simulation Lab	17EDP01	4	0	0	4	2	II

PROFESSIONAL ELECTIVES (PE)

SL. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	17EDX01	Design of Fluid Power systems	NIL	3	3	0	0	3	II
2	17EDX02	Composite Materials and Mechanics	NIL	3	3	0	0	3	II
3	17EDX03	Mechanical Behavior of Materials	NIL	3	3	0	0	3	II
4	17EDX04	Maintenance Engineering	NIL	3	3	0	0	3	II
5	17EDX05	Design of Material Handling Equipment	NIL	3	3	0	0	3	II
6	17EDX06	Experimental Stress Analysis	NIL	3	3	0	0	3	II
7	17EDX07	Advanced Tool Design	17EDB02	3	3	0	0	3	II
8	17EDX08	Biomechanics	NIL	3	3	0	0	3	II
9	17EDX09	Mechatronics in Manufacturing Systems	NIL	3	3	0	0	3	II

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10	17EDX10	Bearing Design and Rotor Dynamics	NIL	3	3	0	0	3	II
11	17EDX11	Additive Manufacturing	NIL	3	3	0	0	3	II
12	17EDX12	Advanced Metal Forming Techniques	NIL	3	3	0	0	3	II
13	17EDX13	Optimization Techniques in Design	17EDA01	3	3	0	0	3	III
14	17EDX14	Computational Fluid Dynamics	17EDA01, 17EDB05	3	3	0	0	3	III
15	17EDX15	Design of Pressure Vessel and Piping	NIL	3	3	0	0	3	III
16	17EDX16	Design of Heat Exchangers	NIL	3	3	0	0	3	III
17	17EDX17	Productivity Management and Re-Engineering	17EDA02	3	3	0	0	3	III
18	17EDX18	Design for Internet of Things	NIL	3	3	0	0	3	III
19	17EDX19	Design for Six Sigma	NIL	3	3	0	0	3	III
20	17EDX20	Advanced Strength of Materials	17EDB01	3	3	0	0	3	III
21	17EDX21	Tribology in Design	NIL	3	3	0	0	3	III
22	17EDX22	Nanomaterials and Nano Technology	NIL	3	3	0	0	3	III
23	17EDX23	Micro Electro Mechanical Systems	NIL	3	3	0	0	3	III
24	17EDX24	Surface Engineering	NIL	3	3	0	0	3	III
25	17EDX25	Engineering Fracture Mechanics	17EDB02	3	3	0	0	3	III
26	17EDX26	Industrial Robotics and Expert systems	NIL	3	3	0	0	3	III
27	17EDX27	Product Lifecycle Management	NIL	3	3	0	0	3	III
28	17EDX28	Quality Concepts in Design	NIL	3	3	0	0	3	III

OPEN ELECTIVES (OE)

SL. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	17BAZ01	Research Methodology	OE	-	3	0	0	3	II
2	17CPZ01	Machine Vision	OE	-	3	0	0	3	II

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1	17EDE01	Technical Seminar	NIL	2	0	0	2	1	II
2	17EDE02	Project Work Phase - I	NIL	12	0	0	12	6	III
3	17EDE03	Industrial Training	NIL	4	0	0	4	1	III
4	17EDE04	Project Work Phase - II	17EDE02	24	0	0	24	12	IV

SL. No.	SUBJECT AREA	SUMMARY				
		CREDITS TOTAL				
		I	II	III	IV	TOTAL
1	FC	7	-	-	-	7
2	PC	15	14	-	-	29
3	PE	-	9	9	-	18
4	EEC		1	7	12	20
TOTAL		22	24	16	12	74

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17EDB01 MECHANICAL VIBRATIONS

L	T	P	C
4	0	0	4

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To understand the fundamentals of vibration and its practical applications	1.1	Understand the basics of vibration and its importance in engineering field.	a,l
2.0	To understand the working principle and operations of various vibration measuring instruments	2.1	Various vibration measuring instruments, vibration control and analysis techniques.	a,e,k,l
3.0	To study the multi degree freedom system and continuous system	3.1	Familiar with the Multi-degree freedom system and continuous system.	a,l
4.0	To understand the various vibration control strategies	4.1	Apply the vibration control system	a,b,e,k,l
5.0	To provide knowledge on experimental methods in vibration analysis.	5.1	Gain knowledge about the experimental methods in vibration analysis	a,b,c,d,e,k,l

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

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 : L : 60 = 60 PERIODS

REFERENCES:

1. Rao, S.S., "Mechanical Vibrations," Prentice Hall, 2011.
2. Thomson, W.T. – "Theory of Vibration with Applications", CBS Publishers and Distributors,New Delhi, 1990.

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3. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.
4. S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw –Hill Publishing Com. Ltd New Delhi,2007.

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17EDX02 COMPOSITE MATERIALS AND MECHANICS

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To understand the fundamentals of composite material strength and its mechanical behaviour.	1.1	Describe the properties of various available composite materials.	a,e,k,l
2.0	Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.	2.1	Understand the mechanics and design related to layered components such as fiber reinforced polymer composites ,isotropic layered structures (example electronic chips) etc and its manufacturing methodologies.	a,b,c,d,e,k,l
3.0	Thermo-mechanical behavior and study of residual stresses in Laminates during processing.	3.1	Basic understanding of lamina constitutive equations and lamina properties from laminate tests	a,b,c,d,e,k,l
4.0	Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.	4.1	Use the ideas developed in the lamina strength analysis and analysis of laminated flat plates	a,b,c,d,e,k,l
5.0	To introduce thermal analysis of composite materials and mechanics	5.1	Select suitable composite or thermal analysis for industrial oriented applications.	a,b,c,d,e,k,l

UNIT I : INTRODUCTION TO COMPOSITE MATERIALS **(10)**

Definition-Matrix materials - polymers - metals - ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers - fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate - Reinforced composite Materials, Dispersion - Strengthened composite, Fiber-reinforced composites Rule of mixtures - Characteristics of fiber - Reinforced composites, Manufacturing fiber and composites.

UNIT II : MANUFACTURING OF COMPOSITES **(10)**

Manufacturing of Polymer Matrix Composites (PMCs) - handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM) - bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquidstate,vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) - hot pressing - reaction bonding process - infiltration technique, direct oxidation- interfaces.

UNIT III : INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS **(12)**

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.

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UNIT IV : LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES	(8)
Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations - Natural Frequencies.	
UNIT V : THERMAL ANALYSIS	**(5)**
Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations - Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.Elaminates, Thermally Quasi-Isotropic Laminates.	
TOTAL : L : 45 = 45 PERIODS	

REFERENCES:

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994,2nd ed., - CRC press in progress.
2. Mallick, P.K., Fiber -"Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993
3. Hyer, M.W., "Stress Analysis of Fiber - Reinforced Composite Materials", McGraw-Hill, 1998
4. Issac M. Daniel and Orilshai, "Engineering Mechanics of Composite Materials", Oxford University Press - 2006, First Indian Edition - 2007
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.
6. Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press(India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008)
7. Chung, Deborah D.L., "Composite Materials: Science and Applications", Ane Books Pvt. Ltd./Springer, New Delhi, 1st Indian Reprint, 2009

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17EDX23 MICRO ELECTRO MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To impart knowledge on MEMS and manufacturing techniques	1.1	Gain knowledge about MEMS and Microsystems	a,b,c,e,l
2.0	To get an exposure on the materials for MEMS and micro systems	2.1	Familiarize with the materials used in MEMS and micro systems	a,b,c,e,l
3.0	To create exposure to packaging techniques of micro system fabrication processes	3.1	Choosing the suitable fabrication technique processes.	a,b,c,e,l
4.0	To impart knowledge on micro manufacturing processes	4.1	Apply knowledge of micro manufacturing techniques and applications to the design and manufacturing of an MEMS device or a micro system	a,b,c,e,l
5.0	To educate the influence of micro system packaging	5.1	Understand the unique selection of packaging materials of MEMS	a,b,c,e,l

UNIT I : INTRODUCTION (9)

Introduction to MEMS and Microsystems - Typical MEMS and Micro system products - Microsystems and micro electronics - Applications of Microsystems in automotive and other industries - Microsensors - Acoustic wave sensors, Bio medical sensors - Optical sensors, Pressure sensors - Micro actuators - Micro grippers, Micro motors, Micro valves, Micro pumps.

UNIT II : MATERIALS FOR MEMS AND MICROSYSTEMS (9)

Substrates and Wafers - Active substrate materials - Silicon as a substrate material - Silicon compounds - Silicon Dioxide, Silicon Carbide, Silicon Nitride, Polycrystalline Silicon - Silicon Piezoresistors - Gallium Arsenide - Quartz - Polymers - Polymers as Industrial Materials, Polymers for MEMS and Microsystems, Conductive Polymers - Packaging Materials

UNIT III : MICROSYSTEM FABRICATION PROCESSES (9)

Introduction - Principle of corrosion - Classification of corrosion - Types of 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 : MICRO MANUFACTURING (9)

Bulk Micro manufacturing - Etching - Isotropic and Anisotrotpic etching, Wet etching, Dry etching - Surface micromachining - General process, Mechanical problems associated with surface micromachining - LIGA Process-general Process, Materials for substrates and photo resists - Electroplating - SLIGA Process.

UNIT V : MICROSYSTEM PACKAGING (9)

Mechanical packaging of microelectronics – Micro system packaging - General considerations, Three levels of micro system packaging - Interfaces in micro system packaging - Essential packaging technologies – Die preparation, Surface bonding, Wire bonding - Three dimensional packaging - Assembly of microsystems - Selection of packaging materials.

TOTAL : L: 45 = 45 PERIODS

REFERENCES:

1. Tai-Ran Hsu, "MEMS & Microsystems Design and Manufacture", McGraw Hill Education, 2010

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2. N.P.Mahalik, "MEMS", McGraw-Hill Companies, 2010.
3. Gardner, W. Julian, K. Varadan Vijay and O. Awadelkarim, Osama, "Micro sensors MEMS and Smart Devices", Jhon Wiley & Sons Ltd, 2001.
4. Gad-el-Hak, Mhamed, The MEMS Handbook, CRC Press, 2002.

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