DEPARTMENT OF MECHANICAL ENGINEERING

M.E. ENGINEERING DESIGN

Regulation 2019

CHOICE BASED CREDIT SYSTEM

(I - IV SEMESTERS CURRICULUM)

Sri Eshwar College of Engineering

(An Autonomous Institution)

(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)

Kondampatti (Post), Kinathukadavu,

Coimbatore – 641202

M.E. ENGINEERING DESIGN

Regulation 2019

Semester I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	P19MA102	Applied Mathematics for Engineering Design	PC	5	3	2	0	4
2	P19ED101	Computer Applications in Design	PC	3	3	0	0	3
3	P19ED102	Research Methodology and IPR	PC	3	3	0	0	3
4	P19ED3XX	Program Elective I	PE	3	3	0	0	3
5	P19ED3XX	Program Elective II	PE	3	3	0	0	3
PRACTICALS								
6	P19ED111	CAD Laboratory	PC	4	0	0	4	2
7	P19ED112	Advanced Analysis and Simulation Laboratory	PC	4	0	0	4	2
8	P19MC5XX	Audit Course I	MC	2	2	0	0	NC
TOTAL				**27**	**17**	**2**	**8**	**20**

Semester II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	P19ED103	Integrated Mechanical Design	PC	3	3	0	0	3
2.	P19ED104	Advanced Mechanics of Materials	PC	3	3	0	0	3
3	P19ED105	Vibration Analysis and Control	PC	3	3	0	0	3
4	P19ED3XX	Program Elective III	PE	3	3	0	0	3
5	P19ED3XX	Program Elective IV	PE	3	3	0	0	3
PRACTICALS								
6	P19ED113	Vibration Laboratory	PC	2	0	0	2	1
7	P19ED201	Design Project	PW	4	0	0	4	2
8	P19MC5XX	Audit Course II	MC	2	2	0	0	NC
TOTAL				**23**	**17**	**0**	**6**	**18**

Semester III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	P19ED3XX	Program Elective V	PE	3	3	0	0	3
2	P19OE4XX	Open Elective*	OE	3	3	0	0	3
PRACTICALS								
3	P19ED202	Project Work - Phase I	PW	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

Semester IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
PRACTICALS								
1	P19ED203	Project Work - Phase II	PW	32	0	0	32	16
TOTAL				**32**	**0**	**0**	**32**	**16**

*Open Elective – L T P C for open electives can either be 3 0 0 3 or 2 0 2 3

Total Number of Credits: 70

SUMMARY

Sl.No.	Course Category	Credits per Semester				Credits	Credit %
		I	II	III	IV		
1.	PC	14	10	-	-	24	34.3
2.	PE	6	6	3	-	15	21.4
3.	OE	-	-	3	-	3	4.3
4.	PW	-	2	10	16	28	40.0
5.	AC	√	√	-	-	-	-
Total		**20**	**18**	**16**	**16**	**70**	**100**

PROGRAM CORE (PC)

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	P19MA102	Applied Mathematics for Engineering Design	PC	5	3	2	0	4
2	P19ED101	Computer Applications in Design	PC	3	3	0	0	3
4	P19ED102	Research Methodology and IPR	PC	3	3	0	0	3
5	P19ED111	CAD Laboratory	PC	4	0	0	4	2
6	P19ED112	Advanced Analysis and Simulation Laboratory	PC	4	0	0	4	2
7	P19ED103	Integrated Mechanical Design	PC	3	3	0	0	3
8	P19ED104	Advanced Mechanics of Materials	PC	3	3	0	0	3
9	P19ED105	Vibration Analysis and Control	PC	3	3	0	0	3
10	P19ED113	Vibration Laboratory	PC	2	0	0	2	1

PROGRAM ELECTIVES (PE)

Sl.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
SEMESTER I- ELECTIVE I								
1	P19ED301	Optimization Techniques in Design	PE	3	3	0	0	3
2	P19ED302	Mechanics of Composite Materials	PE	3	3	0	0	3
3	P19ED303	Design of Material Handling Equipment	PE	3	3	0	0	3
4	P19ED304	Additive Manufacturing and Tooling	PE	3	3	0	0	3
SEMESTER II- ELECTIVE II								
5	P19ED305	Advanced Finite Element Analysis	PE	3	3	0	0	3
6	P19ED306	Industrial Robotics and Expert systems	PE	3	3	0	0	3
7	P19ED307	Quality Concepts in Design	PE	3	3	0	0	3
8	P19ED308	Engineering Fracture Mechanics	PE	3	3	0	0	3
SEMESTER II- ELECTIVE III								
9	P19ED309	Plates and Shells	PE	3	3	0	0	3

10	P19ED310	Modal Analysis of Mechanical Systems	PE	3	3	0	0	3
11	P19ED311	Advanced Metal Forming Techniques	PE	3	3	0	0	3
12	P19ED312	Tribology in Design	PE	3	3	0	0	3
SEMESTER II- ELECTIVE IV								
13	P19ED313	Surface Engineering	PE	3	3	0	0	3
14	P19ED314	Mechanisms Design and Simulation	PE	3	3	0	0	3
15	P19ED315	Product Lifecycle Management	PE	3	3	0	0	3
16	P19ED316	Biomechanics	PE	3	3	0	0	3
SEMESTER III- ELECTIVE V								
17	P19ED317	Design for Internet of Things	PE	3	3	0	0	3
18	P19ED318	Design of Hydraulic and Pneumatic Systems	PE	3	3	0	0	3
19	P19ED319	Bearing design and Rotor Dynamics	PE	3	3	0	0	3
20	P19ED320	Mechanical Behaviour of Materials	PE	3	3	0	0	3
21	P19ED321	Product Design for Sustainability	PE	3	3	0	0	3
22	P19ED322	Computational Fluid Dynamics	PE	3	3	0	0	3
23	P19ED323	Design for Manufacture Assembly and Environments	PE	3	3	0	0	3

OPEN ELECTIVES (OE)

SL.NO.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	P19OE401	Business Analytics	OE	3	3	0	0	3
2	P19OE402	Industrial Safety	OE	3	3	0	0	3
3	P19OE403	Operations Research	OE	3	3	0	0	3
4	P19OE404	Cost Management of Engineering Projects	OE	3	3	0	0	3
5	P19OE405	Composite Materials	OE	3	3	0	0	3
6	P19OE406	Waste to Energy	OE	3	3	0	0	3

PROJECT WORK (PW)

SL. NO.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	P19ED201	Design Project	PW	4	0	0	4	2
2	P19ED202	Project Work - Phase I	PW	20	0	0	20	10
3	P19ED203	Project Work - Phase II	PW	32	0	0	32	16

AUDIT COURSES (AC)

SL.NO.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	P19AC501	English for Research Paper Writing	AC	2	2	0	0	NC
2	P19AC502	Disaster Management	AC	2	2	0	0	NC
3	P19AC503	Sanskrit for Technical Knowledge	AC	2	2	0	0	NC
4	P19AC504	Value Education	AC	2	2	0	0	NC
5	P19AC505	Constitution of India	AC	2	2	0	0	NC
6	P19AC506	Pedagogy Studies	AC	2	2	0	0	NC
7	P19AC507	Stress Management by Yoga	AC	2	2	0	0	NC
8	P19AC508	Personality Development through Life Enlightenment Skills.	AC	2	2	0	0	NC

Sri Eshwar College of Engineering
(Autonomous)

Syllabus

Department	**Engineering Design**	**Programme Code & Name**	**Mech & M.E. (ED)**

Semester – I

P19MA102	**APPLIED MATHEMATICS FOR ENGINEERING DESIGN**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**

Outcomes

After completion of this course, the students will be able to

CO1	**(Understand)** Explain the fundamentals of applied mathematics in engineering	K2
CO2	**(Understand)** Explain the fundamentals of calculus of variations for first and higher order calculus	K2
CO3	**(Understand)** Explain the fundamentals of probability and random variables	K2
CO4	**(Apply)** Apply the technique of Laplace transform for partial differential equations	K3
CO5	**(Apply)** Apply the technique of Fourier transform for partial differential equations	K3

MODULE I MATRIX THEORY **9**

The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.

MODULE II CALCULUS OF VARIATIONS **9**

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods.

MODULE III PROBABILITY AND RANDOM VARIABLES **9**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

MODULE IV LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS **9**

Laplace transform - Definitions - Properties – Transform error function - Bessel's function – Dirac delta function - Unit step functions – Convolution theorem – Inverse Laplace transform : Complex inversion formula – Solutions to partial differential equations : Heat equation - Wave equation.

MODULE V FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS **9**

Fourier transform: Definitions - Properties – Transform of elementary functions - Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations : Heat equation -

Wave equation - Laplace and Poison's equations.

Total: 60 Hours

REFERENCES

1 Andrews L.C. and Shivamoggi, B. "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.

2 Bronson, R. "Matrix Operations", Schaum's outline series, 2 Nd Edition, McGraw Hill, 2011

3 James, G., "Advanced Modern Engineering Mathematics ", 3 Edition, Pearson Education, 2004.

4 Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics forEngineers", Pearson Education, Asia, 8Th Edition, 2015.

5 O'Neil, P.V., "Advanced Engineering Mathematics ", Thomson Asia Pvt. Ltd., Singapore, 2003.

6 Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

P19ED101 **COMPUTER APPLICATIONS IN DESIGN**

L	T	P	C
3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	**(Apply)** Apply the basic principles of computer aided design and graphics in product design and development.	K3
CO2	**(Apply)** Apply the surface and solid modeling techniques in product design	K3
CO3	**(Apply)** Apply the curve generation and assembly modeling techniques in product design	K3
CO4	**(Apply)** Apply top-down design principles to model a design	K3
CO5	**(Evaluate)** Compare the use of curves and surfaces in CAD	K5

MODULE I **INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS** **9**

Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotation) windowing - view ports - clipping transformation.

MODULE II **CURVES AND SURFACES MODELLING** **9**

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations.

Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bicubic surface- Bezier surface and B-Spline surface-surface manipulations.

MODULE III **NURBS AND SOLID MODELING** **9**

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid

Geometry - comparison of representations - user interface for solid modeling.

MODULE IV VISUAL REALISM 9

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages.

MODULE V ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE 9

Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards– Open GL Data Exchange standards – IGES, STEP etc–Communication standards.

Total: 45 Hours

REFERENCES

1. David F. Rogers, James Alan Adams "Mathematical elements for computer graphics" second edition, Tata McGraw-Hill edition.2003
2. Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.
3. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
4. Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.

P19ED201	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Outcomes

After completion of this course, the students will be able to

CO1	**(Understand)** Understand research problem formulation.	K2
CO2	**(Analyze)** Analyze research related information	K2
CO3	**(Understand)** Follow research ethics	K2
CO4	**(Understand)** Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.	K2
CO5	**(Understand)** Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	K2

MODULE I RESEARCH PROBLEM 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

MODULE II LITERATURE STUDY AND PLAGIARISM 9

Effective literature studies approaches, analysis. Plagiarism, Research ethics

MODULE III REPORT WRITING 9

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

MODULE IV NATURE OF INTELLECTUAL PROPERTY 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.

MODULE V PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR 9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL : 45 HOURS

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

P19ED111	**CAD LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Outcomes

After completion of this course, the students will be able to

CO1	Apply design principles to develop conceptual engineering design of any components	K3
CO2	Apply theoretical knowledge to design the mechanical components using modern software tools	K3
CO3	Apply the engineering knowledge to solve real life industrial problems	K3
CO4	Analyze design problems in a systematic manner	K4
CO5	Create the parts design with assembly	K6

CAD Introduction.

Sketcher module

Solid modeling – Extrude, Revolve, Sweep, etc and Variational sweep, Loft ,etc

Surface modeling – Extrude, Sweep, Trim., etc and Mesh of curves, Free form etc

Feature manipulation – Copy, Edit, Pattern, Suppress, History operations etc.

Assembly-Constraints, Exploded Views, Interference check

Drafting - Layouts, Standard & Sectional Views, Detailing & Plotting.

CAD data Exchange formats - IGES, PDES, PARASOLID, DXF and STL

Exercises in Modeling and drafting of Mechanical Components - Assembly using Parametric and feature based Packages like PRO-E / SOLID WORKS /CATIA / NX etc

TOTAL : 60 HOURS

P19ED112	**ADVANCED ANALYSIS AND SIMULATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Outcomes

After completion of this course, the students will be able to

CO1	**(Apply):** Apply the fundamental knowledge on using various analytical tools like ANSYS, MATLAB, etc., for engineering applications	K3
CO2	**(Analyze):** Perform analysis of stress, truss/beam and dynamic analysis of mechanical members.	K4
CO3	**(Analyze):** Simulate simple problems in vibrations and simple mechanisms using simulation software.	K4
CO4	**(Analyze):** Perform two dimensional stress analysis in plate and asymmetric shells.	K4
CO5	**(Analyze):** Analyze the temperature distribution in one dimensional heat transfer problems (walls and fins).	K4

MODULE I SIMULATION **15**

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software.

MODULE II ANALYSIS **45**

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.

3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL : 60 HOURS

Semester – II

P19ED102	**INTEGRATED MECHANICAL DESIGN (Use of Approved Data Book Is Permitted)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Outcomes

After completion of this course, the students will be able to

CO1	Demonstrate key machine elements in a mechanical machine elements	K2
CO2	Investigate standards used in designing of machine elements	K3
CO3	Infer various stresses acting on machine elements according to various loading conditions	K3
CO4	Design shaft, bearings, casings used in power transmission system	K6
CO5	Design gears, gearbox, clutches, brakes for automobile, machine tools and mechanical applications.	K6

MODULE I FUNDAMENTALS AND DESIGN OF SHAFTS 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 - Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity

MODULE II 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.

MODULE III 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.

MODULE IV INTEGRATED DESIGN 18

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 : 45 HOURS

The Pattern of Question Paper will consist of one Question from Unit – 4 for 50% of total marks.

** Term Project must be given for Assessment – 3 (Compulsory)

REFERENCES:

1 Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.

2 Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.

3 Maitra G.M., "Hand Book of Gear Design", Tata McGraw Hill, 1985.

4 Newcomb, T.P. and Spur, R.T., "Automobile Brakes and Braking Systems", Chapman and Hall, 2nd Edition, 1975.

5 Norton L. R., "Machine Design – An Integrated Approach" Pearson Education, 2005

6 Prasad. L. V., "Machine Design", Tata McGraw Hill, New Delhi, 1992.

7 Shigley, J.E., "Mechanical Engineering Design", McGraw Hill, 1986.

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.

P19ED103	ADVANCED MECHANICS OF MATERIALS	L	T	P	C
	(Use of Approved Data Book Is Permitted)	**3**	**0**	**0**	**3**

Outcomes

After completion of this course, students will be able to

CO1	**(Analyze)** Learn about the elastic and plastic behavior of material and analyze stress invariants, principal stresses and their directions.	K4
CO2	**(Analyze)** Determine strain invariants, principal strains and their directions.	K4
CO3	**(Analyze)** Develop constitutive relationships between stress and strain for linearly elastic solid.	K4
CO4	**(Analyze)** Analyze theories of failure and design components for safe operation.	K4
CO5	**(Analyze)** Examine the properties of ideally plastic solid and apply the concepts of energy methods in solving structural problems.	K4

MODULE I ELASTICITY **9**

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law - St. Venant's principle – plane stress - Airy's stress function. Energy methods.

MODULE II SHEAR CENTER AND UNSYMMETRICAL BENDING **9**

Location of shear center for various thin sections - shear flows. Stresses and Deflections in beams subjected

to unsymmetrical loading-kern of a section.

MODULE III STRESSES IN FLAT PLATES AND CURVED MEMBERS 9

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions

MODULE IV TORSION OF NON-CIRCULAR SECTIONS 9

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.

MODULE V STRESSES IN ROTATING MEMBERS AND CONTACT STRESSES 9

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress- deflection of bodies in point and line contact applications.

TOTAL : 45 Hours

REFERENCES:

1 Arthur P Boresi, Richard J. Schmidt, "Advanced mechanics of materials",John Wiley, 2002.

2 Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co., 1985.

3 Srinath. L.S., "Advanced Mechanics of solids", Tata McGraw Hill, 1992..

4 Allan F. Bower, "Applied Mechanics of Solids", CRC press – Special Indian Edition -2012

P19ED104	VIBRATION ANALYSIS AND CONTROL	L	T	P	C
		3	0	0	3

Outcomes

After completion of this course, the students will be able to

CO1	**(Analyze)** Understand the fundamentals of vibration and its practical applications	K4
CO2	**(Evaluate)** Model, approximate, analyse and simulate vibratory systems that include general forcing, general boundary conditions, and nonlinearities using approximate computational tools as necessary	K5
CO3	**(Analyze)** Discern the relevant principles that must be applied to describe or measure the equilibrium or motion of vibratory systems	K4
CO4	**(Apply)** Explain and describe principles and components of vibration analysis and their inter relationships	K3
CO5	**(Analyze)** Establish relation between real system and physical model and examine their vibration response	K4

MODULE I FUNDAMENTALS OF VIBRATION 9

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.

MODULE II TWO DEGREE FREEDOM SYSTEM 6

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

MODULE III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM 8

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.

MODULE IV EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 8

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

MODULE V VIBRATION CONTROL 9

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

TOTAL : 45 HOURS

REFERENCES:

1 Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000

2 Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.

3 S. Graham Kelly & Shashidar K. Kudari, "Mechanical Vibrations", Tata McGraw–Hill Publishing Com. Ltd New Delhi, 2007

4 Thomson, W.T. – "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi,1990.

5 David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice",4th Edition, E and FN Spon, Taylore & Francise e-Library, 2009

P19ED113	**VIBRATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Outcomes

After completion of this course, the students will be able to

CO1	**(Understand)** Understand the basic concepts and behaviour of vibration in machines	K2
CO2	**(Apply)** Evaluate the natural frequencies and other parameters in single degree and two degree vibration systems	K3
CO3	**(Apply)** Demonstrate an understanding on how certain measuring devices are handled for dynamic testing	K3
CO4	**(Evaluate)** Evaluate the natural frequency of rotating and reciprocating systems	K5
CO5	**(Evaluate)** Evaluate the natural frequency for different structural members	K5

List of Experiments

1. To study the forced vibration of the beam for different damping.

2. To determine the radius of gyration 'k' of a given compound pendulum.
3. To determine the radius of gyration of given bar using bi-filler suspension.
4. To determine the radius of gyration of trifilar suspension.
5. To verify the dunker lay's rule viz.
6. To study the pressure profile of lubricating conditions of load and speed.
7. To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
8. To determine the natural frequency of undamped torsional vibration of two rotor shaft system.
9. To determine the frequency of undamped free vibration of an equivalent spring mass system.
10. To determine the frequency of damped force vibration of a spring mass system.

TOTAL : 30 HOURS

P19ED202	**DESIGN PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

After completion of this course, the students will be able to

Outcomes

CO1	**(Apply)** Apply the established technical and practical methods to the solution of well-defined engineering problems.	K3
CO2	**(Understand)** Understand the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the area of practice	K2
CO3	**(Apply)** Familiarize with respect to the design methodologies applied to any component or mechanical system subjected to static, dynamic and thermo-mechanical loads.	K3
CO4	**(Apply)** Familiarize with respect to design standards, design calculations and analysis in designing any mechanical component or system.	K3
CO5	**(Create)** Create the design, based on the engineering disciplines	K6

Each student is required to select any new component or an integrated mechanical system that involves various sub components which are to be designed as per design standards and further required to be analyzed for optimum dimensions with respect to the strength and stiffness.

TOTAL : 60 HOURS