CMR Institute of Technology, Bangalore			
Department: Mechanical Engineering			
Semester: 02	Course : M.Tech		
Composite Materials Technology		14MST21	Lectures/week: 04
Course Instructor(s): Mr. Trishul.M.A			
Course duration: Jan 2016 to May 2016			

Lesson Plan

# Class	Chapter Title/ Reference Literature	Topic Covered	Percentage of portion covered	
			Reference	Cumulative
1-10	TB1	**Introduction to Composite Materials:** Definition, classifications, types of matrices Materials, Characteristics and selection, Types of Composites, Prepegs and sandwich construction, Metal Matrix **Composites. Macro Mechanics of a Lamina :** Hooke's law for different types of Material, Derivation of nine independent constants for orthotropic Material, Hooke's law for two dimensional angle lamina, Numerical problems.	20%	20%
11-20	TB1, RB1	**Micro mechanical Analysis Of a Lamina :** Introduction, Evaluation of four elastic Moduli, Rule of mixture, numerical problems. Failure criteria: Failure criteria for an elementary composite layer, Maximum stress and strain criteria, Tsa-Hill theory, Tsai, Wu tensor theory, Numerical problem, practical recommendations.	20%	40%
21- 30	TB1, RB1	**Macro Mechanical Analysis of Laminate**: Introduction, code, Kirchoff hypothesis, Classical Lamination Theory, A, B, and D matrices , Special cases of laminates, Numerical problems.	20%	60%
31-40	TB2, RB2	**Analysis of Composite Structures:** Optimization of Laminates, composite laminates of uniform strength, application of optimal composite structures, composite pressure vessels, spinning composite disks, composite lattice structures.	20%	80%

41-50	TB2	**Manufacturing and Testing:** Layup and curing - open and closed mould processing, Hand lay-up techniques, Bag moulding and filament, winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining, joining and repair. NDT tests – Purpose, Types of defects, NDT method - Ultrasonic inspection, Radiography, Acoustic emission and Acoustic ultrasonic method. **Applications:** Aircrafts, missiles, Space hardware, automobile, Electrical and Electronics, Marine, Recreational and sports equipment-future potential of composites	20%	100%

Syllabus for Internal Assessment Tests (IAT)*

Sessional #	Syllabus
T1	Class # 01 – 25
T2	Class # 26 - 50

* See calendar of events for the schedules of IATs.

LITERATURE:

Book Type	Code	Author & Title	Publication info	
			Edition & Publisher	ISBN #
Text Book	TB1	Autar K. Kaw, Mechanics of Composite materials	CRC press Newyork	9780849313431
Text Book	TB2	MadhijitMukhopadhay, Mechanics of Composite Materials & Structures	Universities Press 2004.	8173714770
References	RB1	Mein Schwartz, Composite materials handbook	McGraw Hill book company, 1984	9780070558199
References	RB2	Michael W.Hyer, Stress analysis of FRP composites	McGraw Hill International	9781932078862

CMR Institute of Technology, Bangalore			
Department: Mechanical Engineering			
Semester: 02 (M.Tech)	February 2016 – May 2016		
Advanced Machine Design		12MME22	Lectures/week: 06
Course Instructor: Dr. Vijayananda Kaup			

Lesson Plan

Lecture #	Book & Sections	Topics	Portions coverage	
			Individual	Cumulative
1-2	RB 3: 2.1, 2.8 RB1: 1.1 - 1.8	Introduction to AMD	-	-
3-8	TB1 1 & 2	**1a) Failure and modes of failure:** Design definition, Challenges in design, design objectives, failure. Failure modes. Illustrative examples.	8	8
9-12	TB1 3.1 to 3.4, 4 & 5	**1b) Strength of engineering metal, State of stress:** Condon-Morse curves, space lattices, Elastic and plastic deformation. State of stress at a point, principal stresses (normal and shear). Relationship between stress and strain. Illustrative examples.	2	10
13-16	TB1 6	**1c) Theories of failure:** Brush up of max normal stress theory, max shear stress theory, max normal strain theory, total strain energy theory, Distortion energy theory, Mohr's failure theory.	4	14
17-22	TB1 7.1 to 7.5	**2) Fatigue of materials:** Introductory, nature of fatigue, fatigue loading, fatigue testing at labs, fatigue design	12	26
23-28	TB1 7.6 to 7.9	**3) Stress – Life approach:** HCF introduction, SN curves, statistical nature of SN curves, factors affecting SN curves, influence of mean stress, Basquin's relationship to estimate fatigue life	12	38
29-34	TB1 11	**4) Strain – Life approach:** LCF introduction, strain cycling concept, strain life curve and LCF relationships, mean stress effects	12	50
35-40	TB1 3.5 to 3.8, 8.5	**5) LEFM approach:** Fracture mechanics basics, modes of fracture, introduction to LEFM, fracture toughness. Fracture mechanics approach to crack propagation	18	68
41-46	TB1 12	**6) Notches and their effects:** Stress concentrations and gradients. Stress concentration effects. SCF for elastic range, Haigh drawings, notch strain analysis, Neuber's and Glinka's rule. Application of FM to crack growth	12	70
47-52	TB1 8	**7) Fatigue from Variable Amplitude Loading:**Damage accumulation, Cumulative damage theories, Life prediction based on stress-strain, cycle counting methods	14	84
53-58	TB1 17.1 to 17.4	**8) Surface Failure:** Introduction to wear, Adhesive wear, Abrasive wear, corrosion wear, surface fatigue wear, deformation wear, fretting wear and impact wear	16	100
59-64	TB1 13-15, 17.5 to 7.6	**9) Creep, fretting, shock and impact, corrosion:**Introduction to creep and behaviors of creep, introduction to fretting, introduction to corrosion		

Syllabus for Internal Assessment Tests (IAT)*

IAT #	Syllabus
IAT-1	Class # 01 – 22
IAT-2	Class # 23 – 40
IAT-3	Class # 41-58

REFERENCES

Book Type	Code	Author & Title	Publication information	
			Edition // Publisher	ISBN
Text Book	TB1	Jack A Collins, Failure of Materials in Mechanical Design	John Wiley, New York, 1992	0-586-59690-1
Text Book	TB1	Ralph I Stephens, Ali Fatemi, Metal Fatigue in engineering	John Wiley, New York, 2001	0-06-056994-8

CMR Institute of Technology, Bangalore			
Department: Mechanical Engineering			
Semester: 02 (M.Tech)	February 2016 – May 2016		
Dynamics and Mechanism Design		12MMD23	Lectures/week: 06
Course Instructor: Dr. Vijayananda Kaup			

Lesson Plan

Lecture #	Book & Sections	Topics	Portions coverage %	
			Individual	Cumulative
1 - 11	RB 3: 2.1, 2.8 RB1:	**Geometry of Motion:** Introduction, analysis and synthesis, Mechanism terminology, planar, spherical and spatial mechanisms, mobility, Grashoffs law, Equivalent mechanisms, Unique mechanisms, Kinematic analysis of plane mechanisms: Auxiliary point method using rotated velocity vector, Hall-Ault auxiliary point method, Goodman's indirect method.	12.5	12.5
12 - 20	TB 1: 1.2, 1.3, 1.4, 1.5	**Generalized Principles of Dynamics:** Fundamental laws of motion, Generalized coordinates, Configuration space, Constraints, Virtual work, principle of virtual work, Energy and momentum, Work and kinetic energy, Equilibrium and stability, Kinetic energy of a system, Angular momentum, Generalized momentum.	12.5	12.5
21 - 27	TB 1: 2.1, 2.2, 4.1, 4.2	**Lagrange's Equation:** Lagrange's equation from D'Alembert's principles, Examples, Hamilton's equations, Hamilton's principle, Lagrange's equation from Hamilton's equations, Derivation of Hamilton's equation, Examples.	12.5	12.5
28-36	RB 1: 10.1 – 10.6	**Synthesis of Linkages:** type, number, and dimensional synthesis, Function generation, Path generation and Body guidance, precision positions, Structural error, Chebychev spacing, Two position synthesis of slider crank mechanism, Crank - rocker mechanisms with optimum transmission angle		12.5
37-46	RB 1: 10.7 -10.11	**Graphical Methods of Dimensional Synthesis:** Two position synthesis of Crank -rocker mechanisms, three position synthesis, Fourth position synthesis (point precision reduction) Overlay method, Coupler curve synthesis, Cognate linkages.	12.5	12.5
47-52	RB 1: 10.12, 10.13	**Analytical Methods of Dimensional Synthesis:** Freudenstein's equation for four bar mechanism and slider crank mechanism, Examples, Bloch's method of synthesis, analytical synthesis using complex algebra.	12.5	12.5
53-57	RB 2: 10.1 - 10.5	**System Dynamics:** Gyroscopic action in machines, Euler's equation of motion, Phase Plane representation, Phase Plane Analysis, Response of Linear systems to transient disturbances.	12.5	12.5
58-62	RB 1: 11.1, 11.3, 11.5, 11.6	**Spatial Mechanism:** Introduction, Position analysis problem, velocity and acceleration analysis, Eulerian angles.	12.5	12.5

Syllabus for Internal Assessment Tests (IAT)*

IAT #	Syllabus
IAT-1	Class # 01 – 23
IAT-2	Class # 24 – 42
IAT-3	Class # 43 - 62

REFERENCES

Book Type	Code	Author & Title	Publication information	
			Edition // Publisher	ISBN
Text Book	TB1	Greenwood "Classical Dynamics"	Prentice Hall of India, 1988	0-486-69690-1
References	RB1	E. Shigley & J.J.Uicker "Theory of Machines and Mechanisms"	Fifth Edition Mc Graw Hill Company	0-07-056884-7
References	RB2	A.G.Ambedkar" Mechanism and Machine Theory"	PHI, 2007.	978-81-203-3134-1
References	RB3	Ghosh and Mallick, "Theory of Mechanism and Mechanism"	3rd Edition, East West press,	81-85938-93-8

CMR Institute of Technology, Bangalore			
Department: Mechanical Engineering			
Semester: MTech - 2nd sem.	Section(s): -		
Subject: Advanced Theory of Vibrations		**14MDE24**	Lectures/week: 05
Course Instructor(s): Krishnarao Dhuri			
Course duration: 1Feb2016 – 11 May 2016			

Lesson Plan

Class #	Chapter Title / Reference Literature	Topic	Percentage of portion covered	
			Reference	Cumulative
1	**Review of Mechanical Vibrations**	Free vibration of single degree of freedom systemswithout damping,	24%	24%
2		Free vibration of single degree of freedom systems with damping,		
3		Forced vibration of single DOF-systems		
4		Forced vibration of single DOF-systems Continue		
5		Natural frequency		
6		Understanding transient vibrations		
7		Transient vibration of single DOF systems - Impulse excitation		
8		Transient vibration of single DOF systems - Impulse excitation continue		
9		Transient vibration of single DOF systems - arbitrary excitation		
10		Laplace transform formulation		
11		Convolution method		
12		Transient vibration of single DOF systems - Pulse excitation and rise time		
13		Practical aspects of transient vibrations		
14		Design for transient vibrations		
15		Shock response spectrum and shock isolation		
16	**Vibration Control**	Introduction to Vibration isolation theory	22 %	46 %
17		vibration isolation		

18		motion isolation for harmonic excitation		
19		Practical aspects of vibration analysis, shock isolation,		
20		Dynamic vibration absorbers		
21		Dynamic vibration absorbers continue		
22		Vibration dampers		
23		Vibration measurement introduction		
24		Transducers – accelerometer, vibration pickups		
25		Frequency measuring equipments		
26		Vibration exciters		
27		Signal analysis		
28		Advances in vibration controls		
29	**Modal analysis & Condition Monitoring**	Dynamic testing of machines and structures	26%	72%
30		Practical aspects of modal analysis		
31		Experimental modal analysis – hardware		
32		Algorithms for modal analysis		
33		Algorithms for modal analysis continue		
34		Machine condition monitoring and diagnosis		
35		Vibration based condition monitoring		
36		Introduction to Non-linear vibrations		
37		Sources of nonlinearity		
38		Qualitative analysis of nonlinear systems- Phase-plane		
39		Conservative systems		
40		Stability of equilibrium, methods of isoclines		
41		Perturbation method		
42		Perturbation method continue		

43		Method of iteration		
44		Self-excited oscillations		
45	**Random Vibrations**	Random phenomena, Time averaging and expected value	16%	88%
46		Various terms related with random vibrations – stationarity		
47		Frequency method, time vs frequency method		
48		Frequency response function		
49		Use of probability distribution for random vibrations		
50		Correlations – Auto and cross-correlations		
51		Practical usage of correlations		
52		Power spectrum and power spectral density		
53		Fourier transform		
54		Introduction to FFT		
55		Tools available for random vibrations analysis		
56	**Continuous Systems**	Introduction to Vibrating string	12%	100%
57		longitudinal vibrations of rods		
58		longitudinal vibrations of rods continue		
59		Torsional vibrations of rods		
60		Torsional vibrations of rods continue		
61		Euler equation for beams.		
62		Timoshenko beam		

Syllabus for Sessionals :

Sessional #	Syllabus
T1	Class # 01 – 28
T2	Class # 29 – 44
T3	Class # 45– 62

Literature:

Book Type	Code	Author & Title	Edition & Publisher
Text Book	TB1	**Theory of vibrations with applications,**W.T. Thomson	Pearson publication
Text Book	TB2	**Fundamentals of Mechanical vibration**, S.G. Kelly	McGraw-Hill, 2000
Text Book	TB3	**Mechanical vibrations**, S.S. Rao	Pearson education, 4th Edition

CMR Institute of Technology, Bangalore			
Department: Mechanical Engineering			
Semester: MTech - 2nd sem.	Section(s): -		
Subject: Design Optimization		**14CAE251**	Lectures/week: 05
Course Instructor(s): Krishnarao Dhuri			
Course duration: 1 Feb 2016 – 11 May 2016			

Lesson Plan

Class #	Chapter Title / Reference Literature	Topic	Percentage of portion covered	
			Reference	Cumulative
1	**Engineering design practice**	Evolution of design topology	20%	20%
2		Introduction to design and design process		
3		Design vs analysis		
4		Role of computers in design cycle		
5		Impact of CAE on design		
6		Numerical modeling with FEA and correlation with physical tests		
7		Optimization problems in automotive		
8		Optimization problems in aerospace		
9		Optimization of metallic and composite structures,		
10		Minimization and maximization problems		
11		Multi-disciplinary Optimization		
12		Multi-objective optimization		
13	**Optimum design problem formulation**	Types of optimization problems. Mathematics representation for optimization problem	20%	40%
14		Design variables and design constraints, Feasible and infeasible designs		
15		Representation of Equality and inequality constraints optimization		
16		Linear and non-linear optimization.		
17		Optimization theory- fundamental concepts, global and local minimum		
18		Gradient vector and Hessian matrix,		
19		concept of necessary and sufficient conditions		
20		Optimization for unconstrained problems		
21		Optimization for Constrained problems		
22		Continue Optimization for Constrained problems		
23		Lagrange multiplier		

24		Kuhn-Tucker conditions		
25	**Sensitivity analysis and optimization case studies**	Sensitivity analysis	20%	60%
26		Linear and non-linear approximations		
27		Gradient based optimization methods - dual and direct.		
28		Conceptual design optimization and design fine tuning.		
29		Combined optimization – optimization with different objectives		
30		Optimization of multiple static and dynamic loads		
31		Optimization for transient simulations		
32		Case study 1- Mechanical system problem		
33		Continue case study 1		
34		Case study 2 – Interdisciplinary problem		
35		Continue case study 2		
36		Continue case study 2		
37	**Manufacturability in optimization problem**	Introduction to Design for manufacturing	20%	80%
38		Manufacturing methods and rules		
39		Applying manufacturing constraints to optimization problems.		
40		Discussion about design for manufacturing problem		
41		Discussion about unbound problems, over constrained problems, problems with number of multiple solutions		
42		Continue discussion around constraint screening. Design move limits		
43		Active and inactive constraints, constraint violations		
44		Local and global optimum.		
45		Results interpretation for optimization problem for any solver		
46		Discussion about different optimization solvers		
47		Case study – optimization using MATLAB		
48		Continue case study		
49	**Dynamic programming**	Introduction to dynamic programming	20%	100%
50		Applications of dynamic programming		
51		How dynamic programming efficient over other optimization methods		
52		Multistage decision processes		
53		Principle of optimality for dynamic programing		

54		Computational procedure in dynamic programming		
55		The Knapsack problem		
56		Continue discussion on Knapsack problem		
57		Initial value problem in dynamic optimization		
58		More examples on dynamic optimization		
59		Examples		
60		More examples		

Syllabus for IATs:

Sessional #	Syllabus
T1	Class # 01 – 24
T2	Class # 25 – 48
T3	Class # 49– 60

Reference books:

1. Engineering optimization: Theory and practice, S.S. Rao, John Wiley, 2009
2. Introduction to optimum design, Jasbir Arora, McGraw Hill, 2011