

Branch Name:	Mechanical Engineering (CAD/CAM)
Semester/Year:	Semester I / First year
Subject Title:	Advanced Machine Design
Subject Code:	2ET2010102T
Pre-requisite:	Fundamentals of Subjects based on Machine Design

Course Objectives:

1. To understand procedure for general design and material selection
2. To design the mechanical components subjected to creep and fracture.
3. To develop analytical skills for the design components subjected to fatigue.
4. To give students an elementary idea about the tribological design considerations.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	1	-	4	24	60	16	40	-	-	-	-	100

Subject Contents:

Sr. No	Topic	Total Hours	Weightage (%)
1	General Design Procedure: Design Philosophies, Design for X: Reliability, Concurrent Engineering, Aesthetics and Ergonomics, Manufacturing and Assembly. To be covered during Tutorial Session. Material Selection: Introduction, General characteristics of machine component applications, Material Selection Factors and Process, Material Selection Charts.	04	20
2	Fracture Mechanics: Introduction, Rise in stresses due to crack, Crack tip opening displacement, LEFM: Effect of crack on strength of ductile and brittle material, Crack opening modes and Griffith theory, Concept of SIF and Crack Tip Plasticity, Use of K in design and analysis, Determination of plastic zone, size and shape, Limitations of LEFM.	05	20
3	Creep and Damping: True stress and true strain, Creep phenomenon, Creep Curve, Creep parameters, time-temperature parameters and life estimate: Sherby-Dorn and Larson- Miller, Stress relaxation. Stress-Strain-Time relation, Creep deformation under varying stress, Component stress-strain analysis, Energy dissipation in materials.	06	20
4	Tribological considerations in design: Wear and its types. Hydrodynamic, hydrostatic and hydrodynamic lubrication. Porous bearings, stresses in bearing. Determination of static and dynamics load capacity of bearings. Arrangement of bearings for different load conditions.	05	20

5	Fatigue: Introduction, factors affecting fatigue behavior, Theoretical stress concentration factor and notch sensitivity factor, Fatigue under complex stresses, cumulative fatigue design, Linear damage (Miner's Rule), Manson's method, Fatigue crack propagation and life estimation for constant and variable amplitude stress.	05	20
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List of Reference Books:

1. E Dowling Pearson. Mechanical Behavior of Materials: Engineering Methods for Deformation Fracture and Fatigue 4th ed, Pearson India.
2. Norton R L, "Machine Design: An Integrated Approach", 3rd Edition, Pearson Education
3. Kumar Prashant, "Elements of Fracture Mechanics, McGraw-Hill.
4. Juvinall R C & Marshek K M, "Fundamentals of Machine Design", 5th Edition, Wiley India
5. Collins J A, Busby H, Stabb G, Mechanical Design of Machine Elements and Machines: A failure prevention perspective, Wiley India.
6. Shetty M. N., "Dislocations and Mechanical Behavior of Materials, Prentice Hall of India.
7. Dieter, G, "Engineering Design", McGraw-Hill.
8. Johnson Ray C., "Optimum Design of Mechanical elements" Wiley, John & Sons.

List of Tutorials:

1. To understand various factors to be considered affecting design process and understand material selection procedure through case studies.
2. Case Studies related to plastic zone and validation of LEFM.
3. Problems related to life estimation theories and design considerations for creep.
4. Problems related to Tribological considerations in design.
5. Problems related to design of mechanical components subjected to fatigue load.

E-Resources:

1. <http://nptel.ac.in/courses/112105125/>
2. <https://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009/lecture-notes/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Recall the procedure for general design and material selection.	2 Understanding
CLO2	Make use of fracture mechanics, surface failure and creep in design of machine components.	1 Remembering
CLO3	Demonstrate time dependent failure of machine components.	3 Applying 4 Analyze
CLO4	Examine life of machine components based on fatigue failure.	2 Understanding 6 Creating
CLO5	Determine multiaxial stresses in machine components.	5 Evaluating
CLO6	Understand the tribological considerations in design	2 Understanding

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CLO1	H	M	L			M	L				L			
CLO2			M	M	L	L							L	
CLO3		L	M		H			L	M	M			M	
CLO4		L	M		H			L	M	M			M	

CLO5		M		M	L		L							M
CLO6								M		M	L	L		L

H: High, M: Medium, L: Low