

Program Code: ET201	
Subject Code: 1ET2010102	Subject Title: ADVANCED MACHINE DESIGN
Pre-requisite Subject	Fundamentals of Subjects based on Machine Design

Course Objective: The course is intended to strengthen fundamentals of applied mechanics of solids and build understanding of design and analysis of machine components under dynamic loading. The course introduces design and analysis of machine components at elevated temperature. The course also includes fundamentals and application of fracture mechanics and design of pressure vessels and gears as per standard design practices.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
2	2	-	4	60	40	30	20	150

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
01	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	4	20	
02	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.	5	20	
03	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.	6	20	
04	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.	5	20	
05	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.	5	20	

Review Presentation: The student is expected to spend minimum 2 hours per week (as mentioned in the teaching and evaluation scheme) to refer at least two peer reviewed journal papers related to this domain/subject. The student is expected to identify issues/challenges and emerging trends in the domain/subject. Student is supposed to explore various video lectures (E.g. NPTEL) available in the domain/subject. Student is required to make a review-presentation on the work carried out for the same.

Recommended sites for journal papers are (1) asmedigitalcollection.asme.org (2) springer.com (3) sciencedirect.com (5) ieeexplore.ieee.org (6) scholar.google.co.in or others of similar repute.

Course Outcome:

After learning the course the students should be able to

1. Students will be able to select the material of components as per the standard design practice.
2. Students will be able to design mechanical components subjected to creep.
3. Students will be able to design and analyze bearings subjected to dynamic loading.
4. For the design and analysis of components students will be able to incorporate effect of Fatigue.

Tutorials: The tutorial component of the course may consist of following syllabus topics.

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.

List of References:

2. Mechanical Behavior of Materials: Engineering Methods for Deformation Fracture and Fatigue 4th Edition N E Dowling Pearson.
3. Machine Design: An Integrated Approach 3rd Edition R L Norton Pearson Education.
4. Elements of Fracture Mechanics Prashant Kumar McGraw-Hill.
5. Fundamentals of Machine Design 5th Edition R C Juvinall & K M Marshek Wiley India.
6. Mechanical Design of Machine Elements and Machines: A failure prevention perspective J A Collins, H Busby and G Stabb Wiley India.
7. Dislocations and Mechanical Behavior of Materials M. N. Shetty PHI
8. Engineering Design Dieter, G McGraw-Hill
9. Process Equipment Design Brownell and Young Wiley India Pvt Ltd
10. Material handling equipments, N. Rudenko, , MIR publishers.
11. Gear Design, Gitin Maitra, TMH Publication
12. CMTI Handbook-TMH publication