

MM 451 Mechanical Vibrations				DEPARTMENT OF MECHANICAL ENGINEERING					
Semester	Methods of Education							Credits	
	Lecture	Recit.	Lab.	Project / Field Study	Homework	Other	Total	Credit	ECTS Credit
7	42	0	-	12	14	7	75	3	3.0
Language	English								
Compulsory / Elective	Elective								
Prerequisites	MM 202								
Course Contents	Basic definitions. Single degree of freedom systems: Equations of motion, undamped and damped vibrations, free and forced vibrations, response of systems to external excitations. Vibration isolation. Two degree of freedom systems: Equations of motion, coordinate transformation, principal coordinates, vibration modes. Torsional vibration. Introduction to multi-degree of freedom systems.								
Course Objectives	To introduce basic properties and importance of mechanical vibrations in engineering applications. To teach and apply basic methods employed for analysis of engineering problems involving mechanical vibrations.								
Learning Outcomes and Competences	Understanding of basic properties of mechanical vibrations. Learning the methods used for analysis of vibrations which is an indispensable phenomena in physical systems. Learning of dynamic force caused by mechanical vibrations and importance of resonance in mechanical systems. Getting familiar with the actual working condition problems that they students will face when they are engineers.								
Textbook and /or Reference	1. Mechanical Vibrations, S.S. Rao, Addison-Wesley. 2. Mechanical Vibrations, S.G. Kelly, McGraw-Hill. 3. Engineering Vibrations, D.J. Inman, Prentice-Hall.								
Assessment Criteria						If any, mark as (x)		Percentage (%)	
	Midterm Exams					X		50	
	Quizzes								
	Homeworks					X		10	
	Projects								
	Term Paper								
	Laboratory Work					X			
	Other								
	Final Exam					X		40	
Instructors	Prof. Nizami AKTURK, Prof. Sefaattin YUKSEL, Assist.Prof. Tuncay KARACAY								
Week	Subject								
1	INTRODUCTION: A brief history of vibrations, importance of the study of vibration, basic concepts of vibrations; vibration, elementary parts of vibrating systems, degree of freedom, natural frequency.								
2	CLASSIFICATION OF VIBRATIONS: Free and forced vibrations, undamped and damped vibrations, linear and nonlinear vibrations, deterministic and random vibrations.								
3	VIBRATION ANALYSIS PROCEDURE: Spring element, mass or inertia element, damping element, harmonic motion, harmonic analysis.								
4	FREE VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEMS: Free vibration of undamped translational system, solution of equation of motion, harmonic motion, Free vibration of undamped torsional system, energy methods.								
5	FREE VIBRATIONS WITH DAMPING: Free vibration of damped systems, logarithmic decrement, free vibrations with Coulomb damping, free vibrations with hysteretic damping.								
6	HARMONICALLY EXCITED VIBRATIONS OF UNDAMPED VIBRATIONS: Equations of motion for an undamped system under harmonic force and their solution, beating, resonance and natural frequencies.								
7	FORCED VIBRATIONS OF DAMPED VIBRATIONS: Forced vibration of damped systems, response of a system for general periodic forcing, convolution integral, response spectrum.								
8	TWO DEGREE OF FREEDOM SYSTEMS: Equations of motion for two degree of freedom systems and their solution. Torsional systems.								
9	NATURAL FREQUENCIES AND MODE SHAPES: Coordinate coupling and principal coordinates, vibration modes and nodes.								
10	DYNAMIC VIBRATION ABSORBER: Dynamic vibration absorbers and their design, dynamic vibration absorbers without damping, dynamic vibration absorbers with damping.								
11	SEMI-DEFINITE SYSTEMS: Vibrations of semi-definite systems, stability, a case study.								
12	NATURAL FREQUENCIES AND MODE SHAPES: Dunkerley's formula, Rayleigh's method, fundamental frequencies of beams and shafts.								
13	NATURAL FREQUENCIES AND MODE SHAPES: Holzer's method, matrix iteration method, Jacobi's Method, the other methods.								
14	MULTIDEGREE OF FREEDOM SYSTEMS: A general quick view of multidegree of freedom systems, an introduction to matrix methods, some examples of problems faced in the industry.								