

AE 3530 - System Dynamics and Vibration

Hours: 3-0-3

CATALOG DESCRIPTION:

Modeling and analysis of lumped- and distributed-parameter systems, free and forced vibration in mechanical systems, free vibration in structural systems.

PREREQUISITES:

AE2220 Dynamics

Math 2552 Differential Equations

COURSE OBJECTIVES: Provide students with a foundational understanding of dynamic modeling and analysis of both lumped parameter (mechanical) systems and distributed parameter (structural) systems, and free and forced vibration response of those systems.

LEARNING OUTCOMES:

Students will gain mastery level understanding of:

- 1) Modeling of Physical Systems
- 2) Distributed parameter systems versus lumped parameters
- 3) Response of 1st and 2nd Order Dynamic Systems
- 4) Mode shapes, natural frequencies and expansion theorem (modal superposition)

Students will gain basic capability or understand of:

- 5) Response of Higher Order Dynamic Systems
- 6) Free Vibrations (free and forced)

TOPICAL OUTLINE:

	<i>Topic</i>	<i>Hours</i>
I.	Introduction	1
II.	Mathematical background for system analysis Complex numbers, variables and functions Laplace transformation Inverse Laplace Transformation Solution of linear, time invariant differential equations Linearization	5
III.	Modeling of Mechanical Systems Mechanical elements Modeling of mechanical systems Work, Energy, and Power	6
IV.	Linear System Analysis in the Time Domain Transfer functions Transient response of first and second order systems Impulse response	5
V.	Linear System Analysis in the Frequency Domain Frequency response of first and second order systems Bode diagrams Vibration isolation Vibration absorbers	5

VI.	Modeling of Dynamic Systems in State Space	5
	State-space representation	
	Eigenvalues and eigenvectors	
	Solution of state equations	
VII.	Free vibrations of a string	4
	Distributed parameter systems	
	Natural frequencies	
	Mode shapes	
VIII.	Forced response	2
	Transient response	
	Steady state response	
IX.	Torsional vibrations of beams	3
X.	Bending vibration of beams: free response	5
XI.	Mid Term Exam and Quizzes	3
	Total	45