MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 318 Mechanical Vibrations (4 Units) Required

Course Description: (2019-20 Catalog)	Free and forced vibration response of single and multiple degree of freedom systems. Experimental studies of the dynamic behavior of structures and machines. Instrumentation methods utilized in field and laboratory. 3 lectures, 1 laboratory.
Prerequisite Courses:	MATH 344, ME 212, Recommended EE 201.
Prerequisites by Topic:	The student is expected to have a working knowledge of dynamics and differential equations. The student should also be capable of operating standard electronic instrumentation.
Textbook: (and/or other required material)	Engineering Vibration 4th ed., Inman, Daniel J., Pearson, 2013. Laboratory Manual
References:	None
Course Coordinator/Instructor:	Hemanth Porumamilla, Associate Professor of ME
Course Learning Outcomes: On completion of this course students will be able to:	1. Derive mathematical models for simple vibration systems. 2. Compute natural frequencies of simple systems. 3. Evaluate the response of single degree-of-freedom systems to periodic or transient force. 4. Determine critical speeds of rotating machinery. 5. Select vibration isolation systems. 6. Evaluate the effect of damping on the above systems. 7. Synthesize mathematical models of physical systems. 8. Instrument systems for vibration analysis. 9. Operate electromechanical shake tables. 10. Interpret transient and steady state vibration from a physical standpoint. 11. Compute amplitude ratios, natural frequencies, and damping ratios from experimental data. 12. Solve differential equations, both linear and nonlinear, utilizing numerical techniques on one of the local computing systems. 13. Utilize basic FFT spectral analysis equipment for vibration analysis of machinery systems and interpret results. 14. Instrument and analyze multi-degree of freedom systems.

15. Write short technical reports in a professional manner.

Relationship of Course to Mechanical Engineering Student Outcomes:

SO 1: Develop (D)
SO 2:
SO 3:
SO 4:
SO 5:
SO 6: Develop (D)
SO 7:

Topics Covered:

Brief review of dynamics
Natural frequencies of undamped single degree-of-freedom systems
Newton's Methods and energy methods
The effects of viscous, coulomb and hysteresic (structural) damping
Harmonic Response of single degree-of-freedom systems
Vibration isolation
Balancing of rotors
Responses to periodic and transient excitation
Use of Laplace transforms
Vibration measuring instruments
Two degree-of-freedom systems

Laboratory Projects:

Determination of the moment of inertia of a body by vibration techniques.
The use of numerical methods and the digital computer to solve differential equations of motion.
Transient vibrations of structural elements and determination of damping ratios.
Determination of steady state response as a function of frequency and input amplitude utilizing mechanical or electromechanical shake tables.
Analysis and experimentation with multi-degree of freedom systems.
Analysis of basic machinery utilizing FFT spectral analyzer.
Dynamic balancing of a system.

Class/Lab Schedule: Three 50-minute lectures per week; One 170-minute lab per week

Contribution of Course to Meeting the Professional Component:

(a) College-level mathematics and basic sciences:	0 credits
(b) Engineering Topics:	3 credits
Design	1 credit
(c) General Education:	0 credits

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