MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 318  Mechanical Vibrations (4 Units) Required

**Course Description:**
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 326, 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:**

**Laboratory Manual**

**References:**
None

**Course Coordinator/Instructor:** Jim Meagher, 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.
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.
15. Write short technical reports in a professional manner.

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<th>Relationship of Course to MECHANICAL ENGINEERING Program Outcomes:</th>
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**Topics Covered:**
- Brief review of dynamics
- Natural frequencies of undamped single degree-of-freedom systems
- Newtons Methods and energy methods
- The effects of viscous, coulomb and hysteretic (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: Design 3 credits
- (c) General Education: 0 credits

Prepared by: Jim Meagher  Date: 9/10/2013