Boston University - College of Engineering
Course Requisition Form - Summary Page/Data Sheet

Directions: Type normally in the grayed areas, then tab to next area. Type X in the check boxes, then tab to next area.

Date Submitted: 1/15/10

Course Number: ME721 Course Title: Acoustic Bubble Dynamics

First semester to be offered:	☐ Fall	☒ Spring	☐ Summer 20 10	
Last semester to be offered:	☐ Fall	☐ Spring	☐ Summer 20 ____	☒ offer indefinitely
Course to be scheduled	☐ Automatically		☒ On demand (by department request only)	
Course to be offered :	☐ Fall	☐ Spring	☐ Summer (check *all* that apply)	

Course Designation (check *one)*

☒ Lecture

Lecture hrs/wk: 4
Discussion hrs/wk: ____
Laboratory hrs/wk: variable
Semester credits : 4

Course Catalog Description: Bubbles and acoustic cavitation play an important role in many aspects of application of sonic and ultrasonic energy in fluids and biological tissue. This course will introduce the study of bubble phenomena in sound fields. The fundamental physical acoustics of bubbles (and the fundamental physics which can be illustrated by the study of bubble dynamics) will be stressed. The family of Rayleigh-Plesset equations for time-dependent bubble behavior will be derived from the Navier-Stokes equations. Analytical approximations to the Rayleigh-Plesset equations in various limiting cases will be derived and studied. Approximations to the thermodynamic behavior of oscillating bubbles will be considered in detail. Thermal, acoustic and viscous contributions to dissipation will be treated. Numerical solutions will also be studied, specifically in the context of highly nonlinear behavior during acoustically-forced oscillations. Other topics covered will include scattering of sound and acoustic radiation, acoustics of bubbly liquids, bubble-mediated bioeffects, shape instabilities, acoustic levitation, sonoluminescence, heat and mass transfer during bubble oscillations, sonochemistry and cavitation detection and monitoring.

Prerequisites: ENG AM 520, ENG AM 542 or equivalent.

Courses for which this course is a prerequisite: None

Is this course a number change only? ☒Y ☐N
Required Textbook(s): None

References: T.G. Leighton, The Acoustic Bubble, Academic Press, 1997.

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Course Requisition Form – Course Information

Course Number: ME721

Title: Acoustic Bubble Dynamics

Course Content (indicate number of weeks per topic): _____

Topics:	**Weeks:**
1. **Bubble Basics:** definitions; nucleation; mechanics; thermodynamics; applications	(0.5)
2. **Blake Threshold:** derivation; comparison with experiments	(0.5)
3. **Rayleigh Collapse:** derivation for void; peak pressure; effect of gas	(0.5)
4. **Rayleigh-Plesset Equation(s):** derivation for incompressible fluid; linearization; resonance, mass and stiffness; forced response; analytic nonlinear solutions; harmonic, sub-and ultra-harmonic resonances; transient response; numerical nonlinear solutions; resonance superstructure, bifurcations and basins	(4)
5. **Gaseous Mass Diffusion:** Henry's law, liquid preparation and surface tension; non-convective diffusion; "rectified diffusion"; equilibria and stability; numerical and experimental results	(1.5)
6. **Damping Mechanisms:** viscous, acoustic and thermal; heat transfer and thermal damping; "rectified heat transfer"	(1)
7. **Shape Instability:** Faraday experiment, curved surface; experimental examples and results; normal modes theory; analytic and numerical solutions	(2)
8. **Acoustic Levitation:** "Primary Bjerknes' Force"; standing wave resonators; analytic expressions for linear bubble dynamics and resonance;	(0.5)
9. **Acoustic Scattering and Radiation:** scattering from spheres, cross-sections; linear and nonlinear response; bubble sizing; ultrasound contrast agents; wave equation in bubbly media	(1)
10. **Sonoluminescence:** history, SL and SBSL; bubble dynamics, mass transfer and shape instability; light emission mechanism; experiments	(1)
11. **Cavitation Thresholds and Cavitation Bioeffects:** nucleation; inertial cavitation; detection techniques and issues, in vitro and in vivo; experiments and results	(0.5)
12. **Student Presentations:** Student participants must research a specific literature article (or narrowly-defined topic) approved by instructor and present a full 1 hour class on that article or topic. Student may NOT present their own current research work.	(2)

Laboratories no