Course Outcomes

1. Develop a basic theoretical understanding of nanoscale forces acting between a scanning probe tip and a sample.
2. Develop a basic understanding of the commonly used operation modes of AFM.
3. Develop experimental skills to operate AFM’s safely.
4. Develop skills to be able to perform basic imaging and material property measurements using static and dynamic AFM modes.
5. Develop an overview of the research uses of AFM.

Basic theory of AFM (7 hours)
1. Tip-sample interaction forces
2. Operating principle and instrumentation
3. Operating modes of AFM
4. Operation procedure

Experiments with static AFM modes (5 hours)
1. Contact mode imaging
2. Friction force imaging
3. Force distance curves
4. Image processing and metrology

Experiments with dynamic AFM modes (5 hours)
1. Tapping mode imaging with different feedbacks
2. Attractive vs. repulsive regime imaging
3. Phase contrast imaging
4. Dynamic force-distance curves
5. Interpretation of dynamic force-distance curves

Applications of AFM (2 hours)
Applications to Biology, Electronics, Material Science and Mechanics

Revision Date: 6/19/2013
1. **COURSE NUMBER:** ME 59500R Introduction to Atomic Force Microscopy

2. **CREDITS AND CONTACT HOURS:** 1 credit  
   a. Lecture – 1 day per week at 25 minutes for 16 weeks  
   b. Laboratory – 1 day per week at 25 minutes for 16 weeks

3. **COURSE COORDINATOR OR INSTRUCTOR:**  
   A. Raman

4. **TEXTBOOK:**  
   No Text Required

5. **SPECIFIC COURSE INFORMATION:**  
   a. **Catalog Description:** Theory of tip sample interactions, static AFM modes – including force-distance curves, contact mode imaging, set point and error signals, and friction force imaging; dynamic AFM modes – including tapping mode imaging with three different feedback modes (amplitude, phase and mean deflection), phase contrast imaging, effects of frequency tuning, dynamic-force distance curves. Typically offered in the spring and summer.  
   b. **Prerequisites:** None  
   c. **Status:** Elective

6. **SPECIFIC GOALS FOR THE COURSE:**  
   a. **Course Outcomes:**  
      1. Develop a basic theoretical understanding of *nanoscale forces* acting between a scanning probe tip and a sample.  
      2. Develop a basic understanding of the different commonly used *operation modes* of AFM.  
      3. Develop *experimental skills* to operate AFM’s safely.  
      4. Develop skills to be able to perform *basic imaging* and *material property measurements* using static and dynamic AFM modes.  
      5. Develop an overview of the many *research uses* of AFM.  
   b. **Related ME Program Outcomes:**  
      A1. Engineering Fundamentals; B3. Prof/Ethical Responsibility;  
      A3. Experimental Skills; B5. Life-Long Learning;  
      A4. Modern Engr Tools; C1. Leadership;  
      A5. Design Skills; C2. Global Engineering Skills;  
      A6. Impact of Engr Solns; C3. Innovation;  
      B1. Communication Skills; C4. Entrepreneurship  
      B2. Teamwork Skills

7. **LIST OF TOPICS:** See following page.

**PREPARED BY:** A. Raman  
**REVISION DATE:** June 19, 2013