1. *Course number and name*
   ENGR 461: Mechanical and Structural Vibration

2. *Credits and contact hours*
   3 credit hours; two 75-minute lecture sessions/week

3. *Instructor's or course coordinator's name*
   Instructor: Cheng Chen, Associate Professor of Civil Engineering
   Course coordinator: Cheng Chen, Associate Professor of Civil Engineering

4. *Text book, title, author, and year*
   Rao, S. S. *Mechanical Vibrations.* 6th edition, Pearson Prentice Hall, 2016.

   a. *other supplemental materials*

   - A. K. Chopra. *Dynamics of Structures: theory and applications to earthquake engineering*. 4th ed. Prentice Hall, 2011.
   - W. T. Thomson and M. D. Dahleh. *Theory of Vibration with Applications.* 5th ed. Prentice Hall, 1998.
   - R. F. Steidel, Jr. *An Introduction to Mechanical Vibrations.* 3rd ed. John Wiley & Sons, 1989.
   - A. K. Chopra. *Dynamics of Structures: a primer*. Earthquake Engineering Research Institute, 1980.

5. *Specific course information*
   a. *brief description of the content of the course (catalog description)*
      Dynamic excitation and response of mechanical and structural systems; time domain analysis; D' Alembert's principle; modal analysis; vibration damping; resonance and tuned mass damper.

   b. *prerequisites or co-requisites*
      ENGR 201, ENGR 309 and MATH 245.

   c. *indicate whether a required, elective, or selected elective course in the program*
      Selected elective for Civil and Mechanical Engineering.

6. *Specific goals for the course*
   a. *specific outcomes of instruction.*
      - Student understands basic concepts of mass, stiffness, and damping for a SDOF system.
      - Student is able to determine the mass and stiffness for a SDOF system using dynamic equilibrium.
      - Student is able to obtain system damping using log decrement from free vibration test.
      - Student is able to generate the free vibration response to an impact load.
      - Student is able to generate the steady-state response due to a harmonic load or ground motion.

- Student can determine the transient vibration to shock loads and earthquake motion.
- Student can determine maximum response using response spectra.
- Student can use dynamic equilibrium to create the differential equation of motion for a MDOF system, thus determining mass and stiffness matrices.
- Student can obtain stiffness and flexibility matrices using influence coefficients.
- Student can obtain modal frequencies and mode shapes.
- Student can obtain steady-state solutions for harmonic loads using modal analysis.
- Student can obtain transient solutions and maximum responses for non-harmonic loads using modal analysis.
- Student understands the concept of using a vibration absorber to eliminate excessive vibrations when SDOF systems are subjected to input frequencies at or near resonant frequency.
- Student can select the stiffness and mass for a vibration absorber.

b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, c, e, i.

7. Brief list of topics to be covered

- Introduction to vibration
- Derivation of equation of motion
- Free body diagram
- D' Alembert's Principle
- Natural frequency and damping ratio
- Free vibration of undamped single-degree-of-freedom system
- Free vibration of damped single-degree-of-freedom system
- Forced vibration of undamped single-degree-of-freedom system
- Forced vibration of damped single-degree-of-freedom system
- Resonance
- Half-power rule
- Transient and steady-state response
- Equation of motions for multiple-degree-of-freedom system
- Vibration modes
- Vibration control through tuned mass damper

1. *Course number and name*
   ENGR 463 : Thermal Power Systems

2. *Credits and contact hours*
   3 Credits; Class work, two units (two one hour lectures per week); laboratory, one unit (three hour lab work per week).

3. *Instructor's or course coordinator's name*
   Instructor: Dr. Ahmad R. Ganji and Dr. Douglas Codron
   Course coordinator: Dr. Ahmad R. Ganji

4. *Text book, title, author, and year*
   - Yunus A. Cengel and Michael A. Boles, Thermodynamics, Engineering Approach, 8th Ed., McGraw Hill, 2014.
   - Laboratory Manual developed by Dr. Ahmad R. Ganji
   - Class handouts

   a. *other supplemental materials*
   - Bernard D. Wood, Applications of Thermodynamics, 2nd Ed. Waveland Press, 1982.
   - Richard E. Sonntag, Claus Borgnakke and Gordon J. Van Wylen, Fundamentals of Thermodynamics, 6th Ed., John Wiley, 2003.
   - Weston, Energy Conversion, West Pub. Co., 1992.

5. *Specific course information*
   a. *brief description of the content of the course (catalog description)*
   Application of thermodynamics, fluid mechanics, and heat transfer to design of energy systems. Economics and environmental aspects stressed as design criteria. Class work, two units; laboratory, one unit.

   b. *prerequisites or co-requisites*
   ENGR. 302 and ENGR. 467

   c. *indicate whether a required, elective, or selected elective course in the program*
   Required for Mechanical Engineering

6. *Specific goals for the course*
   a. *specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*
   - The students will demonstrate that they have an understanding of the principle of operation of thermal power and refrigeration systems.
   - The students will demonstrate that they have an understanding of the basics of