



VIBRATIONS OF STRUCTURES

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Department of Mechanical Engineering
IIT Kharagpur

TYPE OF COURSE

: Rerun | Elective | UG/PG

COURSE DURATION

: 12 Weeks (24 Jan' 22 - 15 Apr' 22)

EXAM DATE

: 24 Apr 2022

PRE-REQUISITES : Engineering Mathematics, Dynamics of Machines

INTENDED AUDIENCE : Core for PG specializations in Mechanical, Civil and Aerospace. Elective for UG.

INDUSTRIES APPLICABLE TO : Automotive, aerospace, process industries etc.

COURSE OUTLINE :

All mechanical structures have flexibility, which becomes apparent under loading, more prominently under dynamic loading. It is of fundamental importance to understand the vibration characteristics of a structure in order to appropriately design systems subjected to dynamic loading in order to avoid/enhance resonance, sound generation and transmission, and fatigue failure. This course will expose the different modeling and analysis techniques for continuous systems such as strings, bars, beams and plates. Special emphasis is given to variational and approximate methods, which are useful for handling complex systems. The course is expected to be useful for both academic research and industrial applications, and will provide a stepping stone for more specialized and advanced courses.

ABOUT INSTRUCTOR :

Prof. Anirvan DasGupta is a faculty in Mechanical Engineering at IIT Kharagpur since 1999. His interests are in the mechanics of discrete and continuous systems. He has extensively taught courses at undergraduate and postgraduate levels like Mechanics, Kinematics of Machines, Dynamics, Dynamics of Machines, Vibration Analysis, Wave Propagation in Continuous Media, and Rail Vehicle Dynamics.

COURSE PLAN :**Week 1:** Module 1 (Vibrations of strings and bars)

- Transverse Vibrations of Strings-I • Transverse Vibrations of Strings-II
- Axial and Torsional Vibrations of Bars
- Variational Formulation-I • Variational Formulation-II • Modal Analysis-I • Modal Analysis-II
- Properties of Eigenvalue Problem • Modal Analysis: Approximate Methods - I
- Modal Analysis: Approximate Methods - II
- The Initial Value Problem • Forced Vibration Analysis-I • Forced Vibration Analysis - II
- Forced Vibration Analysis - III • Damping in Structures • Tutorial video - I

Week 2: Module 2 (Vibrations of beams)

- Beam Models - I • Beam Models - II • Modal Analysis of Beams
- Applications of Modal Solution • Approximate Methods • Topic in Beam Vibration - I
- Topic in Beam Vibration - II • Dynamics of Curved Beams • Vibrations of Rings and Arches
- Tutorial video - II

Week 3: Module 3 (Vibrations of membranes)

- Dynamics of Membranes • Vibrations of Rectangular Membrane
- Vibrations of Circular Membrane • Tutorial video - III

Week 4: Module 4 (Vibrations of plates)

- Dynamics of Plates • Vibrations of Rectangular Plates • Vibrations of Circular Plates
- Special Problems in Plate Vibrations • Tutorial video - IV