Mechanical and Structural Theory

Course No. 108

FOR WHOM INTENDED This course is intended for individuals whose primary formal training is not in the field of mechanical or structural engineering. Mechanical and structural considerations are fundamental to almost every technical activity, and all technical personnel have to deal, at least to some extent, with some aspects of mechanical engineering. A basic understanding of mechanical principles is essential to better perform their main function.

OBJECTIVES To help participants to understand basic mechanical and structural concepts and terminology. It is not an in-depth mechanical engineering course but rather a course aimed at individuals who require an intensive review of basic principals, without the assumption of any prior knowledge of the topic. The course is fast paced and as non-mathematical as possible.

BRIEF DESCRIPTION OF COURSE The course covers basic concepts of mechanical theory, starting with basic mathematics and conversion factors. To fully comprehend sinusoidal and non-sinusoidal waveforms, a basic understanding of complex algebra is required. The instructor reviews this topic as it applies to mechanical technology.

The instructor next introduces the basics of mechanical and structural theory, such as measurement of mass, displacement, acceleration and velocity, before moving into somewhat greater depth on dynamics theory. Single and multiple degree-of-freedom systems are considered, in regard to spring stiffness, dynamic properties of different materials, natural frequency and damping.

The Rayleigh and Dunkerley methods of calculating the first natural frequency of systems are briefly considered, with examples. Forced vibration and loading effects are also included in the dynamics theory section.

Moving on to structural design fundamentals, the instructor addresses the concepts of stress and strain; moment of inertia and the torsional shape factor. Useful formulas are provided for calculating stiffness and stress, also tables for determining moments of inertia and torsional shape factors. The instructor discusses the dynamic characteristics of structural elements such as compression members, flanges and beams. Finally, the course provides useful tables and formulas for the calculation of beam stiffness and resonant frequency, as well as resonances of plates and columns.

CERTIFICATE PROGRAMS: This course is required for TTi's Electronic Design Specialist (EDS) certificate program. It may be used as an elective for any other TTi Specialist Certificate Program.

PREREQUISITES: There are no definite prerequisites. However, this course is aimed toward individuals involved in various technical fields. An understanding of basic algebra will be useful.

TEXT Each participant will receive a course workbook, which will contain most of the viewgraphs used in the presentation.

COURSE HOURS, CERTIFICATE AND CEUs Open courses meet seven hours per day. Upcoming presentation dates can be found on our current open course schedule. Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

For schedules, general information and registration forms, see TTi's web site.

Course Outline

Introduction
Basic Mathematics
Formulas/Conversion Factors
Introduction to Mechanical Systems
Introduction to Structural Theory
Problem Solving
Introduction to Fourier Analysis

Dynamics Theory
- Principles of Analysis
- Some Fundamentals of Dynamics
- Single-Degree-of-Freedom System
- Mass Measurement
- Spring Stiffness
- Material Parameters
- Calculation of Natural Frequency (f_n)
- Damping
- Natural Frequencies and Modes
- Rayleigh Method
- Dunkerley Method
- Forced Vibration
- Resonances and Natural Frequency
- Response Factors (Magnification Factor)
- Transmissibility

Structural Design Fundamentals
- Stress and Strain
- Moment of Inertia
- Torsional Shape Factor
- Stiffness and Stress Formulas
- Moment of Inertia and Torsional Shape Factor Tables
- Moment of Inertia Transfer Formulas
- Examples
- Instability

Structural Elements
- Stiffness of Beams
- Beam Natural Frequency
- Plate Natural Frequency
- Column Natural Frequency

Final Examination
Conclusion
Award of Certificates for successful completion

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