

Mechanical Shock Testing and Data Analysis Course Syllabus

Monday

- 8:00 am Introductions of Instructors and Students
Vibration Movie (30 min)
Review Daily Schedule: 50 min. lectures with 10 min. breaks
- 9:00 am Response to Mechanical Shock (25 min)
Vesta's Lecture 1: Base Excited Spring-Mass-Damper System used for Shock Response Spectrum & Modal Shapes
- 10:00 am Vesta's Lecture 2: Basic Mechanical Shock Instrumentation
- 11:00 am Vesta's Lecture 3: Mechanical Shock Time Domain Specifications and Frequency Domain Specifications

Lunch 12 – 1 pm.

- 1:00 pm Howie's Lecture 1: Shock Analysis using the Pseudo Velocity Shock Spectrum - Part 1 including definitions, four coordinate paper, stress and velocity, simple shocks, include drop, plateau derivation, asymptotes, 2 g line, and severity concepts, spectrum calculating and plotting, Stress-velocity for rods. Severe velocities table.
- 4:30 pm Adjourn

Tuesday

- 8:00 am Vesta's Lecture 4: Navy Shock Machines and Underwater Explosive Testing
- 9:00 am Vesta's Lecture 5: Basic Mechanical Shock Instrumentation - Piezoelectric Accelerometers
- 10:00 am Vesta's Lecture 6: High Frequency Mechanical Shock Instrumentation
- 11:00 am Vesta's Lecture 7: Data acquisition system calibration and use.
Vesta's Lecture 8: Aliasing Effects of Delta-Sigma Analog to Digital Converters

Lunch 12 – 1 pm.

- 1:00 pm Howie's Lecture 2: Stress velocity for beams. Beam and rod mode shapes. Maximum stress is pseudo velocity. Stress velocity in piping vibrations. Velocity strain gage. Analog curve and interpolating, integrating and errors, need for 10 samples per highest frequency, editing with polynomials, mean removal, high pass filtering. Exercises.
- 4:30 pm Adjourn

Wednesday

8:00 am Vesta's Lecture 9: Conventional Mechanical Shock Testing Machines for Components - Drop Tables; Manufacturer's Specifications, and Design of Drop Table Pulse Programming Materials, Fixture Evaluations

10:00 am Vesta's Lecture 10: Drop Table use for Material Evaluations and Vesta's Lecture 11: MEMS evaluations

11:00 am Vesta's Lecture 12: Full Scale Structural Dynamics

Lunch 12 – 1 pm.

1:00 pm Howie's Lecture 3: Set 3 including relative velocity versus pseudo velocity, useless asymptotes. Fourier transform and residual PVSS. Experimental evidence, comparison of six very different shocks, and analysis concepts. Low pass filtering effects on PVSS. True cut off frequencies. Linear phase filters.

4:30 pm Adjourn

Thursday

8:00 am Vesta Lecture 13: Introduction to Pyroshock Testing and Simulation

9:00 am Vesta Lecture 14: Component Pyroshock Simulations including Custom Apparatus Design.

11:00 am Vesta Lecture 15: Advanced Pyroshock Topics including Near-Field Simulation, Simultaneous three-axis Pyroshock Simulations in time-domain and frequency-domain, advanced pyroshock analysis and current topics (aliasing).

Lunch 12 – 1 pm.

1:00 pm Howie's Lecture 4: Filtering effects on explosive PVSS, and on real simple shocks for fairing. Damping effects, damped plateau, positive negative PVSS, plateau depression, shock polarity, and asymptotes in pos-neg PVSS, example polarities.. Slide set 4. Advanced pseudo velocity concepts; shaker shock deficiency, shock table rebound effects, example severities, Shock on Multi degree of freedom systems. Shock excitation of rods and beams showing PVSS shows maximum stress. Shock isolation and calculation. Isolation exercise.

4:30 pm Adjourn

Friday

8:00 am Vesta's Lecture 16: Hopkinson Bar Basics including Theory, Materials and Configurations

10:00 am Vesta's Lecture 17: Certification of Two Hopkinson Bar Techniques and Uncertainty Analysis

11:00 am Vesta's Lecture 17: Certification of Two Hopkinson Bar Techniques and Uncertainty Analysis (continuation)

11:30 pm Vesta's Lecture 18: Hopkinson Bar Data Analysis

Lunch 12 – 1 pm.

1:00 pm Vesta's Lecture 19: Component evaluations including MEMS evaluations with various Hopkinson configurations

2:00 pm Howie's Lecture 5: Simple shocks have similar PVSS on 4CP; droop zone and traditional SRS plots. Shock calculations of simple and multicycle explosive shocks. Shock severity and fragility. ANSI WG-13 model; DAHS CWE Manual. Damage boundary theory, ASTM D 3332. Assessments and multi-degree of freedom systems. Example problems evaluating severe shocks. Exercise conversion of SRS to PVSS.

4:30 pm Summary and Wrap-up