Digital Signal Processing and Data Analysis
Course No. 197-3

FOR WHOM INTENDED (1) Testing laboratory personnel who want to expand their analysis capabilities, perhaps in the interest of improving their test designs; (2) analysis personnel responsible for the interpretation of data acquired in the laboratory; (3) test requestors/designers who want to know what tools are available and what to expect from them.

BRIEF COURSE DESCRIPTION The objective of the course is to provide participants with a working knowledge of the tools available for analysis of data acquired by digital data acquisition systems for a variety of laboratory and field applications. Basic analysis principals and methods are presented and reinforced with practical examples from everyday testing operations. The interaction between test design, data acquisition and analysis is emphasized. The lectures and discussions are designed to promote understanding of the concepts involved through "mechanical feel" rather than mathematics.

Participants are encouraged to offer problems from their own activities for discussion and solution by the class.

The course is presented as a series of highly interactive lecture /discussion sessions. Problems for individual and group solution are interspersed throughout the course to act as training aids and to evaluate class progress. Special-interest discussions are encouraged outside of the regular course sessions.

DIPLOMA PROGRAMS This course is required for TTi's for Data Acquisition and Analysis Specialist (DAS) diploma program. It may be used as an elective for any other TTi Specialist Diploma Program.

RELATED COURSES In Course 197, Digital Signal Processing, Data Acquisition and Analysis, the content of Course 197-3 is combined with Course 196, Digital Data Acquisition.

PREREQUISITES Participants should have attended TTi's course 196, *Digital Data Acquisition*, or some equivalent training program. A good understanding of the engineering problem to be analyzed is expected. An understanding of basic computer and data acquisition principles will be useful.

TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

COURSE HOURS, CERTIFICATE AND CEUS 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.

INTERNET COMPLETE COURSE 197-3 features over ten hours of video as well as more in-depth reading material. All chapters of course 197-3 are also available as OnDemand Internet Short Topics. See the on-line course outline for details.

NOT AFFILIATED WITH ANY VENDOR. TTi sells no hardware or firmware. Before buying Data Acquisition equipment, take this course. Equipment manufacturers' field sales people may lack time to teach fundamentals. TTi training helps you to negotiate for the equipment you really need.

Course Outline

Introductions and Overview
Review of Basic Concepts
    The time and frequency domains
    Time histories and time series analysis
    Sampling theory; acquiring good data
    Linear systems; transform concepts • Spectra
"Static" (Load/Deflection) Test Analysis
    Basic curve fitting
        Least squares techniques, linear regression, polynomial regression • Spline fitting
    Yield point determination
Oscillating-Signal Analysis
    Basic characterization • Decibels
    Data smoothing, averaging, trend removal...
    Random signals • Probability distribution • Correlation
Spectral Domain Operations
    Calculating and displaying the spectrum
        The Fourier Transform
            What it does (and doesn't) do
            Fast Fourier Transform (FFT)
            Basic relationships and rules • Spectral "arithmetic"
        "1/N" Octave analysis
        Spectral graphing formats
    Engineering applications
        Power Spectral Density (PSD)
        Transfer functions • Forced-response analysis
Data Filtering
    Filtering in the spectral domain
    Time-domain filtering
        FIR, IIR filters
    When to use time-domain and spectral-domain filters
Signal Integration and Differentiation
    Practical problems with real data
Transient Data Analysis: Spectral Analysis
    Shock Response Spectra
Continuous-Data Analysis
    Finite measurement-length effects
        Gibb's Phenomenon...Ringing
        Windowing, window types/uses/advantages and disadvantages
Data Averaging
    Time block averaging • Spectral averaging, PSD
    Average transfer-function calculation • Coherence
Special Topics
    Anti-alias filter-correction techniques • The "Ideal" filter
    Data interpolation: Averaging and derivative techniques
        Spectral extension • Data Acquisition System Calibration
Using the tools • Class problems
Final Review
Award of Certificates for successful completion
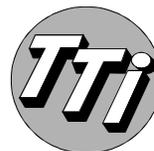
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