COURSE LOCATION:
DELAWARE TECHNICAL & COMMUNITY COLLEGE
400 Stanton-Christiana Road
Newark, Delaware 19713-1260

COURSE DESCRIPTION:
The TA Instruments Thermal Analysis and Rheology training courses (lecture based) are designed to familiarize the user with applications, method development, and operating techniques of the TAI thermal analysis and rheology instrumentation. Each course day is specific to a particular technique so users receive the maximum instructional benefit by attending only those course days applicable to their instrumentation. You should only attend course days for which you already have instruments. The course start time is 8:30 a.m. The length varies depending on the instrument (see attached outlines).

The full training course includes instruction on the following thermal analysis and rheology products: 2000, 2900 and Q Series Thermal Analysis modules (DSC, MDSC, TGA, TMA, DMA); and AR500, AR1000 and AR2000 Rheology instruments.

WHO SHOULD ATTEND?
This course is designed for the scientist, engineer, or technician who desires a more comprehensive understanding of Thermal Analysis and Rheology techniques. The course is lecture based and includes a balance between theory and practical applications. Attendees should have a minimum of two months of hands-on instrument operating experience to obtain the maximum benefit from this course.

Registrants with arrangement questions about this course should contact Lynn Morris, course registrar, at (302) 427-4104.

MEALS AND HOUSING
Following is a list of convenient hotels in the area only a few miles from the course site. You will need to make your own reservations. Rates are subject to change without notice.

<table>
<thead>
<tr>
<th>Hotel</th>
<th>Address</th>
<th>Phone Number</th>
<th>Rate (without meals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairfield Inn</td>
<td>65 Geoffrey Drive</td>
<td>(302) 292-1500</td>
<td>$76.00 + Tax</td>
</tr>
<tr>
<td>Christiana Hilton</td>
<td>100 Continental Drive</td>
<td>(302) 454-1500</td>
<td>$199.00 + Tax</td>
</tr>
<tr>
<td>Homestead Studio Suites</td>
<td>333 Continental Drive</td>
<td>(302) 283-0800</td>
<td>$65.00 + Tax</td>
</tr>
<tr>
<td>Marriott Courtyard</td>
<td>48 Geoffrey Drive</td>
<td>(302) 456-3800</td>
<td>$145.00 + Tax</td>
</tr>
<tr>
<td>Shoney’s Inn</td>
<td>900 Churchmans Road</td>
<td>(302) 368-2400</td>
<td>$60.00 + Tax</td>
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</tbody>
</table>

Breakfast and lunch during the course will be provided. You will be on your own for dinner.

(continued)
TRANSPORTATION
The college and hotels are approximately a 40 minute drive from the Philadelphia International Airport. Car rentals are available at the airport or at the Wilmington Amtrak Train Station.

REGISTRATION
The tuition fee for each module course date is $400.00. Tuition is waived for one individual with the purchase of your module(s) and is valid for one year. The tuition fee for additional attendees is $400.00 per module. Payment should be made by check or credit card (Mastercard, Visa or American Express) at the time of registration.

The training course is offered 4-6 times per year (depending on module). Registration for a particular session closes four weeks prior to the course. Applicants for a filled session will be rescheduled by telephone for the first mutually acceptable date.

Registrations should be sent to:
Lynn Morris
TA Instruments
109 Lukens Drive
New Castle, DE 19720
PHONE: (302) 427-4104
FAX: (302) 427-4001

Checks should be made payable to TA Instruments - Waters LLC and sent to Lynn Morris at the above address. A confirmation of enrollment and a map/directions to the training course facility, as well as the local hotels, will be mailed 30 days prior to the course.

(View Training Course Outlines)
Differential Scanning Calorimetry (DSC) Training Course Outline
(Length: Full Day - approximately 4:30 pm)

I. Theory & Operation
• Calorimeter Theory
• Heat Flux Dsc Design
• Purge Rates

II. Calibration & Sample Preparation
• Baseline Calibration
• Temperature Calibration
• Sample Preparation

III. Glass Transition
• What Is It?
• How Is It Observed and Measured?
• What Affects The Glass Transition?

IV. Melt
• What Is It?
• How Is It Observed and Measured?
• What Affects The Melting?

V. Crystallization
• What Is It?
• How Is It Observed and Measured?
• What Affects The Crystallization?

VI. Heat Capacity/Mdsc
• What Is It?
• How Is It Observed and Measured?
• What Affects The Heat Capacity?

Modulated Differential Scanning Calorimetry (MDSC) Training Course Outline
(Length: Full Day - approximately 4:30 pm)

Special Note to MDSC Users
If you are a new MDSC user, you should plan to attend the DSC course prior to attending the MDSC course. The MDSC course assumes a knowledge of general DSC principles.

I. Theory

II. Calibration and sample preparation

III. Application of MDSC to characterization of heat Capacity including the glass transition

IV. Application of MDSC to characterization of melting and crystallization.

V. Theoretical problems associated with measurements over the melting region

VI. Selecting optimum conditions

VII. Interpreting results

VIII. Typical applications where MDSC provides a benefit over DSC

(continued)
# THERMOMECHANICAL ANALYSIS (TMA)

## Training Course Outline

(Length: 3/4 day - approximately 2:30 pm)

<table>
<thead>
<tr>
<th>Section</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Theory &amp; Operation</strong></td>
<td>Theory, Experimental Parameters, Operating Suggestions</td>
</tr>
<tr>
<td><strong>II. Calibration</strong></td>
<td>Mass, Temperature, Baseline</td>
</tr>
<tr>
<td><strong>III. Maintenance</strong></td>
<td>Changing Hang Down Wire, Thermocouple Replacement, Maintaining Heat Exchanger, Cleaning Furnace Housing</td>
</tr>
<tr>
<td><strong>IV. Software</strong></td>
<td>Software, Instrument Control for Windows NT, Universal Analysis</td>
</tr>
<tr>
<td><strong>V. Applications</strong></td>
<td>Thermal Stability, Compositional Analysis, Oxidative Stability, High Resolution TGA, Simultaneous TGA-DTA (SDT 2960), Evolved Gas Analysis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Introduction</strong></td>
<td>Theory, Hardware</td>
</tr>
<tr>
<td><strong>II. Sample Preparation and Operating Conditions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>III. Calibration</strong></td>
<td>Expansion, Penetration, Flexure, Tension</td>
</tr>
<tr>
<td><strong>IV. Applications</strong></td>
<td></td>
</tr>
</tbody>
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(continued)
# DYNAMIC MECHANICAL ANALYSIS (DMA) Training Course Outline

(Length: Full Day - approximately 4:00 pm)

## I. Theory
- Linear Viscoelasticity
- Transient Testing (Creep and Stress Relaxation)
- Dynamic Mechanical Analysis
- TMA Controlled Force Mode

## II. DMA 2980 - The Instrument
- Instrument Design
- Experimental Considerations
- Sample Considerations and Clamp Selection
- Instrument Parameters

## III. Calibration
- Clamp Calibrations
- Position Calibration
- Instrument Calibration

## IV. Applications of DMA
- Transitions
- Crystallinity
- Crosslinking
- Curing
- Aging
- Effect of Fillers
- Blends/Copolymers

## V. Time-Temperature Superposition
- Theory
- Guidelines for TTS
- Running TTS Experiment

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# RHEOLOGY TRAINING COURSE

(Length: Full Day - approximately 4:00 pm)

This lecture based course is designed to familiarize the novice user of the Rheometer with its potential as a problem solver in product formulation and evaluation. It is also hoped that elements of procedure optimization will be demonstrated for a variety of samples. The three main techniques that will be covered are as follows:

## A. Flow
This section will deal with the measurement of shear viscosity by controlled stress and rate methodologies, and using ramped and equilibrium shear regimes to access complete flow curves. Flow curve modeling via the software will be discussed.

## B. Creep
This section of the course will familiarize the attendees with the measurement of low shear flow measurement as well as the use of viscoelastic modeling and the significance of the Voigt unit.

## C. Oscillation/Dynamic Testing
Here, further aspects of linear viscoelastic behavior will be explored, including the mathematical significance of mechanical moduli in samples, the measurement of thixotropy and thermal changes in materials and the more traditional frequency/time domain probes.

The course will cover theoretical background and the basics of sample evaluation.
THERMAL ANALYSIS / RHEOLOGY TRAINING COURSE
Application for Enrollment

COURSE DATE(S) ________________________

NAME: ____________________________________________

COMPANY: __________________________________________

ADDRESS: __________________________________________

________________________________________________________________________

PHONE: ____________________________________________

Please check below the portion of class you are attending and enclose payment with the application.
Remember to include course date(s) at the top of this form. Course outlines are attached.

☐ DSC Course ☐ TGA/SDT Course ☐ DMA Course

☐ Modulated DSC ☐ TMA Internet Course ☐ Rheology Course

Checks should be made payable to
TA Instruments - Waters LLC and should be
Sent, along with this application form, to:

Lynn Morris
TA Instruments
109 Lukens Drive
New Castle, DE 19720
Fax: (302) 427-4001

Credit Card Payments - Amount $______________: Credit Card ____________________________

Account #: _________________ Expiration Date _________________

Cardholder Name: ____________________________

Note: Please return this form as soon as possible to ensure acceptance and the date of Your choice.
Enrollment is on a first come basis.

• Applicants may cancel up to 10 days prior to the course for a full refund.
• Applicants who have not canceled reservations 10 working days prior to the course are subject to the entire tuition charge or forfeit of tuition waiver.