ChE news

The annual ASEE Meeting will be held at Los Angeles, Calif. on June 17-20, 1968. The ChE Program Chairman for the meeting is Dr. D. K. Anderson, Chemical Engineering Department, Michigan State University, East Lansing, Michigan 48823. The program follows:

Monday, June 17

12:00- 1:30 P.M. Committee	Executive Committee Meeting Dr. L. Bryce Andersen, Presiding

Tuesday, June 18

10:00-11:30 A.M. Lecture	Annual Distinguished Lecturer Dr. George Burnet, Presiding
12:00- 1:30 P.M. Luncheon	Annual Division Business Meeting Dr. L. Bryce Andersen, Presiding
1:45- 5:30 P.M. Conference	Frontier Areas in Chemical Engineering Dr. L. Bryce Andersen, Presiding

Wednesday, June 19

10:00-11:30 A.M. Conference	New Approach to Teaching Chemical Engineering Dr. Donald K. Anderson, Presiding
1:45- 3:30 P.M. Conference	Meeting of Chemical Engineering Department Heads Dr. Wm. H. Honstead, Presiding
6:00- 7:45 P.M. Banquet	Annual Chemical Engineering Division Banquet Dr. L. Bryce Andersen, Presiding Speaker: Silas A. Bradley Dow Corning Center for Aid to Medical Research "Artificial Internal Organs"

The program papers feature two areas of interest to ChE Educators.

I. New Approaches to Teaching Chemical Engineering

The New Stoichiometry, E. J. Henley and E. M. Rosen
A Self-pacing, Auto-graded Course, G. David Schilling
Chemical Engineering Laboratory—An Integrated Ap-Approach, John R. Thygeson
University-Industry Parnerships in Design Education Buford D. Smith
Teaching Optimization Methods, Louis L. Edwards

II. Frontier Areas in Chemical Engineering

An Environmental Focus for Engineering Education Seymour Calvert
Education for a New Environment-Biomedical Engineering, Richard C. Seagrave
Ocean Engineering, Carl H. Gibson
Space Engineering, John L. Mason

ChE problems for teachers

Readers are again urged to send publishable solutions to the problems for teachers in volume 2, no. 1 of CEE either to Dr. Levenspiel or to the Editor.

The following problems were written by Professors R. K. Irey and J. H. Pohl at the University of Florida. Readers may send solutions to the Editor. The solution will be published in a future issue dealing with thermodynamics.

1. For a single component closed system, the Gibbs equation is written as

$$du = Tds - \sum_{j=1}^{N} \vec{F}_j \cdot d\vec{x}_j$$

The F_j's and x_j's are the generalized forces and displacements of the N reversible work modes.

a. Develop a set of N + 1 equations relating the partial derivatives of u to thermodynamic functions.

b. Develop N + 1 Maxwell relations for the system.

The following analogs are defined:

For the Gibbs Function: $\psi = u + \sum_{j=1}^{N} \vec{F}_j \cdot \vec{x}_j - Ts$

For the Helmholtz Function: $\psi_q = u - Ts$

and for enthalpy $\psi_\omega = u + \sum_{j=1}^{N} \vec{F}_j \cdot \vec{x}_j$

c. How many equations similar to those of part a) can we develop from the analogs? (Example: $(\partial\psi/\partial T)_{\vec{F}_j} = -s$)

d. How many independent Maxwell relations are available?

e. Derive the Maxwell relation for $(\partial \vec{F}_j/\partial T)_{\vec{x}_i, \vec{x}_1}$.

2. For a single component closed system, the Gibbs equation is written as

$$du = Tds - \sum_{j=1}^{N} \vec{F}_j \cdot d\vec{x}_j .$$

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We define an analog of enthalpy as

$$\Psi_\omega = u + \sum_{j=1}^{N} \vec{F}_j \cdot \vec{x}_j$$

The F_j's and x_j's are the generalized forces and displacements of the N reversible work modes. Let the generalized specific heat at constant generalized force and the generalized specific heat at constant generalized displacement be defined respectively as

$$C_{\vec{F}_i} = \left(\frac{\partial \Psi_\omega}{\partial T}\right)_{\vec{F}_i} \quad ; \quad C_{\vec{x}_i} = \left(\frac{\partial u}{\partial T}\right)_{\vec{x}_i}$$

a. Show that

$$C_{\vec{F}_i} - C_{\vec{x}_i} = T \sum_{j=1}^{N} \left(\frac{\partial \vec{F}_j}{\partial T}\right)_{\vec{x}_i, \vec{x}_j} \cdot \left(\frac{\partial \vec{x}_j}{\partial T}\right)_{\vec{F}_i, \vec{F}_j}$$

b. If $C_{\bar{x}_i}{}^*$ represents available data on the specific heat at given values of the N general displacements $\bar{x}_j$ show that

$$C_{\vec{x}_i} - C_{\vec{x}_i}^* = T \sum_{j=1}^{N} \int_{\vec{x}_j^*}^{\vec{x}_j} \left(\frac{\partial^2 \vec{F}_j}{\partial T^2}\right)_{\vec{x}_i, \vec{x}_j} \cdot d\vec{x}_j$$

3. For a multicomponent, open system, the Gibbs equation can be written as

$$dU = TdS + \sum_{j=1}^{N} \vec{F}_j d\vec{x}_j + \sum_{k=1}^{\nu} \Psi_k' dn_k + \Psi dm$$

where N is the number of reversible work modes and ν is the number of components of the system,

ψ_k' is the partial molar total Legendre transform of species k,

ψ is the total Legendre transform per unit mass.

a. How many equations relating partial derivatives of U to thermodynamic functions are available?

b. How many Maxwell relations are available?

c. With the following analogs:

For the Gibbs Function: $\Psi = U + \sum_{j=1}^{N} \vec{F}_j \cdot \vec{x}_j - TS$

For the Helmholtz Function: $\Psi_\ell = U - TS$

and enthalpy $\Psi_\omega = U + \sum_{j=1}^{N} \vec{F}_j \cdot \vec{x}_j$

How many equations similar to part (a) and (b) can we develop?

d. Show that

$$\left(\frac{\partial \vec{F}_j}{\partial m}\right)_{S, \vec{x}_i, \vec{x}_j, n_\ell} = -\left(\frac{\partial \Psi}{\partial x_j}\right)_{S, m, n_\ell, \vec{x}_i}$$

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