Appendix B: Derivation of Eq (43)

The first term of the right hand side of Eq (41) is written as

$$-\sum_1^\infty C_n Y_n(1)\frac{Nu_0}{(Nu_0-4\beta_n)}$$
$$=\sum_1^\infty \frac{2}{(n\pi)^2}\frac{Nu_0}{(4n^2\pi^2-Nu_0)}$$
$$=\frac{2}{\pi^2}\sum_1^\infty\left[-\frac{1}{n^2}+\frac{1}{(n^2-Nu_0/4\pi^2)}\right] \qquad \text{(B1)}$$

The right hand side of Eq (B1) becomes

$$\sum_1^\infty (1/n)^2=\pi^2/6$$

$$\sum_1^\infty \frac{1}{n^2-Nu_0/4\pi^2}=\frac{2\pi^2}{Nu_0}-\frac{\pi^2}{\sqrt{Nu_0}}\cot(\sqrt{Nu_0}/2)$$

Then we obtain

$$-\sum_1^\infty C_n Y_n(1)\frac{Nu_0}{4\beta_n-Nu_0}$$
$$=-\frac{1}{3}+\frac{4}{Nu_0}-\frac{2}{\sqrt{Nu_0}}\cot(\sqrt{Nu_0}/2) \qquad \text{(B2)}$$

This corresponds to Eq (42). Substituting Eq (B2) into Eq (41), and considering that $\phi_1(1)=1/3$, we obtain

$$Nu_0=4\Big/\left[\frac{4}{Nu_0}-\frac{2}{\sqrt{Nu_0}}\cot(\sqrt{Nu_0}/2)\right] \qquad \text{(B3)}$$

From Eq (B3), we obtain

$$\cot(\sqrt{Nu_0}/2)=0$$

Therefore

$$Nu_0=(2m+1)^2\pi^2 \quad (m=0,1,2,\ldots) \qquad \text{(B4)}$$

where $4\beta_n-Nu_0$ must be larger than zero. Since the smallest value of $\beta_n=\pi^2$, m must be zero. Thence we obtain

$$Nu_0=\pi^2$$

Book review

Heat Conduction

S. Kakac and Y. Yener

This is a good book on heat conduction and is intended as a textbook for senior/first year graduate students in heat transfer and also as a reference for heat transfer engineers.

The book is similar in some respects to the text by P. J. Schneider. Extended surfaces and steady-state one-dimensional cases are covered, for example, in both books. Also the Heisler charts are given and the book displays other features that are helpful for engineering practitioners, such as thermal properties of some solids.

Good features of the book include an appropriate mathematical level and the good coverage of the major conventional topics. There is also an excellent chapter on further methods of solution besides the usual methods of separation of variables, integral transforms and Laplace transforms. These include Duhamel's method, the integral method, the variational method and methods for solving phase change problems. The writing style is good and the book is easy to read. Unfortunately the type design of the letters is not one of those commonly used in books.

The book shares some weaknesses with others on heat conduction and boundary value problems. One of these is the lack of explicit numerical evaluation of infinite series. Associated with this are occasional inaccurate statements regarding convergence. For example, on p. 202 it is stated that the series converge rapidly and satisfactory accuracy can be obtained with only a few terms; unfortunately one of the given equations cannot always be evaluated without using a great many terms. Another weakness is the omission of the Thomas algorithm for solving a tridiagonal set of algebraic equations in the finite difference chapter. It is only fair to note that no other advanced heat conduction book includes this important algorithm. Instead the authors mention solving the matrix equation

$$AT=C$$

by using the inverse A^{-1}, to obtain for the unknown temperature vector, T,

$$T=A^{-1}C$$

According to numerical analysis authors (see J. R. Rice, *Matrix Computations and Mathematical Software*, McGraw-Hill, 1981, p. 23) this an inefficient approach.

On the whole, the book is certainly a welcome addition to the heat transfer literature and can be very effectively used by both students and practicing engineers.

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This is an American review of a book previously reviewed in March 1986 by a UK reviewer.