Partial Differential Equations:

Theory and Completely Solved Problems

Errata for First Printing

• **Part I**

Chapter 1.

page 26: 3. "(Fig. 1.5)," should be "(Fig. 1.4),"

Chapter 2.

page 45: 1. "and hence" should be "and"

page 59: 3. "$\cosh(2n-1)a$" should be "$\cosh a$"

Chapter 4.

page 125: 2. "We give the proof of part (b) only;" should be "We given the proof of the second statement in part (b) only;"

page 127: 6.

$$\lambda_n \geq \frac{-\int_a^b \phi_n(x)^2 q(x)\,dx}{\int_a^b \phi_n(x)^2 \sigma(x)\,dx} \geq -\frac{Q}{M}$$

should be

$$\lambda_n \geq \frac{-\int_a^b \phi_n(x)^2 q(x)\,dx}{\int_a^b \phi_n(x)^2 \sigma(x)\,dx}$$

page 127: 7, 8. "for all $n \geq 1$, where Q and M are the maximum values of $q(x)$ and $\sigma(x)$ on $[a,b]$. Finally, if $q(x) \leq 0$ for $a \leq x \leq b$, from (4.10) we have $\lambda_n \geq 0$ for $n \geq 1$."

should be

"for all $n \geq 1$. Finally, if $q(x) \leq 0$ for $a \leq x \leq b$, from (4.10) we have $\lambda_n \geq 0$ for $n \geq 1$."

Chapter 5.

page 150: 9. "As Section 5.1," should be "As in Section 5.1,"

page 155: 2. "$\beta_n\big[\cos\mu_n(x-ct)+\cos\mu_n(x+ct)\big]$" should be "$\beta_n\big[\cos\mu_n(x-ct)-\cos\mu_n(x+ct)\big]$"

Chapter 6.

page 179: 4. "(Fig. 7.2)." should be "(Fig. 6.2)."

page 188: 6. "and $t > 0$, We" should be "and $t > 0$. We"

page 190: 9. "If (λ, R) is an eigenpair" should be "If (R, λ) is an eigenpair"

page 191: 4. "and assuming that $s \neq 0$," should be "and assuming that $x \neq 0$,"

page 192: 7. " In general, the solution to the Cauchy-Euler equation (6.10) is

$$u(x) = \begin{cases} c_1 x^{s_1} + c_2 x^{s_2}, & \text{if } s_1 \neq s_2, \\ c_1 x^s + c_2 x^s \log x, & \text{if } s_1 = s_2 = s, \\ x^\alpha [c_1 \cos(\beta \log x) + c_2 \sin(\beta \log x)], & \text{if } s_1, s_2 = \alpha \pm i\beta. \end{cases} \tag{6.12}$$

"

should be
"In general, the solution to the Cauchy-Euler equation (6.10) is

$$u(x) = \begin{cases} c_1 x^{s_1} + c_2 x^{s_2}, & \text{if } s_1 \neq s_2, \\ c_1 x^s + c_2 x^s \log x, & \text{if } s_1 = s_2 = s, \\ x^\alpha [c_1 \cos(\beta \log x) + c_2 \sin(\beta \log x)], & \text{if } s_1, s_2 = \alpha \pm i\beta. \end{cases} \tag{6.12}$$

■"

page 195: 7. "The solution to Airy's equation $u'' + xu = 0$ is

$$u(x) = x^{1/2} \left[c_1 J_{\frac{1}{3}} \left(\frac{2}{3} x^{\frac{3}{2}} \right) + c_2 J_{-\frac{1}{3}} \left(\frac{2}{3} x^{\frac{3}{2}} \right) \right].$$

"

should be "The solution to Airy's equation $u'' + xu = 0$ is

$$u(x) = x^{1/2} \left[c_1 J_{\frac{1}{3}} \left(\frac{2}{3} x^{\frac{3}{2}} \right) + c_2 J_{-\frac{1}{3}} \left(\frac{2}{3} x^{\frac{3}{2}} \right) \right].$$

■"

page 199: 5. "(see Appendix **??**)," should be "(see Appendix **A**),"

page 210: 10. "$\cdots + a_2 J_m(z_{m2}x) + \cdots a_n J_m(z_{mn}x) + \cdots$,"
should be "$\cdots + a_2 J_m(z_{m2}x) + \cdots + a_n J_m(z_{mn}x) + \cdots$,"

page 216: 11. "

$$a_n = \frac{\displaystyle\int_0^a f(x) J_m \left(\frac{z_{mn}}{a} r \right) r \, dr}{\displaystyle\int_0^a J_m \left(\frac{z_{mn}}{a} r \right)^2 r \, dr}$$

for $n \geq 1$."
should be "

$$a_n = \frac{\displaystyle\int_0^a f(r) J_m \left(\frac{z_{mn}}{a} r \right) r \, dr}{\displaystyle\int_0^a J_m \left(\frac{z_{mn}}{a} r \right)^2 r \, dr}$$

for $n \geq 1$."

page 217: 5. "Setting $t = 0$, we have

$$f(r,\theta) = u(r,\theta,0) = \sum_{m=0}^{\infty} \sum_{n=1}^{\infty} J_m\big(\sqrt{\lambda_{mn}}\, r\big)\big(a_{mn} \cos m\theta + c_{nm} \sin m\theta\big),''$$

should be
"Setting $t = 0$, we have

$$f(r,\theta) = u(r,\theta,0) = \sum_{m=0}^{\infty} \sum_{n=1}^{\infty} J_m\big(\sqrt{\lambda_{mn}}\, r\big)\big(a_{mn} \cos m\theta + c_{mn} \sin m\theta\big),''$$

page 218: 1. "this allows us, to find" should be "this allows us to find"

Chapter 8.

page 271: 2.

$$\int_0^\infty B(\omega) \sin \omega x \, d\omega = \frac{2}{\pi} \int_0^\infty \frac{1 - \cos \omega}{\omega} \, d\omega;$$

should be

$$\int_0^\infty B(\omega) \sin \omega x \, d\omega = \frac{2}{\pi} \int_0^\infty \frac{1 - \cos \omega}{\omega} \sin \omega x \, d\omega;$$

page 297: 3. "are appled to" should be "are applied to"

Chapter 9.

page 309: 4. "hence is the error function" should be "hence the error function"

page 319: 2.

$$\frac{\widehat{f}(\omega)}{2} = \mathcal{F}\left[f_{\text{even}}(x)\right].$$

should be

$$\frac{\widehat{f}(\omega)}{2} = \mathcal{F}\left[f_{\text{even}}(x)\right](\omega).$$

page 328: 4. "$-\infty < x < \infty$," should be "$-\infty < x < \infty,\ t > 0$,"

page 329: 4. "$-\infty < x < \infty$," should be "$-\infty < x < \infty,\ t > 0$,"

• **Part II**

Chapter 11.

page 359: $\overline{2}$.

$$\begin{aligned}
\text{“}\ldots \quad &= \int_0^a \frac{1}{2}\left[\cos\frac{(n-m)\pi x}{a} - \cos\frac{(n+m)\pi x}{a}\right] dx \\
&= \frac{a}{2(n-m)} \sin\frac{(n-m)\pi x}{a}\Bigg|_0^a \\
&\qquad\qquad - \frac{a}{2(n+m)} \sin\frac{(n+m)\pi x}{a}\Bigg|_0^a \\
&= \frac{a}{2(n-m)} \left[\sin(n-m)\pi - \sin 0\right] \\
&\qquad\qquad - \frac{a}{2(n+m)} \left[\sin(n+m)\pi - \sin 0\right] \\
&= 0, \quad \ldots\text{”}
\end{aligned}$$

should be

$$\begin{aligned}
\text{“}\ldots \quad &= \int_0^a \frac{1}{2}\left[\cos\frac{(n-m)\pi x}{a} - \cos\frac{(n+m)\pi x}{a}\right] dx \\
&= \frac{a}{2(n-m)\pi} \sin\frac{(n-m)\pi x}{a}\Bigg|_0^a \\
&\qquad\qquad - \frac{a}{2(n+m)\pi} \sin\frac{(n+m)\pi x}{a}\Bigg|_0^a \\
&= \frac{a}{2(n-m)\pi} \left[\sin(n-m)\pi - \sin 0\right] \\
&\qquad\qquad - \frac{a}{2(n+m)\pi} \left[\sin(n+m)\pi - \sin 0\right] \\
&= 0, \quad \ldots\text{”}
\end{aligned}$$

page 360: 4. “at all points $x = 2n\pi$,” should be “at all points $x = n\pi$,”

page 360: 3. “all points $(2n+1)/2$,” should be “all points $(2n+1)\pi/2$,”

page 363: 8. “since f is piecewise” should be “since $\overline{f}$ is piecewise”

page 363: 7. “converges to $f(x)$ for each $x \in \mathbb{R}$.” should be
“converges to $\overline{f}(x)$ for each $x \in \mathbb{R}$, where $\overline{f}$ is the $2a$-periodic extension of f.”

page 364: 12. “for all $x \neq \pm na$ and to 0 for $x = \pm na$.” should be
“for $-a < x < a$ and to 0 for $x = \pm a$.”

Chapter 12.

page 399: 3. “$\dfrac{d}{dx}\left(x\,\dfrac{dY}{dx}\right) + \dfrac{\mu}{x}\,Y, = 0 \quad \text{for} \quad 1 < x < e$” should be
“$\dfrac{d}{dx}\left(x\,\dfrac{dY}{dx}\right) + \dfrac{\mu}{x}\,Y = 0 \quad \text{for} \quad 1 < x < e$”

page 400: 5. “$\phi(0) = A \cdot 0 + B = A \cdot 2\pi + B$,” should be
“$\phi(0) = A \cdot 0 + B = A \cdot 2\pi + B = \phi(2\pi)$,”

page 404: 8. “$c_1 = d_1 = 1$ and $c_2 = d_2 = 0$.” should be
“$\alpha_1 = \alpha_2 = 1$ and $\beta_1 = \beta_2 = 0$.”

page 410: 12. "$p'(x) = \alpha(x)\, H$," should be "$p'(x) = \alpha(x)\, H(x)$,"

page 410: Bottom line missing, should be "Note that $p(x) > 0$ and $\sigma(x) > 0$ provided that $\beta(x) > 0$. "

page 417: 7. "$0 = \displaystyle\int_0^1 \phi_n L(\phi_m) - \phi_m L(\phi_n)\, dx$" should be

"$0 = \displaystyle\int_0^1 \left[\phi_n L(\phi_m) - \phi_m L(\phi_n)\right]\, dx$"

page 417: 4. "zeros of $J_0(z)$, then" should be "zeros of $J_0'(z)$, then"

page 418: 4. "zeros of $J_0(z)$, then" should be "zeros of $J_0'(z)$, then"

page 423: 1. Move

$$a_n = \frac{\displaystyle\int_0^1 f(x)\phi_n(x)\, dx}{\displaystyle\int_0^1 \phi_n(x)^2\, dx}$$

to the top of the next page.

Chapter 13.

page 433: 11. "for n, $m \geq 0$." should be "for n, $m \geq 1$."

page 451: 15. "$v(a) = T, \quad t > 0$," should be "$v(a) = T$,"

Chapter 14.

page 497: 3.

$$= \rho \int_0^L \frac{\partial}{\partial t}\left[c^2 \left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial t}\right)^2\right] dx$$

should be

$$= \frac{\rho}{2} \int_0^L \frac{\partial}{\partial t}\left[c^2 \left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial u}{\partial t}\right)^2\right] dx$$

page 510: 5.

$$1 - r^2 = f(r) = \sum_{n=1}^{\infty} \frac{8}{z_m^3 J_1(z_m)} J_0(z_n r), \quad 0 < r < 1$$

should be

$$1 - r^2 = f(r) = \sum_{n=1}^{\infty} \frac{8}{z_n^3 J_1(z_n)} J_0(z_n r), \quad 0 < r < 1$$

page 511: 8.

$$\frac{\partial^2 u}{\partial t^2} = \left(\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r}\right), \quad 0 < r < 1, \quad t > 0,$$

should be

$$\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r}, \quad 0 < r < 1, \quad t > 0,$$

page 517: 10. "$J_{3m}'(\sqrt{\lambda} i\, a) = 0$;" should be "$J_{3m}'(\sqrt{\lambda}\, a) = 0$;"

Chapter 15.

page 564: 7. "and $\dfrac{\partial u}{\partial y}(x, y) \leq M$," should be "and $\left|\dfrac{\partial u}{\partial y}(x, y)\right| \leq M$,"

Chapter 17.

page 613: 2. The equation

$$\frac{\Lambda(t)}{1 - s(t)} = \frac{1}{1 - s(0)} - b \int_0^t \Lambda(\tau)\, d\tau,$$

should have the label (17.11), and all subsequent labels and references should be increased by 1.

Chapter 19.

page 634: $\underline{13}$. "$-\infty < x < \infty$," should be "$-\infty < x < \infty, \quad t > 0$,"

page 638: $\overline{2}$. "value-nitial" should be "value-initial"

page 638: $\overline{8}$. "initial boundary value problem" should be "boundary value-initial value problem"

page 659: $\underline{4}$. "value-i-initial" should be "value-initial"