ERRATA AS OF NOVEMBER 2024 FOR CHOKSI: PARTIAL DIFFERENTIAL EQUATIONS: A FIRST COURSE

All subsequent errata postings will consist of these and any new errors/typos found since September 2024.

(1) This is not really an error but rather a helpful comment to be placed after Definition 1.4.2 on Page 5: For the definition of a linear PDE: add after the definition *Note that a PDE can still be linear even if* $\mathcal{L}(u)$ *involves coefficients of* u *or its partial derivatives which depend on the independent variables* $\mathbf{x}$*, irrespective of whether or not that dependence is linear.*
Also, c in the definition is any real number.

(2) Exercise 1.3 on Page 14 should read: Let $u(x,t) = (f')^{-1}(x/t)$ where f is a C^1 function such that f' is invertible. Show that u solves $u_t + f(u)_x = 0$ on $\Omega = \{(x,t)|t > 0\}$.

(3) For Exercise 1.5 on Page 14. The Euler-Tricomi equation should read $u_{xx} - xu_{yy} = 0$ (i.e. note the minus sign).

(4) Exercise 1.10 on Page 15 : should read "for any positive integer".

(5) On Pages 34 and 35, it's best to delete all references to *conservation of mass* since at this stage we have not given any precise meaning to u. We discuss mass in the next section, and link it to (2.10) there.

(6) Page 36 second paragraph: ρ has dimension of mass per volume (length^3) **not** mass per time.

(7) Page 46, second to last displayed equation the y should be in the denominator, i.e.,
$$x_0 = y^2 + \frac{x - y^2}{y(\log y + 1)}.$$

(8) Page 55, last displayed equations: the solutions for $(x(s), y(s))$ should be $x(s) = p_1^0 s + x_0$ and $y(s) = p_2^0 s + y_0$.

(9) Page 78, Exercise 2.22b): second term in the PDE should be yu_y not yu_x.

(10) Page 85, outlined box of Fig 3.1 (right) with the triangle: hypotenuse should read $\sqrt{1+u_x^2}$.

(11) Page 86, just below equation (3.1): **Delete** "together with assumption (1)". Assumption (1) is not needed. The point I was trying (badly) to make was

that, *hence both the density and the tension will be constant*.

(12) On Pages 100, 303 and 600: Remove the t from all references of **Leibniz**!!!

(13) Page 111 (last paragraph): the normal modes only depend on the material size so the sentence should read: *They are preferred shapes associated with the material size (the length l).* Note that the natural frequencies depend on the size and the material parameters T and ρ.
Also, for the bottom of the page, to be consistent with the displayed equation, one should say *As we shall see in Chapter 12, there is a sequence of normal modes and natural frequencies:*

(14) On Page 120 top: Delete *where μ and ϵ are constants* – these constants are in c.

(15) On Page 121 problem 3.11b: you may assume, for example by taking initial conditions with compact support, that for any time t, $u(\cdot, t)$ has compact support. Note that we have not proved this fact.

(16) Page 132, Footnote 7 should read:
"Namely, the inequality $\mathbf{a} \cdot \mathbf{b} \leqslant |\mathbf{a}||\mathbf{b}|$ for any $\mathbf{a}, \mathbf{b} \in \mathbb{R}^3$."

(17) On Page 191: all occurrences of "principle value" should be "principal value"!!!!

(18) Page 202 Exercise 5.25: One should write this expression **exactly** as Dirac did: So it should read

$$\text{“} \int \delta(a-x)\, dx\, \delta(x-b) \;=\; \delta(a-b)\text{”}.$$

(19) Top of page 216: "Following the remark closing the last subsection" should be "Following footnote 5 on page 213".

(20) (**IMPORTANT CORRECTION**) On page 232, second displayed equation, there should be **no complex conjugate** for $f(x)$. That is, we interpret any complex-valued locally integrable function $f(x)$ as a **tempered distribution** by

$$\langle F_f, \phi \rangle = \int_{-\infty}^{\infty} f(x)\, \phi(x)\, dx, \qquad \text{for all } \phi \in \mathcal{S}(\mathbb{R}).$$

This **corrected** definition is, in fact, consistent with how we have interpreted complex-valued functions in the sense of tempered distributions in the subsequent material. It is also consistent with the motivation at the top of page 230 for definition of the Fourier transform of a distribution.

Note that this distributional pairing differs from the L^2 inner product of two complex-valued functions f and ϕ (as defined on page 455) wherein the complex conjugate does appear.

(21) Second line of Page 257: "degenerated" should be "degenerates" in "(the definition degenerated in dimension $N = 1$)".

(22) Tables on Page 260: for the Fourier transforms of $f(ax)$ and $f(c\mathbf{x})$, include $a > 0$ and $c > 0$.

(23) On page 262 in the table, the distributional Fourier transform of δ_a should be e^{-iak}; i.e., there is a missing minus sign.

(24) Top of page 267 in Exercise 6.24: there should be absolute values around the determinant.

(25) Page 267 in Exercise 6.26: It should be

$$\widehat{x^n} = 2\pi i^n \delta_0^{(n)}.$$

(26) Page 300: add the following parenthesis to "Here the boundary conditions at $x = 0, l$ are irrelevant" **(assuming they are sufficiently nice that a smooth solution exists)**.

(27) On page 315, second line of Exercise 7.14: "Let $\triangle > 0$ be some" should be "Let $\delta > 0$ be some".

(28) On the bottom of page 336 and top of 337: For notational consistency, use j as the index instead of i in all the sums from 1 to N.

(29) On page 337, below forth displayed equation, should read: "for any positive constant C."

(30) On page 337, in the definition box of the fundamental solution: ω_N is the volume of the unit **ball** in $\mathbb{R}^N$ (**not** the unit sphere).

(31) On top of Page 354 in Exercise 8.26: the trivial inequality should be $ab \leqslant a^2/2 + b^2/2$.

(32) On Page 386 in the third box, the $\mathbf{x}$ should be a $\mathbf{k}$ in the Fourier transform of $\delta_{\mathbf{a}}$.

(33) On Page 403 in Theorem 10.3, add to the hypotheses the fact that: Ω is a **bounded** domain.

(34) (**IMPORTANT CORRECTION**) On the bottom of page 423 and top of 424: In the Representation Formula which is equation (10.43), the two terms in the surface integral should be reversed – as they are in equation (10.10) on page 403. On the next displayed formula there should be a minus sign in front of the surface integral. In Theorem 10.10 at the top of page 424, there should also be a minus sign in front of the surface integral.

(35) On page 434, 6th line of the second paragraph: “about the plane” should read “above the plane”.

(36) On page 464 (and also 468), I should include the term *basis* in quotation marks with the following footnote warning: This use of basis should not be confused with the term in a general vector space (including infinite-dimensional). This well-accepted notion of basis is purely algebraic and requires any element to be a **finite** linear combination of basic elements. A general abstract result is that every vector space has a basic, but for infinite-dimensional spaces, like our spaces of function on (a, b), it is impossible to know exactly what this basis is. Here we are really talking about an orthogonal set of functions which are complete in the sense that almost every function can be written as an infinite linear combination of set elements.

(37) On page 507: In Caption of Figure 12.1 the second equation should read $y = -\tan\alpha$. Two lines below this caption, “looking for points u” should be “looking for points α”.
Also the notational choice of $\alpha = \sqrt{\lambda}$ was a poor choice given that α was already used as the diffusion coefficient in the PDE (12.16). Instead, $\beta = \sqrt{\lambda}$ would have been a better choice of notation.