1 Errata in Chapter 1

1. Chapter 1, p. 13, 6th line.
   Add a + before $\cos^2\theta$.

2. Chapter 1, p. 14, 1st line.
   Replace *unit* by *basis*.

3. Chapter 1, p. 28. Eq. (1.82). Remove $\mathbf{e}_i\mathbf{e}_j$.

$$\boldsymbol{\sigma} : \boldsymbol{\tau} \; = \; \sum_{i=1}^{3} \sum_{j=1}^{3} \sigma_{ij}\tau_{ji} \, .$$

4. Chapter 1, p. 47, line 5
   Change *linearly with time from that at* to **linearly with time from its initial position**.

5. Chapter 1, p. 47, line 5 from bottom
   Change *exponentially with time from that at* to **exponentially with time from its initial position**.

6. Chapter 1, p. 58, 3 lines above Eq. (1.182). Change to
   .... riding a boat which moves with relative velocity

$$\mathbf{u}^{Rel} \; = \; \mathbf{u}^{Boat} + \mathbf{u}^{Water} \, , \tag{1.182}$$

   where $\mathbf{u}^{Boat}$ and $\mathbf{u}^{Water}$ are the velocities of the boat and the water, respectively. The concentration .....

7. Chapter 1, p. 66. Equation before Eq. (1.205). Typing error: Replace

$$\int_{(t)} \quad \text{by} \quad \int_{S(t)}$$

8. Chapter 1, p. 67. Equation (1.207). Remove $V(t)$ from RHS:

$$\frac{1}{V(t)} \frac{dV(t)}{dt} \; = \; \nabla \cdot \mathbf{u}|_{\mathbf{r}^*} \; ,$$

9. Chapter 1. Pb. 1.19.
   This problem is trivial. Of course, one has to employ the formula for the total derivative, but the time derivative of T is zero. Better remove.

10. Chapter 1. Pb. 1.21.
    It is much easier to examine whether vorticity exists by finding directly the vorticity:

$$\boldsymbol{\omega} \; = \; \nabla \times \mathbf{u} \, .$$

   (There is no need to use Stokes theorem and employ a closed curve).

2 Errata in Chapter 2

1. Chapter 2. p. 89, Eq. (2.42).
   A d/dt is missing in front of the first integral. Change as follows:

$$\frac{d}{dt}\int_V \rho\mathbf{u}\,dV \;=\; -\int_S \mathbf{n}\cdot(\rho\mathbf{u}\mathbf{u})\,dS \;+\; \int_S \mathbf{n}\cdot(-p\mathbf{I} \;+\; \boldsymbol{\tau})\,dS \;+\; \int_V \rho\mathbf{g}\,dV\,.$$

3 Errata in Chapter 3

1. Chapter 3. p. 126. Sentence above Example 3.3.1.
   Change as follows:
   These four equations are commonly known......

2. Chapter 3. p. 128. Table 3.3, 1st equation.
   Change as follows:

$$\frac{1}{r}\frac{\partial}{\partial r}(ru_r) \;+\; \frac{1}{r}\cdots$$

4 Errata in Chapter 5

1. Chapter 5. p. 180. Typing error. Replace 1/2 by 3/2. Thus, the formula for the mean curvature should be

$$2H \;=\; \frac{\frac{d^2h}{dx^2}}{\left[1+\left(\frac{dh}{dx}\right)^2\right]^{3/2}}\,.$$

2. Chapter 5. p. 185.
   Fig. 5.4 is too dark.

5 Errata in Chapter 6

1. Chapter 6. p. 198.
   Correct the result for the average velocity:
   The average velocity, $\bar{u}_x$, in the channel is:

$$\bar{u}_x \;=\; \frac{Q}{2WH} \;=\; -\frac{1}{3\eta}\,\frac{\partial p}{\partial x}\,H^2\,.$$

   (The total channel width is $2H$ and not H.)

2. Chapter 7. p. 203.
   A minus sign is needed in front of the gravity term in Eq. (6.28) as follows:

$$p = \frac{\partial p}{\partial x} - \rho g \cos\theta \, y + c$$

3. Chapter 6. p. 210. Fig. 6.10
   The shear stress sketch in Fig. 6.10 is wrong. It should be negative and not positive.

4. Chapter 6. p. 212. Before Eq. (6.49). Typing error.
   The correct limits of integration are:

$$\int_{\kappa R}^{R} .$$

5. Chapter 6. p. 218. Last equation. A ρ is missing. Replace by:

$$p = \rho \int \frac{u_\theta^2}{r} \, dr - \rho g \, z \qquad \Longrightarrow$$

6. Chapter 6. Example 6.3.1, pp. 219-223. The example is correct since gravity is neglected. However, it will be more paedagogical if gravity is included. (Students will more easily follow Example 6.3.2.)

   - Problem statement. Remove:
     in the absence of gravity.
   - Figure 6.15. Add $-\rho g z$ in all expressions for p.
   - Add $-\rho g z$ in Eq. (6.67).
   - Add $-\rho g z$ in Eq. (6.70).
   - Before Eq. (6.71) modify to:
     by setting $p{=}p_0$ at $r{=}R_1$ and $z{=}z_0$.
   - Add $-\rho g(z - z_0)$ in Eq. (6.71).
   - Add $-\rho g z$ in Eq. (6.76).
   - Add $-\rho g z$ to the expression of p below.
   - Add $-\rho g z$ in Eq. (6.79).

7. Chapter 6. p. 241. 1st equation. Typing error (y instead of Y).
   It should be

$$\frac{d^2 Y}{dy^2} \quad \text{and} \quad \text{not} \quad \frac{d^2 Y}{dY^2} .$$

8. Chapter 6. p. 253. Last line of Example 6.6.1.
   Replace "of the u_θ" by "of u_θ".

6 Errata in Chapter 7

1. Chapter 7. p. 286. Eq. (7.38).
   It should be
   $$u_0(x) = e^{2(1-x)} \quad \text{and} \quad \text{not} \quad u_0(x) = e^{2(1-t)}$$

2. Chapter 7, p. 292

   - In Fig. 7.9, show the length L of the converging channel.
   - Just before Eq. (7.59) add:
     (see Section 9.1.2)
   - Eqs. (7.59) and (7.60) should be corrected as follows:
     $$\alpha^2 Re \, \frac{Du_x}{Dt} = -\frac{\partial p}{\partial x} + \alpha^2 \frac{\partial^2 u_x}{\partial x^2} + \frac{\partial^2 u_x}{\partial y^2}$$
     and
     $$\alpha^4 Re \, \frac{Du_y}{Dt} = -\frac{\partial p}{\partial y} + \alpha^4 \frac{\partial^2 u_y}{\partial x^2} + \alpha^2 \frac{\partial^2 u_y}{\partial y^2} \, ,$$
     Note that in the last derivative we should have u_y and not u_x.
   - Just after Eq. (7.60) add:
     where $Re \equiv \rho V L/\eta$.
   - Modify sentence after Eq. (7.60) as follows:
     Lubrication flow corresponds to $\alpha^2 Re \ll 1$ and $\alpha \ll 1$;

7 Errata in Chapter 9

1. Chapter 9.
   The material is similar to that of Chapter 8 of Tasos's book. Compare and check equations.

2. Chapter 9, p. 329, Eq. (9.3).
   Second partial derivative is denoted incorrectly. Correct to:
   $$\frac{\partial p}{\partial x} = \frac{\partial^2 u_x}{\partial z^2} \, .$$

3. Chapter 9. p. 331

   - Second derivatives in Eqs. (9.7) and (9.8) are typed incorrectly. Replace brackets by parentheses and change to:
     $$\rho \left(\frac{\partial u_x}{\partial t} + u_x \frac{\partial u_x}{\partial x} + u_z \frac{\partial u_x}{\partial z} \right) = -\frac{\partial p}{\partial x} + \eta \left(\frac{\partial^2 u_x}{\partial x^2} + \frac{\partial^2 u_x}{\partial z^2} \right) \, ,$$
     $$\rho \left(\frac{\partial u_z}{\partial t} + u_x \frac{\partial u_z}{\partial x} + u_z \frac{\partial u_z}{\partial z} \right) = -\frac{\partial p}{\partial z} + \eta \left(\frac{\partial^2 u_z}{\partial x^2} + \frac{\partial^2 u_z}{\partial z^2} \right) \, .$$

- Correct Eqs. (9.9) and (9.10) as follows:

$$
\begin{aligned}
\alpha^2 \, Re \left(\frac{\partial u_x}{\partial t} + u_x \frac{\partial u_x}{\partial x} + u_z \frac{\partial u_x}{\partial z} \right) &= -\frac{\partial p}{\partial x} + \alpha^2 \frac{\partial^2 u_x}{\partial x^2} + \frac{\partial^2 u_x}{\partial z^2} \ , \\
\alpha^4 \, Re \left(\frac{\partial u_z}{\partial t} + u_x \frac{\partial u_z}{\partial x} + u_z \frac{\partial u_z}{\partial z} \right) &= -\frac{\partial p}{\partial z} + \alpha^4 \frac{\partial^2 u_z}{\partial x^2} + \alpha^2 \frac{\partial^2 u_z}{\partial z^2} \ .
\end{aligned}
$$

- Just after Eq. (9.10) add:
  where $Re \equiv \rho V L/\eta$.
- Eq. (9.11). Second partial derivative is denoted incorrectly. Correct to:

$$
-\frac{\partial p}{\partial x} + \frac{\partial^2 u_x}{\partial z^2} = 0 \ ,
$$

- Just before Eq. (9.11):
  Replace $a \approx 0$ by $\alpha \approx 0$.
  Replace $aRe \approx 0$ by $\alpha^2 Re$.
- p. 332, 1st sentence. Replace by:
  Equation (9.11) is the dimensionless form of Eqs. (9.3) and (9.4), derived intuitively in the previous section for channel flow.
- Refer to Ockendon's Book, pp. 64-65.

4. Chapter 9. p. 335, last equation
   It should be

$$
\tau_{zy}(y = H) \ = \ \eta \frac{\partial u_z}{\partial y} \ = \ 0 \ .
$$

   instead of

$$
\tau_{zy}(y = H) \ = \ \eta \frac{\partial^2 u_z}{\partial y^2} \ = \ 0 \ .
$$

5. Chapter 9. p. 336, Figure 9.4.
   Replace w by W.

6. Chapter 9. p. 337, last equation
   It should be

$$
H(z = L) \ = \ H_f \ , \quad \text{and} \quad \frac{dH}{dz}(z = L) \ = \ 0 \ .
$$

7. Chapter 9. p. 338, last line - 1st line of p. 339
   Replace by : For the special case of negligible gravity (St=0, say in horizontal coating), the transformation....

   Also note that the assumption $H_f/W \ll 1$ is not necessary.

   Conclusion: **rework the whole example and reproduce Fig. 9.5 using the perturbation techniques of Chapter 6**. This will make chapter 6 more meaningful. **FUTURE PROJECT**.

8. Chapter 9. p. 343, Figure 9.9.
   Denote the ring height by l and not by ρ.

9. Chapter 9. p. 357.
   Fig. 9.16 is too dark.

10. Chapter 9. p. 365.
    Pb. 9.13 is wrong! Correct and expand according to the solution of Dr. Brod.
    FUTURE PROJECT.

8 Errata in Chapter 10

1. Chapter 10. p. 376. Table 10.1, Axisymmeric Flow in Spherical Coordinates
   It should be:

$$u_r \equiv -\frac{1}{r^2 \sin\theta} \frac{\partial \psi}{\partial \theta}$$

2. Chapter 10. p. 384. Eq. (10.34). It should be $-$ and not $+$:

$$\psi_\lambda = a_\lambda \, r^{\lambda+1} \left[(\lambda - 1) \sin(\lambda + 1)\theta - (\lambda + 1) \sin(\lambda - 1)\theta \right] , \quad \lambda = 2, 3, \cdots$$

3. Chapter 10. p. 399. Pb. 10.5 (b)
   It should be: found in Problem 10.3.