These have not been checked carefully.

1. (a) $Y(s) = (1 + F(s))/(s^2 - 6s + 9)$; (b) $y(t) = te^{3t} + H(t-1)(t-1)e^{3(t-1)}$.

2. (a) Yes; $y(x) = 2 - x$; (b) $\tan 2\sqrt{\lambda} = 2\sqrt{\lambda}$, $\phi_n(x) = \sin\big(\sqrt{\lambda_n}(x-2)\big)$;
(d)$f(x) = c_0(2-x) + \sum_{n=1}^{\infty} c_n \sin\big(\sqrt{\lambda_n}(x-2)\big)$, $c_0 = 3\int_0^2 f(x)(2-x)\,dx\,/\,8$,
$c_n = \int_0^2 f(x)\sin\big(\sqrt{\lambda_n}(x-2)\big)\,dx / \int_0^2 \sin^2\big(\sqrt{\lambda_n}(x-2)\big)\,dx$.

3. (b) $u(x,t) = v(x) + \sum_{n \text{ odd}} \cos(n\pi x/2)e^{-n^2 t}$, with $a_n = -(2/\pi)\int_0^{\pi} v(x)\cos(n\pi x/2)\,dx$ and $v(x) = x^2/8 + x + 1 - \pi - \pi^2/8$.

4. (a) $\hat{u}(\omega,t) = C(\omega)e^{-4i\omega t}$; (b) $\hat{u}(\omega,t) = \hat{f}(\omega)e^{-4i\omega t}$; (c) $u(x,t) = f(x-4t)$.

5. From Appendix D: (a) $e^{-ix}e^{-x^2/4}/\sqrt{\pi}$; (b) $2e^{-3i\omega}/(\omega^2+1) + 4/(\omega^2+4)$.

6. (b) $r_1 = 1$, $r_2 = -1/2$, (b) $x + x^3/14 + x^5/616 + \cdots$, (c) $((n+r)^2 - (n+r) - 1)a_n = a_{n-2}$.

7. (a) $X'' + \lambda X = 0$, $T'' + (\lambda - 1)T = 0$.
(b) $u(x,t) = \sum_{n=1}^{\infty} \sin n\pi x(A_n\cos(\omega_n x) + B_n\sin(\omega_n x))$, $\omega_n = \sqrt{n^2\pi^2 - 1}$.
(c) $A_n = 0$, $B_n = (2/\omega_n)\int_0^1 x\sin(n\pi x)\,dx$.

8. (a) At $(0,0)$ unstable focus and at $(\pm 1, 0)$ saddle, in both linearized and true systems.
(b) At $(0,0)$ clockwise spiral out; at $(\pm 1, 0)$ straight lines $y = 2x$ out, $y = -x$ in.

9. (a) $u(x,y) = \displaystyle\sum_{n=1,3,5,\ldots} (-1)^n \frac{4}{n\pi\sinh(4n\pi/3)} \sin\frac{n\pi y}{3}\sinh\frac{n\pi x}{3}$;

(b) Correction: the boundary condition in (b) should have been $u(x,3) = 2\sin 3\pi x$.

$$u(x,y) = \sum_{n=1,3,5,\ldots} (-1)^n \frac{4}{n\pi\sinh(4n\pi/3)} \sin\frac{n\pi y}{3}\sinh\frac{n\pi x}{3} + \frac{2}{\sinh(9\pi y)}\sin 3\pi x\sinh 3\pi y;$$

(c) $u(x,y) = \dfrac{1}{\sinh(21\pi/8)}\cos\dfrac{7\pi x}{8}\sinh\dfrac{7\pi(3-y)}{8}$.