1. (10%)

   (3%) ROC $|z| > 2$: $h[n] = 2 \cdot (-1)^n u[n] + 3 \cdot 2^n u[n]$.

   (3%) ROC $|z| < 1$: $h[n] = -2 \cdot (-1)^n u[-n-1] - 3 \cdot 2^n u[-n-1]$.

   (4%) ROC $1 < |z| < 2$: $h[n] = 2 \cdot (-1)^n u[n] - 3 \cdot 2^n u[-n-1]$.

2. (10%)

   (a) (3%) $y_r(t) = \sin(2\pi F_0 t)$ for $\theta_0 = 0$ and $y_r(t) = \sin(2\pi F_0 t + \pi/2)$ for $\theta_0 = \pi/2$.

   (b) (3%) $y_r(t) = 2\sin(\theta_0) \cdot \cos(2\pi F_0 t)$.

   (c) (4%) $y_r(t) = \sin(2\pi \cdot 10t + \pi)$ for $\theta_0 = 0$ and $y_r(t) = \sin(2\pi \cdot 10t + \pi/2)$ for $\theta_0 = \pi/2$.

3. (12%) Skipped.

4. (13%)

   (a) (3%) $X_3(e^{j\omega}) = 8000 \cdot \frac{1 - 0.1^4 e^{-j4\omega}}{1 - 0.1 e^{-j\omega}} \cdot \frac{1 - 0.5^4 e^{-j4\omega}}{1 - 0.5 e^{-j\omega}}$.

   (b) (5%) $x_4[n] = \{8124, 4812, 2481, 1248\}$.

   (c) (5%) $x_5[n] = \{8000, 4800, 2480, 1248, 124, 12, 1, 0\}$.

5. (13%)

   (a) (3%) Skipped.

   (b) (3%) Skipped.

   (c) (4%) Skipped.

   (d) (3%) Over (a): fewer registers; over (b): shorter critical path.

6. (12%) $A_s = 32$ dB and $\triangle\omega = 0.2\pi$.

   (a) (4%) Hann window.

   (b) (4%) 0.3π.

   (c) (4%) $L = 31$.

7. (10%) Skipped.

8. (20%)

(a) (5%)

$$X1 = \text{myfft}([x1 \; \text{zeros}(1, 379)], 512);$$
$$X2 = \text{myfft}([x2 \; \text{zeros}(1, 355)], 512);$$
$$X3 = X1.*X2;$$
$$X3\text{flip} = [X3(1) \; X3(512 : -1 : 2)];$$
$$x3 = \text{myfft}(X3\text{flip}, 512)/512;$$
$$x3 = x3(1 : 289);$$

(b) (5%)

$$X4 = \text{myfft}(x4, 64);$$
$$X4\_\text{pad} = [X4(1 : 32) \; X4(33/2) \; \text{zeros}(1, 31*64 - 1) \; X4(33/2) \; X4(34 : 64)];$$
$$X4\_\text{padflip} = [X4\_\text{pad}(1) \; X4\_\text{pad}(2048 : -1 : 2)];$$
$$x5 = \text{myfft}(X4\_\text{padflip}, 2048)/64;$$

(c) (10%)

$$X8 = X6 + j*X7;$$
$$X8\text{flip} = [X8(1) \; X8(1024 : -1 : 2)];$$
$$x8 = \text{myfft}(X8\text{flip}, 1024)/1024;$$
$$x6 = \text{real}(x8);$$
$$x7 = \text{imag}(x8);$$