Started on	Sunday, 19 November 2023, 11:46 AM
State	Finished
Completed on	Sunday, 19 November 2023, 12:27 PM
Time taken	40 mins 52 secs
Grade	**9.00** out of 10.00 (**90**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Flag question

Channel equalization refers to

Select one:

- (•) Removing the effect of ISI ✔
- ( ) Making all the channel gains equal
- ( ) Making all the channel gains equal
- ( ) Making the channels of different users equal

Your answer is correct.

The correct answer is: Removing the effect of ISI

Question **2**

Correct

Mark 1.00 out of 1.00

Flag question

Consider an Inter Symbol Interference channel $y(k) = h(0)x(k) + h(1)x(k-1) + v(k)$. Let an $r = 2$ tap channel equalizer be designed for this scenario based on symbols $y(k), y(k+1)$ to detect $x(k)$. Let the equalizer vector be denoted by $\mathbf{c}$ and the effective channel matrix by $\mathbf{H}$. The matrix $\mathbf{H}$ for this scenario is

Select one:

- (•) $\begin{bmatrix} h(0) & h(1) & 0 \\ 0 & h(0) & h(1) \end{bmatrix}$ ✔
- ( ) $\begin{bmatrix} h(0) & h(1) \\ h(1) & h(0) \end{bmatrix}$
- ( ) $\begin{bmatrix} h(1) & h(0) & 0 \\ 0 & h(1) & h(0) \end{bmatrix}$
- ( ) $\begin{bmatrix} h(0) & h(1) \\ h(0) & h(1) \end{bmatrix}$

Your answer is correct.

The correct answer is: $\begin{bmatrix} h(0) & h(1) & 0 \\ 0 & h(0) & h(1) \end{bmatrix}$

Question **3**

Correct

Mark 1.00 out of 1.00

Flag question

Consider an Inter Symbol Interference channel $y(k) = h(0)x(k) + h(1)x(k-1) + v(k)$. Let an $r = 2$ tap channel equalizer be designed for this scenario based on symbols $y(k), y(k+1)$ to detect $x(k)$. Let the effective channel matrix for this scenario be denoted by $\mathbf{H}$. The projection matrix $\mathbf{P_H}$ of $\mathbf{H}^T$ is,

Select one:

- $\mathbf{H}^T(\mathbf{H}^T\mathbf{H})^{-1}\mathbf{H}$
- $(\mathbf{H}^T\mathbf{H})^{-1}$
- $\mathbf{H}(\mathbf{H}^T\mathbf{H})^{-1}\mathbf{H}^T$
- $\mathbf{H}^T(\mathbf{H}\mathbf{H}^T)^{-1}\mathbf{H}$ ✔

Your answer is correct.

The correct answer is: $\mathbf{H}^T(\mathbf{H}\mathbf{H}^T)^{-1}\mathbf{H}$

Question **4**

Correct

Mark 1.00 out of 1.00

Flag question

ISI in a wireless system results when

Select one:

- Symbol duration is very large
- Symbol duration is very small ✔
- Velocity of the mobile is large
- Velocity of the mobile is small

Your answer is correct.

The correct answer is: Symbol duration is very small

Question **5**

Correct

Mark 1.00 out of 1.00

Flag question

In an OFDM system, after addition of the cylic prefix, which of the following statements is true

Select one:

- The output symbols across the subcarriers are a linear convolution between the channel filter and the time-domain transmit samples obtained after IFFT
- The output symbols across the subcarriers are a circular convolution between the channel filter and the transmit symbols loaded on the subcarriers
- The output time-domain samples are a circular convolution between the channel filter and the time-domain transmit samples obtained after IFFT ✔
- The output time-domain samples are a multiplication of the FFT coefficients of the channel filter and the time-domain transmit samples obtained after IFFT

Your answer is correct.

The correct answer is: The output time-domain samples are a circular convolution between the channel filter and the time-domain transmit samples obtained after IFFT

Question **6**

Incorrect

Mark 0.00 out of 1.00

Remove flag

Consider a two tap frequency selective channel with channel taps $h(0), h(1)$. Let $x(l)$, $0 \leq l \leq 3$ denote the samples obtained via IFFT. These are transmitted over the channel after addition of a cyclic prefix of length 2 symbols. Let $v(l)$ denote the noise sample at time l. The received symbol $y(0)$ at time $l = 0$ is

Select one:

- $h(0)x(0) + v(0)$ ✖
- $h(0)x(1) + h(1)x(0) + v(1)$
- $h(0)x(0) + h(1)x(1) + v(0)$
- $h(0)x(0) + h(1)x(3) + v(0)$

Your answer is incorrect.

The correct answer is: $h(0)x(0) + h(1)x(3) + v(0)$

Question **7**

Correct

Mark 1.00 out of 1.00

Remove flag

Consider a two tap frequency selective channel with channel taps $h(0), h(1)$. Let $x(l)$, $0 \leq l \leq 3$ denote the samples obtained via IFFT. Then, the channel coefficient $H(2)$ across subcarrier $k = 2$ is

Select one:

- $h(0) + h(1)$
- $h(0) - jh(1)$
- $h(0) - h(1)$ ✔
- $h(0) + jh(1)$

Your answer is correct.

The correct answer is: $h(0) - h(1)$

Question **8**

Correct

Mark 1.00 out of 1.00

Remove flag

Consider an $N = 4$ subcarrier OFDM system with **conventional** channel estimation i.e. pilot symbols transmitted on all the subcarriers. The ISI channel has $L = 2$ taps, denoted by $h(0), h(1)$. The received samples $y(k)$ for $k = 0, 1, 2, 3$ are respectively $1, -\frac{1}{2}j, -\frac{1}{2}j, 1$. The symbol $Y(1)$ received on subcarrier $k = 1$ in the frequency domain is

Select one:

- $\frac{1}{2} + \frac{3}{2}j$ ✔
- $\frac{1}{2} + \frac{1}{2}j$
- $\frac{1}{2} - \frac{3}{2}j$
- $-\frac{1}{2} + \frac{1}{2}j$

Your answer is correct.

The correct answer is: $\frac{1}{2} + \frac{3}{2}j$

Question **9**

Correct

Mark 1.00 out of 1.00

Flag question

Consider the multiple transmit antenna channel estimation model given by $\bar{\mathbf{y}} = \mathbf{X}\bar{\mathbf{h}} + \bar{\mathbf{v}}$, with $\bar{\mathbf{v}}$ denoting the additive noise vector comprising of zero-mean i.i.d. Gaussian noise samples. The MMSE estimate at high SNR for this scenario reduces to the

Select one:

- Matched Filter
- ML estimate ✔
- LMMSE estimate
- Unbiased Estimate

Your answer is correct.

The correct answer is: ML estimate

Question **10**

Correct

Mark 1.00 out of 1.00

Flag question

Consider the multiple transmit antenna channel estimation model given by $\bar{\mathbf{y}} = \mathbf{X}\bar{\mathbf{h}} + \bar{\mathbf{v}}$, with, $\mathbf{X}, \bar{\mathbf{y}}$ denoting the pilot matrix, output vector, respectively and $\bar{\mathbf{v}}$ denoting the additive noise vector comprising of zero-mean i.i.d. Gaussian noise samples of variance σ^2. The channel coefficients are zero-mean i.i.d. Gaussian with variance σ_h^2. The covariance matrix $\mathbf{R}_{yy}$ of the output vector y is

Select one:

- $\sigma_h^2 \mathbf{X}^T \mathbf{X} + \sigma^2 \mathbf{I}$
- $\sigma_h^2 \bar{\mathbf{h}} \bar{\mathbf{h}}^T + \mathbf{I}$
- $\sigma_h^2 \mathbf{X} \mathbf{X}^T + \sigma^2 \mathbf{I}$ ✔

- $\sigma_h^2\mathbf{I} + \sigma^2\mathbf{X}\mathbf{X}^T$

Your answer is correct.

The correct answer is: $\sigma_h^2\mathbf{X}\mathbf{X}^T + \sigma^2\mathbf{I}$

Finish review