

Started on	Sunday, 26 November 2023, 5:30 PM
State	Finished
Completed on	Sunday, 26 November 2023, 6:24 PM
Time taken	53 mins 57 secs
Grade	9.00 out of 10.00 (90%)

Question **1**

Correct

Mark 1.00 out of 1.00

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The integral $\int_{-\infty}^{\infty} a^2 e^{-a^2} da$ evaluates to

Select one:

- ☐ 0
- ☐ $\frac{\sqrt{\pi}}{2\sqrt{2}}$
- ☒ $\frac{\sqrt{\pi}}{2}$ ✓
- ☐ $\sqrt{\frac{\pi}{2}}$

Your answer is correct.

The correct answer is: $\frac{\sqrt{\pi}}{2}$

Question **2**

Correct

Mark 1.00 out of 1.00

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SER of M –ary QAM for $SNR = \rho$ is

Select one:

- ☒ $4 \left(1 - \frac{1}{\sqrt{M}}\right) Q \left(\sqrt{\frac{3\rho}{(M-1)}}\right)$ ✓
- ☐ $4 \left(1 - \frac{1}{\sqrt{M}}\right) Q \left(\sqrt{\frac{\rho}{(M-1)}}\right)$
- ☐ $\left(1 - \frac{1}{\sqrt{M}}\right) Q \left(\sqrt{\frac{3\rho}{(M-1)}}\right)$
- ☐ $4 \left(1 - \frac{1}{M}\right) Q \left(\sqrt{\frac{3\rho}{(\sqrt{M}-1)}}\right)$

Your answer is correct.

The correct answer is: $4 \left(1 - \frac{1}{\sqrt{M}}\right) Q \left(\sqrt{\frac{3\rho}{(M-1)}}\right)$

Question **3**

Incorrect

Mark 0.00 out of 1.00

🚩 Remove flag

Let x_i denote i.i.d. zero-mean Gaussian random variables with $\sigma = 2$. Then, $\sum_{i=1}^N x_i^2$ equals the random variable

Select one:

- ☒ χ_N^2 ✖
- ☐ $\frac{1}{2}\chi_N^2$
- ☐ $2\chi_N^2$
- ☐ $4\chi_N^2$

Your answer is incorrect.

The correct answer is: $4\chi_N^2$

Question **4**

Correct

Mark 1.00 out of 1.00

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The PDF of χ_N^2 -Central chi-squared RV with N degrees of freedom is

Select one:

- ☐ $\frac{1}{2^{\frac{N}{2}-1}\Gamma(\frac{N}{2})}x^{\frac{N}{2}}e^{-\frac{1}{2}x}, x \geq 0$
- ☒ $\frac{1}{2^{\frac{N}{2}}\Gamma(\frac{N}{2})}x^{\frac{N}{2}-1}e^{-\frac{1}{2}x}, x \geq 0$ ✔
- ☐ $\frac{1}{2^{\frac{N}{2}}\Gamma(N)}x^{\frac{N}{2}-1}e^{-x}, x \geq 0$
- ☐ $\frac{1}{2^{\frac{1}{2}}\Gamma(\frac{1}{2})}x^{\frac{N}{2}-1}e^{-\frac{1}{2}x}, x \geq 0$

Your answer is correct.

The correct answer is: $\frac{1}{2^{\frac{N}{2}}\Gamma(\frac{N}{2})}x^{\frac{N}{2}-1}e^{-\frac{1}{2}x}, x \geq 0$

Question **5**

Correct

Mark 1.00 out of 1.00

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The P_D for the random signal detection problem is

Select one:

- ☒ $Q\left(\frac{\gamma}{\sigma^2 + \sigma_s^2}\right)$ ✔
- ☐ $\frac{\Gamma\left(\frac{N}{2}, \frac{\gamma}{\sigma^2 + \sigma_s^2}\right)}{\Gamma\left(\frac{N}{2}\right)}$
- ☐ $Q\left(\frac{\gamma}{\sigma^2 + \sigma_s^2}\right)$
- ☐ $\frac{\Gamma\left(\frac{N}{2}, \frac{\gamma}{\sigma^2}\right)}{\Gamma\left(\frac{N}{2}\right)}$

Your answer is correct.

The correct answer is: $Q_{\chi_N^2}\left(\frac{\gamma}{\sigma^2 + \sigma_s^2}\right)$

Question **6**

Correct

Mark 1.00 out of 1.00

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Let U denote a central χ_{50}^2 RV. Then, variance of U equals

Select one:

- ☒ 100 ✓
- ☐ 2500
- ☐ 200
- ☐ 400

Your answer is correct.

The correct answer is: 100

Question **7**

Correct

Mark 1.00 out of 1.00

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The GLRT problem described in lectures is

Select one:

- ☐ $\mathcal{H}_0: \bar{\mathbf{y}} = \bar{\mathbf{v}}, \mathcal{H}_1: \bar{\mathbf{y}} = A\bar{\mathbf{s}} + \bar{\mathbf{v}}$, where $A, \bar{\mathbf{s}}$ are unknown
- ☐ $\mathcal{H}_0: \bar{\mathbf{y}} = \bar{\mathbf{v}}, \mathcal{H}_1: \bar{\mathbf{y}} = A\bar{\mathbf{s}} + \bar{\mathbf{v}}$, where $\bar{\mathbf{s}}$ is unknown and A is unknown
- ☒ $\mathcal{H}_0: \bar{\mathbf{y}} = \bar{\mathbf{v}}, \mathcal{H}_1: \bar{\mathbf{y}} = A\bar{\mathbf{s}} + \bar{\mathbf{v}}$, where A is unknown and $\bar{\mathbf{s}}$ is known ✓
- ☐ $\mathcal{H}_0: \bar{\mathbf{y}} = \bar{\mathbf{v}}, \mathcal{H}_1: \bar{\mathbf{y}} = A\bar{\mathbf{s}} + \bar{\mathbf{v}}$, where $A, \bar{\mathbf{s}}$ are known

Your answer is correct.

The correct answer is: $\mathcal{H}_0: \bar{\mathbf{y}} = \bar{\mathbf{v}}, \mathcal{H}_1: \bar{\mathbf{y}} = A\bar{\mathbf{s}} + \bar{\mathbf{v}}$, where A is unknown and $\bar{\mathbf{s}}$ is known

Question **8**

Correct

Mark 1.00 out of 1.00

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Consider $\gamma = 4, \sigma^2 = 4, \bar{\mathbf{s}} = [1 \quad -1 \quad 1 \quad -1]^T$. P_{FA} for the GLRT described in class is

Select one:

- ☐ $2Q\left(\frac{1}{\sqrt{2}}\right)$
- ☐ $2Q(\sqrt{2})$
- ☒ $2Q(1)$ ✓

☐ $Q(2)$

Your answer is correct.

The correct answer is: $2Q(1)$

Question **9**

Correct

Mark 1.00 out of 1.00

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Cognitive Radio allows

Select one:

- ☐ Secondary users to always access licensed spectrum
- ☐ Primary users to access spectrum only in limited slots
- ☐ Primary users to sense the spectrum before accessing
- ☒ Secondary users to access licensed spectrum when there is a spectral hole ✓

Your answer is correct.

The correct answer is: Secondary users to access licensed spectrum when there is a spectral hole

Question **10**

Correct

Mark 1.00 out of 1.00

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The probability of detection for spectrum sensing for $N = 10$, $\sigma^2 = 2$, $\sigma_s^2 = 10$, is

Select one:

- ☐ $Q_{\chi^2_{20}}\left(\frac{\gamma}{12}\right)$
- ☒ $Q_{\chi^2_{20}}\left(\frac{\gamma}{6}\right)$ ✓
- ☐ $Q_{\chi^2_{10}}\left(\frac{\gamma}{12}\right)$
- ☐ $Q_{\chi^2_{10}}\left(\frac{\gamma}{6}\right)$

Your answer is correct.

The correct answer is: $Q_{\chi^2_{20}}\left(\frac{\gamma}{6}\right)$

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