NPTEL Online Certification Courses

Indian Institute of Technology Kharagpur

Course: Signal Processing for mm Wave communication for 5G and beyond

Assignment:

Week -3

TYPE OF QUESTION: MCQ/MSQ

Number of questions: 10 **Total mark: 10 X 1 = 10**

Q.1 Trough (opposite of peak) in wireless gain versus (α) frequency (f) plot is observed due to

a. Reflection
b. Absorption
c. Scattering
d. Friis' pathloss

Answer: b. Absorption

Explanation: See, Lecture 11.

Q.2: The most appropriate assumption of random, complex channel vector $h_l$can be

a. Gaussian distributed
b. Gaussian, identical and independently distributed (iid)
c. Gaussian distributed, iid and zero mean
d. Circularly symmetric, iid, zero mean and Gaussian distributed

Answer: d

Explanation: See, lecture 11.

Q.3 Suppose, in a hypothetical communication setting, the channel parameter is given by $h = \sum_i x_i$, where x_i is Bernoulli distributed (whether the signal is passed, or not passed as a binary fashion), then the distribution of h_i is given by

a. Poisson distributed
b. Gaussian distributed
c. Binomial distributed
d. Gamma distributed

Answer: c. Binomial distributed.

Explanation: Sum of Bernoulli distributed variables follows Binomial distribution.

Q.4: Suppose in a wireless channel model, the distribution of h follows uniform in (0.1,0.9), the variance of the channel parameter h is given by

a. 0.05
b. 0.40
c. 0.16
d. 0.025

Answer: a. 0.05

Explanation: Variance of a uniform distributed variable in (a, b) is given by $\frac{(b-a)^2}{12}$.

Q.5 Assume that in a wireless communication system the channel follows Gaussian distribution as $h_l \sim CN(0, \sigma^2)$, where $\sigma = 0.5$. What will be variance of the real component of the channel parameter h ?

a. 0.25
b. 0.5
c. -0.25
d. 0.125

Answer: d. 0.125

Explanation: The complex circularly symmetric Gaussian distributed channel parameter contains equal power in real and imaginary components respectively. Hence, the variance will be $\frac{\sigma^2}{2}$.

Q.6: Assume that, the $z(h) = x^2 + 2y^2$, where, x, y are real and imaginary parts of the channel parameter, h. The trace of the Jacobian matrix for the parameter h^2 is

a. $2x + 4y$
b. 0
c. $2x + 2y$
d. $2x$

Answer: a. $2x + 4y$

Explanation: See, lecture 11.

Q.7: The doppler delay (τ) is related to a user moving at a velocity v, is given by

a. $\frac{v}{c}t$
b. $\frac{\delta r}{c}$
c. $\frac{c}{\delta r}$
d. Both a and b

Answer: d. Both a and b.
Explanation: See, lecture 13.

Q.8: The strong assumption made in time-series model of channel parameters, is

a. Uncorrelated
b. Independent
c. Independent and identical (IID)
d. Correlated

Answer: d. Correlated

Explanation: time-correlation of channel taps is the basis of time-series modelling. See, lecture 14.

Q.9: Assume that, a wireless channel is varying over time, where the channel parameter $h_l(t)$ has mean $\mu(t)$, and time-autocorrelation $R_x(\tau)$. We will say that the random process $h_l(t)$ a wide-sense stationary (WSS) process, for any two times, t_1 and t_2, if and only if

a. $\mu(t_1) = \mu(t_2), R_x(\tau) = R_x(t_2 + t_1)$
b. $\mu(t_1) = \mu(t_2), R_x(\tau) = R_x(t_2 - t_1)$
c. $\mu(t_1) < \mu(t_2), R_x(t_2) < R_x(t_1)$
d. $\mu(t_1) > \mu(t_2), R_x(t_2) < R_x(t_1)$

Answer: b. $\boldsymbol{\mu(t_1) = \mu(t_2), R_x(\tau) = R_x(t_2 - t_1)}$

Explanation: For a WSS process, mean is time independent, and time-autocorrelation will depend on the time-difference only.

Q. 10: The correct relation between autocorrelation function (ACF) of $h_l(t)$, and its average spectrum (PSD) is

a. Average PSD=IDTFT(ACF)
b. Average PSD=DTFT(ACF)
c. Average PSD=$\frac{1}{DTFT(ACF)}$
d. None of the above

Answer: b. Average PSD=DTFT(ACF)

Explanation: If we take the discrete time Fourier transform of the autocorrelation time-sequence of channel taps, we will get average power spectral density (PSD).
