NPTEL Online Certification Courses

Indian Institute of Technology Kharagpur

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

Assignment:

Week -1

TYPE OF QUESTION: MCQ/MSQ

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

Q.1 Suppose, a UWB signal has a centre frequency of 79 GHz and a BW of 4 GHz. The channel gain is typically

a. Always highest at 79 GHz
b. Highest at 77 GHz
c. Highest at 81 GHz
d. Remain same throughout the BW.

Answer: b. 77 GHz

Explanation: The channel is typically frequency dependent for UWB, and the channel does not behave as all pass filer. Hence, the channel gain is different at different RF. At lower RF, the gain is generally more.

Q.2 During signal reconstruction of the signal by Interpolation method at the receiver, the bandwidth of the signal

a. Increases
b. Decreases
c. Initially increases, then decreases
d. Does not change

Answer: d. Does not change

Explanation: By interpolation, signal bandwidth does not change.

Q.3 Suppose, a signal can be perfectly reconstructed at Nyquist frequency of 20 MHz. Assume that, the guard-band among the symbols are 2 MHz. The chance of getting an inter-symbol interference (ISI), if you do

a. Down-sampling greater than 0.5 times Nyquist frequency
b. Up-sampling greater than 0.5 times Nyquist frequency
c. Down-sampling less than 0.5 times Nyquist frequency
d. Up-sampling less than 0.5 times Nyquist frequency

Answer: a. Down-sampling greater than 0.5 times Nyquist frequency

Explanation: $f_{Nyquist}$=2*BW, hence, BW=10 MHz. Guard band protects another 2 MHz. Beyond the guard-band, an ISI may occur. By doing down-sampling greater than 0.5 times Nyquist frequency, i.e., more than 2 MHz signal bandwidth is enhanced. Hence, ISI may occur.

Q.4 For frequency flat-fading channel, the number of channel tap(s)

a. One
b. Two
c. Three
d. Infinity

Answer: a. One

Explanation: For, frequency flat-fading channel, only one major path is considered. The channel bandwidth is more than the data bandwidth in this case.

Q.5 The different time-delay in a channel is given by {1us, 2us, 5us, 8us}. The 3-dB coherence bandwidth of the channel is (us represents microseconds)

a. 62.5 KHz
b. 6.25 KHz
c. 250 KHz
d. 25 KHz

Answer: a. 62.5 KHz

Explanation: The 3-dB coherence bandwidth is expressed as $C_b = 1/(2 * \tau_m)$, where τ_m is the maximum delay.

Q.6 By increasing RF from 6 GHz to 200 GHz within a fixed distance communication channel, which of the following phenomena is the most appropriate

a. The number of reflectors remains same
b. The number of scatterers is increased
c. The number of scatterers remains same
d. There will be no change in the pathloss phenomena

Answer: b. The number of scatterers is increased

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Explanation: Many reflectors start behaving as non-smooth surfaces and acts like scatterers. Pathloss is huge in 200 GHz RF as compared 6 GHz.

Q.7 Small scale fading is related to

a. Constructive and destructive interference of multiple signal paths between transmitter and receiver system
b. Independent of the frequency of the signal
c. Take place at spatial scale of the order of the carrier wavelength
d. Both (a) and (c)

Answer: d. Both (a) and (c)

Explanation: See lectures of week 1.

Q.8 In wireless channel, the frequency dependence of individual attenuations and propagation delays may be neglected for

a. Wideband channel
b. Narrowband channel
c. Ultra-wideband (UWB)
d. THz Channel

Answer: b. Narrowband channel

Explanation: See lectures of week 1.

Q.9 The delay spread of a wireless channel is 10 ms. The coherence time is approximately

a. 25 s
b. 0.25 s
c. 0.05 s
d. 10 ms

Answer: a. 25 s
Explanation: See lectures of week 1.

Q.10 The incorrect one is (Note, Tc is the coherence time, Wc is the coherence bandwidth)

a. flat fading: W<<Wc
b. fast fading: Tc<< Delay requirement
c. slow fading: Tc>> Delay requirement
d. frequency-selective fading: W<<Wc

Answer: d. frequency-selective fading: W<<Wc

Explanation: See lectures of week 1.
