

You may use either english or finnish language.
 Use of literature is not allowed.
 Use of the Faculty's calculator is allowed.
 Compiler of the exam: Jukka Rinne.

1. Give concise explanation to following:

- a) Difference between linear and circular polarization
- b) Difference between first- and second-order fading statistics
- c) Difference between reflection and scattering
- d) Difference between narrowband and wideband radio channel
- e) Main factors which affect the prediction distance of propagation models
- f) Why the shadowing effect has to be taken into account in radio network design?

What is Walfisch-Ikegami model? Explain the main idea(s) regarding the model. Compare the modelling principle with free space model.

Answer to the following questions:

- a) Why mobile radio channels are frequency and time dispersive?
- b) How coherence time and coherence bandwidth are used to categorize fading channels?

Supposing that there is free space propagation between transmitter and receiver. The transmitter power is 1W and antenna gain is 10 dB. The receiver is located at 2 km distance from the transmitter and the receiver antenna has effective area of 10 m².

- a) What is the received power?
- b) What is the received power if the distance is doubled?

5. Consider fading channel with power delay profile

$$p(\tau) = \frac{1}{T} e^{-\tau/T}, \quad \tau \geq 0$$

Assuming that $T=10$ ns, determine

- a) the channel frequency correlation (coherence) function,
- b) the mean propagation delay,
- c) the rms delay spread,
- d) the coherence bandwidth, and
- e) the Doppler spectrum of the channel.