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B.Tech. V-Sem. (Main&Back) Examination, November/December - 2025
Artificial Intelligence
SCS5-11 Wireless Communication

Time : 3 Hours

Maximum Marks : 70

Instructions to Candidates:

Attempt all Ten questions from Part A, Five questions out of seven questions from Part B and Three questions out of five questions from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.

(Mentioned in form No. 205).

PART - A

(Answer should be given up to 25 words only)

All questions are compulsory.

(10×2=20)

1. Explain the concept of frequency reuse ratio.
2. What is Doppler spread? How does it affect signal transmission?
3. What is the difference between narrowband and wideband channels?
4. Differentiate between fast fading and slow fading.
5. Define coherence bandwidth and its significance.
6. What is Offset-QPSK.
7. What is the purpose of an adaptive equalizer?
8. Define spatial multiplexing in MIMO systems.
9. Define PAPR in OFDM systems.
10. Write two differences between FDMA and TDMA.

PART - B

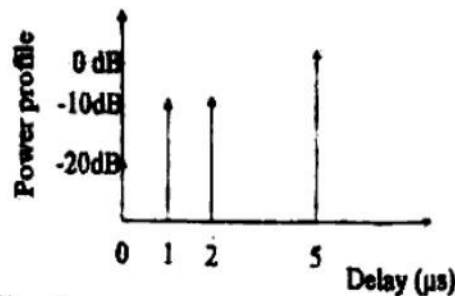
(Analytical / Problem Solving Questions)

Attempt any Five questions.

(5×4=20)

1. Describe the Fraunhofer region and provide the relevant mathematical expression.

2. A complex baseband of transmitter operates at a 80 MHz frequency spectrum and its receive power delay profile is given below figure.



Find the following.

- RMS delay spread.
 - Average weighted delay.
 - Coherent Bandwidth.
3. Assume a path loss exponent of $n = 4$ and consider trunking efficiency 30 W. A receiver is located 8 km from a transmitter. The carrier frequency is 1.9 GHz. Free space propagation is assumed $G_t = 2$ and $G_r = 1$. Find
- The magnitude of the electric field at the receiver antenna.
 - The power at the mobile unit using two-ray ground reflected model when $h_t = 40\text{m}$, $h_r = 2\text{m}$ and ground reflection is -1.
4. Derive the probability density function (pdf) of $y = x^2$, where x is Rayleigh random variable whose pdf is $f_x(x) = xe^{-\frac{x^2}{2}}$.
5. A mobile communication system uses the Two-Ray Ground Reflection Model to model the signal propagation. The transmitter is at a height of 30 meters above the ground, and the receiver is at a height of 1.5 meters. The transmitted power is 50 W. The distance between the transmitter and receiver is 2km. The frequency of operation is 900 MHz. Compute the received signal strength in dBm.
6. Explain the principle of OFDM. Discuss how cyclic prefix and windowing improve performance in fading channels.
7. Describe handoff process. A mobile user is moving at a speed of 72km/h in a cellular network where the cell radius is 1km. If the user makes a call lasting 10 minutes, determine the expected number of handoffs during the call.

PART - C

(Descriptive / Analytical / Problem Solving / Design Questions)

Attempt any Three questions.

(3×10=30)

- Explain the concept of multi-Antenna systems and compute the optimum weighting coefficients for multi antenna system employing maximum ratio combining scheme.
- Explain the Hata Model using suitable example and diagram. Also discuss its importance and role in the wireless communication.

3. Explain Fresnel zone with suitable diagram. A 6 GHz signal is transmitted over a distance of 8km. A tower at the midpoint has an obstacle at a height of 10m. Does the obstacle interfere with the first Fresnel zone?
4. A hexagonal cell within four cell system has a radius of 1.387km. A total of 60 channels are used within the entire system. If the load per user is 0.029 Erlangs and $\lambda = 1$ call/hour. The system is designed with a 5% probability of delayed calls, and each cell experiences a traffic intensity of 15 Erlangs and 10 Erlangs for 15 channels per cell and 10 channels per cell, respectively. Compute the following. <https://www.pyqonline.com>
- How many users per square kilometer this system can support?
 - Probability (waiting time of delayed call > 10 second)
 - Probability (call will be delayed > 10 second)?
5. Write short notes (any Two)
- Zero Forcing Scheme.
 - Rake Receiver.
 - DQPSK.
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