VIT

Vellore Institute of Technology

**School of Electronics Engineering**
**Fall 2024-25**
**CAT I**
**Programme Name & Branch: B.Tech - ECE**

**Wireless and Mobile Communications (BECE307L)**

**Slot: A1** **Exam Duration: 90 mins** **Maximum Marks: 50**

**Instructions:**

- Answer all the questions
- Erlang B, Erlang C, Q Tables, and Okumura charts are permitted.
- Assume suitable values for any missing variables.

| | |
|---|---|
| Q1. | a) Describe the concept of frequency reuse and provide an example to illustrate it. **(5)**<br>b) With a neat schematic, explain the procedure of how a call is maintained without dropping during a handover between cell sites. **(5)** |
| Q2. | a) Consider a communication system where the transmitter emits a power $P_t$ of 10 mW at a frequency of 5 GHz. The gains of the transmitting and receiving antennas are 5 dB and 10 dB, respectively. The system operates over a distance of 5 km in free space. Using the Friis free space propagation model, calculate the received power $P_r$ in dBm. **(5)**<br>b) A mobile is located 5 km away from a base station and uses a vertical $\frac{\lambda}{4}$ monopole antenna with a gain of 2.55 dB to receive cellular radio signals. The E field at 1 km from the transmitter is measured to be $10^{-3}\frac{V}{m}$. The carrier frequency used for this system is 900 MHz.<br>i. Find the length and the effective aperture of the receiving antenna. **(2)**<br>ii. Find the received power at the mobile using the two-ray ground reflection model assuming the height of transmitting antenna is 50 m and the receiving antenna is 1.5 m above ground. **(3)** |
| Q3. | A 7 cell cluster (with N = 7) has 30 MHz allocated to it for forward channels and each channel is 200 kHz. Assume blocked-calls-delayed system with a probability of delay of 1%, and each user makes one 10 minute call for every 3 hours.<br>i. What is the number of users that can be supported? **(3)**<br>ii. What is $P\ [delay > 10sec]$? **(3)**<br>iii. What is the number of users that can be supported, if it is a blocked-calls-cleared system with GOS of 1%? **(4)** |

**Q4.** A network operator wishes to deploy a mobile network working at 2.4 GHz on a large urban city. Given the receiver has a height of 2 m and the transmitter base station is 50 m tall, and they are separated with a distance of 20 km. Determine

i. The path loss, considering the Okumura model. **(5)**

ii. Compare your results with same specifications for Hata model. **(5)**

**Q5.** i. Calculate the mean excess delay, and the RMS delay spread for the multipath profile given in the Table 1. **(6)**

Table 1. Power delay profile

| Delay (ns) | Power (dB) |
|---|---|
| 0 | 0 |
| 50 | 0 |
| 75 | -10 |
| 100 | -20 |

ii. Estimate the channel's 50% coherence bandwidth given in part (i). **(2)**

iii. What type of fading would a signal with a bandwidth of 300 kHz experience when transmitted through this channel? **(2)**