21 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain briefly the evolution of different generations of cellular systems. [4]
2. Define handoff margin with appropriate figure. [3]
3. A telephone network company needs to expand its capacity based on demand on a city. A group of engineer was selected to find the solution. Among the solution sectoring and cell splitting were major technique for expansion purpose. Being an cellular planning engineer which option do you think is best and why? [5]
4. What is "small scale fading"? Describe briefly its types in radio propogation. Explain the factors which influence small scale fading. [2+4+4]
5. Determine the smallest symbol period Ts, and thus the greatest symbol rate that must be sent through RF channel with given power delay profile without using an equalizer.

Power [dB]	0	0	-10	-20
Delay [us]	0	50	75	100

Modulation provides suitable BER performance whenever $\sigma_\tau/T_S \leq 0.1$. [8]

6. Explain any two outdoor propagation models used in mobile ratio environment. [3+3]
7. Explain the transmission and detection process of QPSK modulation technique. [6]
8. Describe a signal processing operation that minimizes the effects of ISI. Explain various space diversity techniques. [2+6]
9. What are the characteristics of speed signal? Explain the operation of linear predictive coder. [2+6]
10. What is space division Multiple Access? Explain any two hybrid spread spectrum multiple access technique which minimizes the effect of near for effect. [2+6]
11. Briefly explain different traffic and control channels used in GSM? [8]
12. Write short notes on: (Any two) [2×3]
    a) Frequency Hopped Multiple Access
    b) Viterbi decording algorithm
    c) Wireless local Area Network (WLAN)

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV/ II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Compare and contrast the first, second, third and forth generation of mobile communication standards in terms of technology advancement. [6]
2. a. Why does minimizing reuse distance maximize spectral efficiency of a cellular system? [4]
   b. For a seven cell reuse pattern, find the minimum distance between centers of co-channel cells. Area of each cell is uniform and is equal to 23 square km. [4]
3. Estimate the feasibility of a 10-km wireless link in suburban area, with one access point and one client radio, using Okumura model for path loss. The median attenuation value is 20 dB and gain due to environment is 13 dB. The height of access point antenna is 100 m and that of client antennal is 10 m: [12]
   a. Access point is connected to antenna with 5-dBi gain, with a transmitting power of 20-dBm and a receive sensitivity of –80-dBm
   b. Client is connected to antenna with 20-dBi gain, with a transmitting power of 15-dBm and a receive sensitivity of –75-dBm
   c. Cables in both systems are short, with a loss of 3-dB at each side at 2.4-GHz frequency of operation.
4. What is known as scattering? Derive an expression for two ray ground reflected model. [2+8]
5. Explain the operation of OFDM with an appropriate block diagram. [8]
6. Why is there a need to implement diversity? Describe the various diversity combining techniques. [4+6]
7. Describe the operation of any two source coders used in speech coding. [6]
8. Explain the principle of Frequency Hopping Multiple Access. Briefly describe two hybrid spectrum multiple access technique which can mitigate near-far problem. [4+6]
9. Write short notes on any two: [5+5]
   a. Specifications of GSM.
   b. Regulatory issues
   c. Convolutional encoding and decoding

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Magh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Briefly explain development of mobile communication and evolution path upto 3G technology. [4]

2. (a) Explain handover process in cellular system. Mention various types of handover with application [6]

   (b) Obtain the expression $\frac{S}{I} = \frac{\sqrt[n]{3N}}{i_0}$ where symbols have their usual meaning. [4]

3. Explain Okumura model of outdoor radio propagation. Determine the median path loss for T-R separation of 50Km, transmit antenna effective height of 100m and receive antenna effective height of 10m in a suburban area with correction factor of 9dB at 900MHz. Assume median attenuation relative to free space 43dB. [4+4]

4. Explain Diversity techniques used in wireless communication. Give brief description of combining methods used for Space Diversity. [4+4]

5. Describe Spread Spectrum Multiple Access, SSMA variants and application with suitable diagram. [8]

6. Describe Waveform and Voice Coding techniques. Mention characteristics of speech. Draw a suitable diagram of GSM CODEC. [4+2+2]

7. Explain Doppler Spread and Coherence Bandwidth. Classify fading on the basis of RMS Delay spread and Coherence Time. [4+4]

8. Explain briefly channel structure of GSM. Show that TDMA frame efficiency cannot reach 100% in GSM [6+2]

9. Compare system architecture of CDMA with LTE. Mention function of entities in the architecture. [3+5]

10. Write Short Note (Any Two) [2X5]
    a. Adaptive Equalization
    b. QPSK
    c. Turbo Coding

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32 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Digital Signal Processing *(EX 753)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain the general application areas of digital Signal Processing. Consider a continuous time signal $x(t) = \sin 2000\pi t + 5\cos 12000\pi t + 10\sin 6000\pi t$.
   a) What is the discrete time signal obtained after sampling the signal at a sampling rate of 5000 samples per second for $0 \le n \le 3$? [3+4]
2. Define causal and stable system with examples. [3]
3. Find a convolution between two signals x[n] and h[n] where,
$$x[n] = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & \text{otherwise} \end{cases} \text{ and } h[n] = \begin{cases} a^n & 0 \le n \le 6 \\ 0 & \text{otherwise} \end{cases} \quad (a > 1).$$ [8]
4. Using long division determine the inverse Z-transform of,
$$X(z) = \frac{1}{1 - \left(\frac{3}{2}\right)z^{-1} + \left(\frac{1}{2}\right)z^{-2}} \text{ when, ROC : } |Z| > 1 \text{ and ROC: } |Z| < \frac{1}{2}$$ [6]
5. Define ROC. Explain the properties of ROC with suitable examples. [1+4]
6. Why we need a DFT? Find 8-point DFT of sequence x[n] = {1,0,2,0,-1,1,1} using Decimation in Time Fast Fourier Transform (DITFFT) algorithm. [1+6]
7. State Multiplication of two DFTs property of DFT. Find $x_3[n]$ if DFT of $x_3[n]$ is given by $X_3(k) = X_1(k)X_2(k)$ where $X_1(k)$ and $X_2(k)$ are 5-point DFT of $x_1[n] = \{1,2,3,-1,5\}$ and $x_2[n] = \{2,1,-3\}$ respectively. [1+5]
8. For a system with poles at $0.45 \pm j1.06$ and zero at $0.58 \pm j2.06$. Plot the location of poles and zeroes in the z-plane and also plot the magnitude response of the system. [8]
9. Convert the following filter into a lattice ladder structure.
   $H(z) = 1 + 2z^{-1} + 2z^{-2} + z^{-3}$ [6]
10. Design a low pass digital filter by Bilinear Transformation method to an approximate Butterworth filter, if passband edge frequency is 0.25π radians and maximum deviation of 0.99 dB below 0 dB gain in the passband. The maximum gain of -14.85 dB and frequency is 0.59π radians in stopband, Consider sampling frequency 0.5 Hz. [11]
11. List out the key points of windowing and design the symmetric FIR low pass filter for which desired frequency response is expressed as
$$H_d(\omega) = \begin{cases} e^{-j\omega\tau} & \text{for} |\omega| \le \omega_c \\ 0 & \text{elsewhere} \end{cases}$$
The length of the filter should be 7 and $\omega c = 1$ radians/sample. Use Hanning window as a prototype. [2+7]

31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX 751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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***Hata Model**

L_{50} (*urban*) (dB) = $69.55 + 26.16\log f_c - 13.82\log h_{te} - a(h_{re}) + (44.9 - 6.55\log h_{te})\log d$

For medium sized city

$a(h_{re}) = (1.1\log f_c - 0.7)h_{re} - (1.56\log f_c - 0.8)$ dB

For large city

$a(h_{re}) = 8.29(\log 1.54h_{re})^2 - 1.1$ dB for $f_c \leq 300$ MHz

$a(h_{re}) = 3.2(\log 11.75h_{re})^2 - 4.97$ dB for $f_c \geq 300$ MHz

L_{50} (*Suburban*) (dB) = L_{50} (*urban*) $- 2[\log(f_c/28)]^2 - 5.4$

L_{50} (*rural*) (dB) = L_{50} (*urban*) $- 4.78(\log f_c)^2 + 18.33\log f_c - 40.94$

1. a) Compare various generations of mobile communications up to the fourth generation. [4]
   b) What are various practical handoff considerations? Explain. [4]
2. Determine: [6]
   a) the cell cluster size
   b) the number of cell clusters in the service area
   c) the maximum number of users in service area at any instant
3. a) Discuss what is meant by the term FADING. Describe briefly its types in radio propagation. [2+2]
   b) Let us consider a medium sized city and assume the typical GSM downlink parameters. The Base Station (BS) is transmitting with power 50W. The minimum acceptable received power at Mobile Station (MS) is -91 dBm. The carrier frequency is 900 MHz, the height of BS is 30m and height of MS is 1m. Estimate the maximum cell radius and corresponding cell area using Hata Model. (*The expression below should be provided in the question) [6]
4. a) Describe Direct Sequence and Frequency Hopped Spread Spectrum Techniques. [4]
   b) State the advantages and disadvantages (two of each): [4]
      (i) Frequency Division Multiple Access (FDMA)
      (ii) Time Division Multiple Access (TDMA)
      (iii)Code Division Multiple Access (CDMA)
   c) Define the terms Coherence Bandwidth and Coherence Time explaining their significance in mobile radio propagation. [4]
5. a) Explain briefly adaptive equalization algorithms (any two) [4]
   b) Explain various space diversity techniques along with block diagrams. [4]
6. a) Describe Outdoor Propagation Models (any two) [5]
   b) Describe vocoders with block diagram. Briefly explain different kind of vocoders. [2+3]
7. a) Explain with necessary diagram system architecture of GSM. Mention functions of various Blocks in the architecture. [7]
   b) What is channelization code? Explain briefly forward channels in cdma IS-95. [4]
8. Write short notes: (Any three) [3×5]
   a) WiMAX
   b) Handover

31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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1. Differentiate between 2G and 3G with examples of appropriate technologies used. Explain the terms prioritized handoff and cell dragging. [4+2]
2. State the difference between large scale and small scale propagation model. Explain the different propagation mechanisms which have impact on propagation in mobile environment. [3+6]
3. A BS transmitter has a power output of 10 watts operating at a frequency of 250 MHz. The transmitter is connected by 20 m of an RF coaxial cable, which has a loss of 3-dB/100 m specification, to an antenna that has a gain of 9dBi. The receiving antenna is 25 km away and has a gain of 4 dBi. There is negligible loss in the receiver feeder line, but the receiver is mismatched; the receiving antenna and feeder cable are designed for 50 ohm impedance. The receiver impedance loss due to mismatch is of about 0.2 dB. Calculate the power delivered to the receiver, assuming free-space propagation. [8]
4. What do you understand by RACK receiver? Explain the working of a M branch RACK receiver. [8]
5. What are the different characteristics of speech signals? How they are used in designing of coders? [8]
6. What is self jamming problem in CDMA? Explain the operation of FHMA with the help of block diagram. Explain any two hybrid spread spectrum multiple access technique along with their advantage and disadvantage. [2+4+6]
7. Explain the working of all traffic and control channels used in GSM. [8]
8. Explain with block diagram the concept of Maximum Likelihood Sequence Estimation. Define time diversity. Explain two implementations of time diversity. [6+1+5]
9. Write short notes on: [3×3]
   a) WiMax
   b) LTE
   c) Viterbi decoding algorithm

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Briefly describe the evolution of wireless communications from first to third generation. [6]
2. A city with a coverage area of 1500 sq km is covered with a 12-cell system each with a radius of 1.387 km. If the total spectrum allocated is 28.5 MHz with a full duplex channel bandwidth of 25 MHz. Assume a GOS of 0.02 for a blocked calls cleared system, is specified and the offered traffic per user is 0.03 Erlangs and traffic intensity of each cell is 84 Erlang, compute: [12]

   (a) the number of cells in the service area

   (b) the number of channels per cell

   (c) the maximum carrier traffic

   (d) the total number of users that can be served for 2% GOS

   (e) the number of mobiles per unique channel.

   (f) Theoretical maximum number of users that could be served at one time by the system.
3. Explain the transmitter and receiver of DPSK modulation scheme. Briefly explain about pseudo-noise (PN) sequence. Why is it used? [4+2+2]
4. What do you understand by frequency reuse concept? Define Co-channel reuse Ratio in details. [6]
5. Explain the mobile radio propagation in terms of large scale path loss and small scale fading. [8]
6. Explain the Transmission and Detection of QPSK modulation technique. [8]
7. Why we need equalization technique in communication? Explain the basic equalization technique. [2+5]
8. What are the characteristics of speech signal? Explain the operation of Linear predictive coder. [2+6]
9. Explain the different types of spread spectrum multiple access techniques. Compare FDMA with CDMA. [6+2]
10. What is small scale fading? Describe the different factor that influences the small scale fading. [3+6]

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

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1. Explain the evolution of cellular radio 1G to 3G. [4]
2. Prove that for a hexagonal geometry the co-channel reuse ratio is given by $Q = \sqrt{3N}$; Where $N = i^2 + j^2 + ij$. A cellular service provider decides to use a digital TDMA scheme which can tolerate a Signal-to-Interference Ratio of 15 dB in the worst case. Find the optimal value of N for [4+4]
   a) Omni directional antennas
   b) 120° Sectoring
   c) 60° Sectoring

   [Use path loss exponent of 4 and consider trunking efficiency]
3. Derive the expression for phase difference in two ray free space propagation model. [8]
4. A mobile is located 5 km away from a base station and a vertical $\lambda/4$ monopole antenna with a gain of 2.55 dB to receive cellular radio signals. The electric field at 1 km from the transmitter is measured to be 10^{-3} V/m. The carrier frequency used for this system is 900 MHz. [6]
   a) Find the length and effective aperture of the receiving antenna.
   b) Find the received power at the mobile using two ray ground reflection model assuming the height of the transmitting antenna is 50 m and the receiving antenna is 1.5 m above ground.
5. What is the difference between path loss and fading of signal? Explain time dispersion fading and its types. [2+6]
6. Explain the transmitter and receiver of OQPSK modulation. Discuss why $\pi/4$-QPSK is more preferred than OQPSK modulation. [5+2]
7. Why diversity is important in wireless communication system? Explain different types of diversity techniques. [2+6]
8. Explain the operation of formant vocoder. What are the characteristics of speech signal? [4+4]
9. Explain the terms Multiple access, Time Division CDMA (TCDMA) and Time Division Frequency Hopping as related to wireless communication system. [7]
10. What is a multiple access technique? Explain TDMA, CDMA and SDMA. [2+6]
11. What are the basic signal processing operations to be performed to convert a speech signal into a radio signal and back in GSM? Describe briefly. [8]

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32 TRIBHUVAN UNIVERSITY
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1. Discuss the evolution from 1G to 2G, 2.5G in the case of cellular network based on TDMA. [4]
2. Describe the techniques used for enhancing the capacity and coverage in cellular radio network. [8]
3. a) With appropriate expressions, distinguish between Rayleigh fading channel and Rician fading channel. [2]
   b) A wireless channel is characterized by the following power-delay profile: [6]

Power [dB]	0	-10	-20	-23
Delays [ns]	0	100	200	400

   Determine the root mean square (rms) delay spread and the 90% coherence bandwidth of the above channel. Is this channel flat fading or frequency selective fading for:
   i) An AMPS system with transmission bandwidth 30 kHz?
   ii) A GSM system with transmission bandwidth 200 kHz?
4. Explain any two outdoor propagation models used in mobile network environment. [3+3]
5. What are the parameters of mobile multipath channel? Explain. [7]
6. What is an OFDM? Generalize the modulation and demodulation technique of OFDM. [8]
7. a) Discuss and compare different types of antenna diversity technique. [4]
   b) Explain with block diagram the concept of Maximum Likelihood Sequence Estimation equalization. [4]
8. What is a channel coding? Explain types of linear predictive coder. [2+6]
9. a) Define near-far effect. Briefly describe any one hybrid spread spectrum multiple access technique which can mitigate the near-far problem. [2+2]
   b) What are the advantages of TDMA cellular system over FDMA cellular system? [4]
10. Explain the principle of FHMA. What do you mean by near-far effect in CDMA? How is it solved? Explain. [3+4]
11. What is GSM and CDMA standard? Explain the architecture of GSM. [4+4]

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31 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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- ✓ *Assume suitable data if necessary.*

1. List the significant improvements introduced in the second, third and beyond third generation standards of cellular communication systems. [6]
2. Explain the difference between co-channel and adjacent channel interference. Prove that the co-channel reuse ratio is given by $Q = \sqrt{3N}$, where $N = i^2 + ij + j^2$ is the cluster size. If 20 MHz of total spectrum is allocated for a duplex (i.e. bidirectional) wireless cellular system and each simplex (i.e. one-way) channel has 25 KHz of bandwidth, find [3+4+3]
   a) The number of duplex channels, and
   b) The total number of channels per cell, assuming a cluster size of N = 4.
3. Explain indoor propagation models (any two). [8]
4. Determine the radio coverage range of a base station that transmits a RF signal at 150 W, given the receiver threshold level is –104 dBm. Assume that the path loss at the first meter is 15 dB in a mobile radio propagation condition. (Path loss exponent = 4) [6]
5. Discuss the principle of Orthogonal Frequency Division Multiplexing modulation scheme. Briefly explain different types of spread spectrum modulation techniques. [4+4]
6. What is diversity? Explain any two types of diversity techniques in detail. [2+6]
7. What is vocoder? Explain any two predictive coders. [2+6]
8. Define multiple access. What are the merits and demerits of Code Division Multiple Access? If a normal GSM time slot consists of 6 trailing bits, 8.25 guard bits, 26 training bits, and 2 traffic bursts of 58 bits of data, find the frame efficiency. [2+6+4]
9. Draw and explain the frame structure for GSM. Describe how various traffic and control channels are used while making a call in GSM system. [4+4]
10. Write short notes on: (any two) [6]
    a) Viterbi Decoding Algorithm
    b) Doppler Spread and Coherence Time
    c) GMSK Modulation Technique

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31 TRIBHUVAN UNIVERSITY
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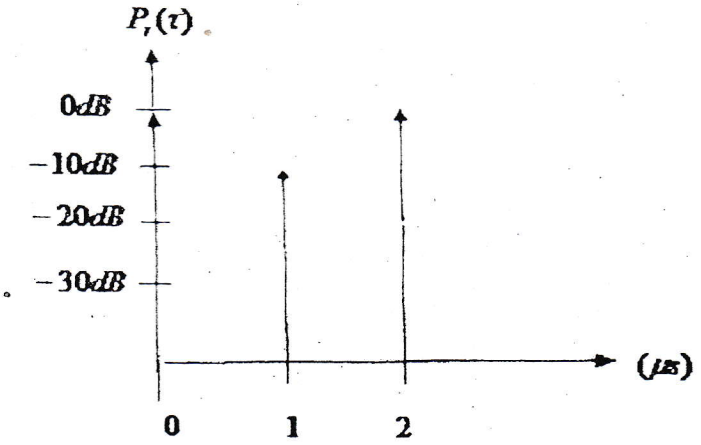
1. Explain the evolution of wireless communication in terms of technology and worldwide market penetration. [6]
2. What is hand off? Explain its strategy used in GSM. [8]
3. Determine the propagation path loss for signal at 800 MHZ, with a transmitting antenna height of 30 m and a receiving antenna height of 2 m, over a distance of 10 km, using two-ray mobile point-to-point propagation model. How is it compared with that of free-space propagation path loss model? [4+4]
4. Define Doppler spread. Describe the types of small scale fading based on Doppler spread. Calculate the mean excess delay and rms delay spread for the multipath profile given below. Estimate the 90% and 50% coherence bandwidth of the channel. [4+4]



5. What are MSK and GMSK modulation techniques? Draw the block diagram of OFDM modulator and demodulator and explain them. [8]
6. Describe the fundamentals of equalization with respect to communication system? Explain with block diagram the function of Rake receiver. [4+4]
7. Why we need speech coding techniques? Explain the basic concept of VOCODER. [4+4]
8. What is multiple Access technique? Compare FDMA with CDMA. [2+4]
9. Draw the architecture of GSM and explain it. [8]
10. Write short notes on: [4×3]
    a) Rayleigh and Ricean fading distribution
    b) Regulatory issues in wireless systems
    c) Viterbi decoding algorithm

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