EC6801 WIRELESS COMUNICATION

UNIT I - WIRELESS CHANNELS

1. What is meant by multipath propagation?

The signal can get from the TX to the RX via a no. of different propagation paths. The signal gets reflected and diffracted by different objects. So each of the paths has a distinct amplitude, delay and direction of arrival. This effect is known as multipath propagation.

2. What is meant by small and large scale fading?

The rapid fluctuations of the amplitudes, phases; or multipath delays of a radio signal over a short period of time or travel distance is known as small scale fading.

The rapid fluctuations of the amplitudes, phases, or multipath delays of a radio signal over a long period of time or travel distance is known as large scale fading.

3. What is the significance of propagation model?

The major significance of propagation model is

- Propagation model predicts the parameter of receiver..
- It predicts the average received signal strength at a given distance from the transmitter.

4. Define Doppler shift.

If the receiver is moving towards the source, then the zero crossings of the signal appear faster and the received frequency is higher. The opposite effect occurs if the receiver is moving away from the source. The resulting chance in frequency is known as the Doppler shift (fD).

6. Define coherence time and coherence bandwidth.

Coherence time is the maximum duration for which the channel can be assumed to be approximately constant. It is the time separation over which two received signals have strong potential for amplitude correlation.

Coherence bandwidth is the maximum frequency difference for which signals are strongly correlated in amplitude.

7. Define EIRP.

EIRP (Equivalent Isotropic ally Radiated Power) of a transmitting system in a given direction is defined as the transmitter power that would be needed, with an isotropic radiator, to produce the same power density in the given direction. EIRP=Pt.Gt

Where Pt -transmitted power in W

Gt-transmitting antenna gain

8. Explain path loss.

The path loss is defined as the difference (in dB) between the effective transmitted power and the received power. Path loss may or may not include the effect of the antenna gains.

9. What are the three basic propagation mechanisms?

The three basic propagation mechanisms which impact propagation in a mobile communication System is 1.Reflection 2.Diffraction 3.Scattering.

10. Write the effects of fading.

1. Rapid changes in signal strength over a small travel distance or time interval
2. Random frequency modulation due to varying Doppler shifts on different multipath signal
3. Time dispersion caused by multipath propagation delays.

11. What is reflection?

Reflection occurs when a propagating electromagnetic wave impinges upon an object, which has very large dimension when compared to the wavelength of propagating wave.

12. What is diffraction?

Diffraction occurs when the radio path between the transmitter and receiver is obstructed by a surface that has sharp irregularities

13. What is scattering?

Scattering occurs when the medium through which the wave travels consists of objects with dimensions that are small compared to the wavelength and where the number of obstacles per unit volume is large.

14. What are the factors influencing small scale fading?

The factors which influence small scale fading are:

Multipath propagation, Speed of the mobile, Speed of surrounding objects and the transmission bandwidth of the signal.

15. What is the necessity of link budget?

The necessities of link budget are:

i.A link budget is the clearest and most intuitive way of computing the required Transmitter power. It tabulates all equations that connect the Transmitter to the received SNR

ii.It is reliable for communications

.iii.It is used to ensure the sufficient receiver power is available

.iv.To meet the SNR requirement link budget is calculated.

16. What is flat fading?

If the mobile radio channel has a constant gain & linear phase response over a bandwidth Which is greater than the bandwidth of the transmitted signal, then the received signal will undergo flat fading.

17. What is frequency selective fading?

If the channel possesses a constant gain & linear phase response over a bandwidth that is Smaller than the bandwidth of the transmitted signal, then the channel creates frequency Selective fading on the received signal

Differentiate the propagation effects with mobile radio.

Slow Fading	Fast Fading
Slow variations in the signal strength.	Rapid variations in the signal strength.
Mobile station (MS) moves slowly.	Local objects reflect the signal causes fast fading.
It occurs when the large reflectors and diffracting objects along the transmission paths are distant from the terminal.	It occurs when the user terminal (MS) movefor short distances.

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19. What is MSC?

Mobile switching centre coordinates the routing of calls in large service area. It connects the base station and mobiles to PSTN. It is also called as MTSO(Mobile telephone switching office.

20. What do you mean by forward and reverse channel?

Forward channel is a radio channel used for transmission of information from base station to mobile. Reverse channel is a radio channel used for transmission from mobile to base station

PART – B

1a)What you mean by path loss model? Explain large scale path loss,

b).Define propagation model and, explain the two types of propagation model?

2. Explain the free space path loss model, and describe the following

a).log-distance path loss model, b).log-normal shading path loss model c). Determination of percentage of coverage area

3. Explain following a). Explain friis free space equation. b). Explain d-4 law? c). Explain path loss equation for a free space propagation model.

4. Derive the expression for electric field, path loss and received power for a Two Ray model?

5. a). Explain small scale fading and, what are the factors affecting the small scale fading.

b).a mobile is located at 5Kms away from base station and uses a vertical λ/4 monopole antenna with a gain of 2.55 dB to receive cellular radio signals. The E- field at 1Km from transmitter is measured to 10-3V/m the carrier frequency is 900MHz.Find the length and effective aperture of the effective the receiving antenna

6. a. Explain power delay profile, mean excess delay , RMS delay spread & Maximum excess delay. b. calculate mean excess delay , RMS delay spread & maximum excess delay for the figure given below . Also estimate the coherence bandwidth of the channel.

Time in micro seconds	power in dB
0	-20
1	-10
2	-10
5	0

7. Explain the following a. Doppler shift b. Doppler spread c. Coherence time

8. Explain fading due to multipath delay spread?

9. Explain fading due to Doppler spread and coherence time?

10. Define small scale fading, write the detail of following small scale fading a).Time dispersion parameter b). Coherence band width

11. Compute the rms delay spread for the following delay profile

Time in micro seconds	power
0	1
1	1
2	1

a. Calculate the rms delay spread for the figure

. **b. IF BPSK modulation is used , what is the maximum bit rate that can be sent through the channel without needing an equalizer** ?

Unit-2 Cellular Architecture

1. Write some examples for wireless communication system.

Cordless phones, handheld walkie-talkies, pagers, mobiles, remote controllers For home entertainment.

2. What is base station?

A fixed station in mobile radio system used for radio communication with mobiles. It has transmitter and receiver section. It is located at the centre of coverage area.

3. What is MSC?

Mobile switching centre coordinates the routing of calls in large service area. It connects the base station and mobiles to PSTN. It is also called as **MTSO(Mobile telephone switching office).**

4. What do you mean by forward and reverse channel?

Forward channel is a radio channel used for transmission of information from base station to mobile. Reverse channel is a radio channel used for transmission from mobile to base station.

5. What is the function of control channel? What are the types?

Control channel is used for transmission of call setup, call request, call initiation & Control. Types are forward control channel, reverse control channel.

6. Define cell

Each cellular base station is allocated to a group of radio channels to be used within a small geographic area called as cell.

7. What is foot print?

Actual radio coverage of a cell is called as footprint. It is determined from the field measurements or propagation prediction models.

8. What is channel assignment? What are the types?

For efficient utilization of radio spectrum a frequency reuse scheme with increasing capacity and minimizing interference is required. For this channel assignment is used.

Types : Fixed channel assignment, dynamic channel assignment.

9. What is fixed channel assignment?

If the channels in each cell are allocated to the users within the cell, it will be called as fixed channel assignment. If all channels are occupied, the call will be blocked.

10. What is dynamic channel assignment?

If the voice channels are not allocated permanently in a cell, it will be called as dynamic channel assignment. In this assignment, channels are dynamically allocated to users by the MSC.

11. What is hand off?

When a mobile moves into a different cell while conversation in progress, the MSC automatically transfers the call from one cell to other cell without any interference. This is called as hand off.

12. Define dwell time.

The time over which the call may be maintained within a cell without handoff is called as dwell time. This time is governed by factors such as propagation, interference, distance between subscribers and base station.

13. What is soft handoff?

Soft handoff refers to a feature used by the CDMA standards, where a cell phone is simultaneously connected to two or more cells (or cell sectors) during a call. If the sectors are from the same physical cell site (a sectorised site), it is referred to as handoff.

14. What is co channel interference?

The interference between the signals from co-channel cells is called as co-cannel interference

15. Define co-channel reuse ratio.

It is define as the ratio of the distance between the centers of nearest co-channel cells to the radius of the cell. Q = D/R

16. Define adjacent channel interference.

`Interference resulting from signals which are adjacent in frequency to the desired signal is called adjacent channel interference.

17. Define Grade of service.

It is defined as the measure of the ability of a user to access a trunked system during the busiest hour.

18. What is blocked call clear system (BCC)?

In a system, a user is blocked without access by a system when no channels are available in the system. The call blocked by the system is cleared and the user should try again .This is called BCCsystem.

19. What is blocked call delay system?

If a channel is not available immediately, the call request may be delayed until a channel becomes available.

20. Define cell splitting.

Cell splitting is the process of subdividing congested cells reduction in antenna height and transmitter power. It increases the capacity of cellular system.

21. What is sectoring?

Sectoring s a technique for decreasing co-channel interference and thus increasing the system performance by using directional antennas.

22. Define frequency reuse.

Frequency reuse is the process of **using the same radio frequencies** on **radio transmitter sites within a geographic area** , which are **separated by sufficient distance** to cause minimal interference with each other. Frequency reuse allows for a dramatic increase in the number of customers that can be served (capacity) within a geographic area on a limited amount of radio spectrum

PART B

1. Compare FDMA, TDMA & CDMA?

2. Briefly explain the principle of cellular networks?

3. Write short notes on frequency reuse & channel assignment strategies?

4. Explain Handoff and interference systems?

5. Explain the Multiple Access methods with neat diagrams?

6. Explain Grade of service, blocked calls cleared, blocked calls delay?

7. Explain cell sectoring and cell splitting in detail?

8. Explain "repeaters for range extension" and "microcell zone" concept?

9. Calculate channel capacity of TDMA in cell system.

10. Calculate channel capacity of FDMA in cell system.

11. Calculate channel capacity of CDMA in cell system.

12.Write detail about interference and system capacity of cellular system

13.Write detail about trunking and grade of service of cell system

14. How to improve coverage and capacity of cellular system

UNIT III

DIGITAL SIGNALING FOR FADING CHANNELS

1. What is QPSK?

The Quadrature Phase Shift Keying (QPSK) is a 4-ary PSK signal. The phase of the carrier in the QPSK takes 1 of 4 equally spaced shifts. Two successive bits in the data sequence are grouped together.

1 symbol = 2 bits

This reduces bit rate and bandwidth of the channel. Coherent QPSK = 2 x coherentBPSK system The phase of the carrier takes on one of four equally spaced valuessuch as $\pi/4$, $3\pi/4$, $5\pi/4$ and $7\pi/4$.

2. What is meant by MSK?

A continuous phase FSK signal with a deviation ratio of one half is referred to asMSK. It is a spectrally efficient modulation scheme.

4.Define offset QPSK and $\pi/4$ differ entail QPSK.

In offset QPSK the amplitude of data pulses are kept constant. The time alignment of the even and odd bit streams are offset by one bit period in offset QPSK.. In $\pi/4$ QPSK, signaling points of the modulated signal are selected from two QPS K constellations which are shifted by $\pi/4$ with respect to each other. It is differentially encoded and detected so called $\pi/4$ differential QPSK.

4.Write the advantages of MSK over QPSK.

In QPSK the phase changes by 90degree or 180 degree .This creates abrupt amplitude variations in the waveform, Therefore bandwidth requirement of QPSK is more filters of other methods overcome these problems , but they have other side effects.

MSK overcomes those problems. In MSK the output waveform is continuous in phase hence there are no abrupt changes in amplitude.

5.List the advantages of digital modulation techniques.

The advantages of digital modulation techniques are:

I.Immunity to channel noise and external interference

ii.Flexibility operation of the system

iii.Security of information.

iv.Reliable since digital circuits are used.

v.Multiplexing of various sources of information into a common format is possible.

vi.Error detection and correction is easy.

6.Define M-ary transmission system?

In digital modulations instead of transmitting one bit at a time, two or more bits are transmitted simultaneously. This is called M-ary transmission.

7.What is linear modulation?

In linear modulation technique the amplitude of the transmitted signal varies linearly with the modulating digital signal. In general, linear modulation does not have constant envelope. Ex. Pulse shaped QPSK, OQPSK, π/4QPSK

8.Define non linear modulation?

In the non linear modulation the amplitude of the carrier is constant, regardless of the variation in the modulating signals. Non-linear modulations may have either linear or constant envelopes depending on whether or not the baseband waveform is pulse shaped.

9.What is the need of equalization?

Equalization can be used to compensate the Inter Symbol Interference created by multipath within time dispersion channel.

10. What is diversity?

Diversity is used to compensate for fading channel impairments and is usually implemented by using two or more receiving antennas. Diversity improves transmission performance by making use of more than one independently faded version of the transmitted signal.

11.What are the factors that influence the choice of digital modulation?

The factors that influence the choice of digital modulation are:

i.Low BER at low received SNR.

ii.Better performance in multipath and fading conditions.

iii.Minimum bandwidth requirement.

iv.Better power efficiency.

v.Ease of implementation and low cost.

12. Why MSK cannot be directly used in multi user communications?

1.The main lobe of MSK is wide. This makes MSK unsuitable for the applications where extremely narrow bandwidths and sharp cut-offs are required.

2.Slow decay of MSK power spectral density curve creates adjacent channel interference.

Hence MSK cannot be used for multiuser communications.

13.What is the need of Gaussian filter?

Gaussian filters used before the modulator to reduce the transmitted bandwidthof the signal. It uses less bandwidth than conventional FSK.

14.Give some examples for constant envelope modulation.

- BFSK,
- MSK,
- GMSK
-

15.Mention any two criteria for choosing a modulation technique for a specific wireless application?

The spectral efficiency of the modulation format should be as high as possible. This can best be achieved by a higher order modulation format. This allows the transmission of many data bits with each symbol. Adjacent channel interference must be small. This entails that the power spectrum of the signal should show a strong roll-off outside the desired band. Furthermore, the signal must be filtered before transmission

16.State the advantages of offset-QPSK.

The big advantage of OQPSK is to suppress out-of-band interference. The OQPSK will Limit the phase-shift to not more than 90° at a time. This yields much lower amplitude fluctuations than non-offset QPSK .

17.List the advantages of GMSK.

GMSK modulation has improved spectral efficiency when compared to other phase shift keyed modes. It can be amplified by a non-linear amplifier and remain undistorted. In GMSK modulation none of the information is carried as amplitude variations. This means that is immune to amplitude variations and therefore more resilient to noise.

18.List the salient features of MSK scheme.

Salient features of MSK are:

i.It has constant envelope, smoother waveforms than QPSK

ii.Relatively narrow bandwidth.

iii.Coherent detection suitable for satellite communications.

iv.Side lobes are zero outside the frequency band, so it has resistance tocochannel interference.

19.Define PAPR.

The peak-to-average power ratio (PAPR) is the peak amplitude squared (giving the peak power) divided by the RMS value squared (giving the average power).

20.What is OFDM?

Orthogonal frequency division multiplexing splits the information into N parallel streams, which are then transmitted by modulating N distinct carriers. In order to separate the subcarriers by the receiver, they have to be orthogonal.

21. Define cyclic prefix.

In OFDM, delay dispersion leads to a loss of orthogonality between the subcarriers and thus leads to Inter Carrier Interference (ICI). These negative effects can be eliminated by a special type of guard interval called the cyclic prefix.

PART B

1. Discuss about QPSK transmitter and receiver with signal space diagram and give an expression for spatial effect

2. Explain transmitter and receiver with signal space diagram and give an Expression for spectral efficiency.

3. Explain windowing techniques in OFDM systems.

4. Explain cyclic prefixing in OFDM system

5. Explain orthogonal frequency division multiplexing with diagram

6. Discuss about the performance of digital modulation in frequency selective fading channels

7. Explain about the performance of digital modulation in flat fading channel

8. Explain GMSK transmitter and receiver with signal spacing diagram and give an expression for spectral efficiency 9. Briefly explain Peak Average Power Ratio(PAPR) in OFDM

10. What is MSK , explain with transmitter and receiver diagram . Explain the various types of demodulation of MSK

UNIT IV

MULTIPATH MITIGATION TECHNIQUES

1.What are the techniques used to improve the received signal quality?

Equalization, Diversity and Channel coding

2.Write the functions of diversity.

Diversity is used to compensate for fading channel impairments, and is usually implemented by using two or more receiving antennas. Diversity improves transmission performance by making use of more than one independently faded version of the transmitted signal.

3.Define spatial diversity.

The most common diversity technique is called spatial diversity, whereby multiple antennas are strategically spaced and connected to a common receiving system. While one antenna sees a signal null, one

of the other antennas may see a signal peak, and the receiver is able to select the antenna with the best signals at any time.

4.Principle of diversity

The principle of diversity is to ensure that the same information reaches the receiver (RX)on statistically independent channels

5.What is the function of channel coding?

Channel coding is used by the receiver to detect or correct some of the errors introduced by the channel in a particular sequence of message bits.

6.What is equalizer?

The device which equalizes the dispersive effect of a channel is referred to as an equalizer.

7. Define adaptive equalizer and write its operating modes.

To combat ISI, the equalizer coefficients should change according to the channel status soas to track the channel variations. Such an equalizer is called an adaptive equalizer since it adapts to the channel variations. Operating modes: Training mode and tracking mode

8.Write a short note on i)linear equalizers ii)non-linear equalizers

If the output is not used in the feedback path to adapt, then this type of equalizer is called linear equalizer.

If the output is fed back to change the subsequent outputs of the equalizer, this type of equalizer is called non linear equalizers.

9.Why nonlinear equalizers are preferred? List out the nonlinear equalization methods.

The linear equalizers are very effective in equalizing channels where ISI is not severe. These verity of ISI is directly related to the spectral characteristics. In this case there are spectral nulls in the transfer function of the effective channel, the additive noise at the receiver input will be dramatically enhanced by the linear equalizer. To overcome this problem, non linear equalizers can be used.

Decision feedback equalization (DFE), Maximum likelihood symbol detection and Maximum likelihood sequence estimation (MLSE) are the nonlinear equalization methods used.

10. **Compare macro and micro diversity.**

Macrodiversity	Microdiversity
Large-scale fading is caused by shadowing due to variations in both the terrain profile. This cause Macrodiversity	Small scale fading results in a Rayleigh distribution of signal strength over small distances. This cause Microdiversity
The distance between the transmitters is much longer than the wavelength in Macrodiversity	In microdiversity the distance is in the order of or shorter than the wavelength

12.Define STCM.

Channel coding can also be combined with diversity a technique called Space-Time Coded Modulation. The space-time coding is a bandwidth and power efficient method for wireless communication

12.What is tracking mode in an adaptive equalizer?

Immediately following this training sequence the user data is sent and the adaptive equalizer at the receiver utilizes a recursive algorithm to evaluate the channel and estimate filter coefficients to compensate for the distortion created by multipath in the channel.

13.What are the nonlinear equalization methods used?

Commonly used non linear equalization methods are:

i.Decision feedback equalization

iiMaximum likelihood symbol detection

iii.Maximum likelihood sequence estimation

14.Define Switched Diversity

If the signal level falls below the threshold, then the receiver switches to a new antenna which is called as switched diversity

15.Differentiate selection diversity and combining diversity.

Selection Diversity	Combining Diversity
The best signal is selected and processed while all other signals are discarded.	All signals are combined before Processing and the combined signal is decoded.
Simple circuits are used.	At individual receiver, phasing circuits are needed.
None of the signal is not in acceptable SNR.	It works well.

16.Define training mode in an adaptive equalizer?

First, a known fixed length training sequence is sent by the transmitter then the receivers equalizers may adapt to a proper setting of minimum bit error rate (BER) detection where the training sequence is a pseudo random binary signal or a fixed and prescribed bit patten.

17.Define Switched Diversity

If the signal level falls below the threshold, then the receiver switches to a new antenna which is called as switched diversity.

18. Define feedback or scanning diversity.

All the signals are scanned in a fixed sequence until one signal is found to be above a predetermined threshold.

19. Define temporal diversity.

Wireless propagation channel is time variant, so for sufficient decor relation, the temporal distance between antennas must be at least the half of maximum Doppler frequency

20.What is meant by frequency diversity?

Correlation is increased by transmitting information on more than one carrier frequency. Frequencies are separated by more than one coherence bandwidth of the channel. So the signals will not experience same fades.

PART B

1. Derive for the mean square error for linear equalizer during training adaptive equalizer

2. Explain the working principle of nonlinear equalizer based on decision feedback equalizer

3. Derive the expression for least mean square algorithm

4. Write different kind of performance of adaptive equalizer algorithm are determine the various factor and explain. 5. Explain the detail of maximum like hood sequence estimation (MLSE) of Nonlinear equalizer

6. Write detail operation of micro diversity in terms of Special, Temporal, Frequency, Angle polarization

7. What you mean by combining diversity and explain selective, switching combining diversity

8. Explain the following a). Error probability in flat-fading channels b).Symbol error rate in frequency selective fading channel

9. Write brief explanation of Rake receiver 10. Write combining techniques using combination of signal a. Maximum ratio combining b. Equal gain combining c. optimum combining d. Hybrid selection -maximum ratio combining

UNIT V

MULTIPLE ANTENNA TECHNIQUES

1.Differentiate selection diversity and combining diversity.

Selection Diversity	Combining Diversity
The best signal is selected and processed while all other signals are discarded.	All signals are combined before processing and the combined signal is decoded.
Simple circuits are used.	At individual receiver, phasing circuits are needed.
None of the signal is not in acceptable SNR.	It works well.

2. Define MIMO Systems.

MIMO systems are systems with Multiple Element Antennas (MEAs) at both transmitter and receiver. MIMO system offers high data rates and lower error rates.

3.**Define spatial multiplexing.**

Spatial multiplexing uses MEAs at the TX for transmission of parallel data streams. An original high-rate data stream is multiplexed into several parallel streams, each of which is sent from one transmit antenna element. A basic condition is that the number of receive antenna elements is at least as large as the number of transmit data streams

4.**Differentiate micro and macro diversity.**

Micro diversity	Macro diversity
Small scale fading results in a Rayleigh distribution of signal strength over small distances. This causes Microdiversity	Large-scale fading is caused by shadowing due to variations in both the terrain profile. This causes Macrodiversity
Used to reduce small scale fading effects.	Used to reduce large scale fading effects.
Multiple reflection causes deep fading. This effect is reduced.	Deep shadow causes fading. This effect is reduced.
BS-MS are separated by small distance.	BS-MS are separated by large distance.
In microdiversity the distance is in the order of or shorter than the wavelength.	The distance between the transmitters is much longer than the wavelength

5.**What is Preceding.?**

preceding scheme is designed to minimize the mean-squared error between the transmitted and received data with a per-user power constraint. Preceding allows to perform many complex processing at BS or Access Point(AP). It reduces computational complexities and provides better performance.

6.**Define Beamforming.**

Beam forming or smart antenna system uses phased array of antennas for transmitter and receiver. It can be used in any antenna system to create required antenna directive pattern to give the required performance under the given conditions.

7.**Define SDMA**

Space division multiple access controls the radiated energy for each user in space. It serves different users by using spot beam antennas.

8.**Define Transmit diversity.**

Diversity effect is achieved by transmitting signals from several transmit antenna. Two main cases are considered in transmit diversity. They are, 1.Transmitter diversity with the CSI(Channel State information) 2. Transmitter diversity without the CSI(Channel State information

9.**What is meant by frequency diversity?**

Correlation is increased by transmitting information on more than one carrier frequency. Frequencies are separated by more than one coherence bandwidth of the channel. So the signals will not experience same fades.

10.**Define Receiver diversity.**

Receiver diversity uses two separate, collocated antennas for receive functions. Such a configuration eliminates the need for a duplexer and can protect sensitive receiver components from the high power used in transmit

11. Write the two types of spread spectrum?

Types of spread spectrum are: Direct Sequence Spread Spectrum (DS-SS) Frequency hop spread spectrum (FH-SS)

12. What do you mean by spread spectrum?

Spread spectrum multiple access uses signals which have a transmission bandwidth whose magnitude is greater than the minimum required RF bandwidth. A pseudo noise (PN) sequence converts a narrowband signal to a wideband noise like signal before transmission

13. What is PN sequence?

Pseudo noise sequence is a coded sequence of 1's and 0's with autocorrelation properties.

14. When is the PN sequence called as maximal length sequence?

When the pseudo-noise sequence generated by linear feedback shift register has the length (N) of 2m-1 where m is number of stages in shift register is called maximal length sequence.

15. Write the properties which a PN sequence should have.

Properties of PN sequence are: i. Balance property ii. Run property iii. Correlation property

16. Define chip duration and chip rate.

The duration of every bit in PN sequence is known as chip duration. The number of bits (chips) per second is called chip rate.

17.List the advantages and disadvantages of DS-SS.

Advantages of DS-SS: i. The performance of DS-SS in presence of noise is superior to FH-SS. ii. Good antijamming capability. iii. Low multipath interference. Disadvantages of DS-SS: i. Poor synchronization. ii. Requires large bandwidth.

18. Define jamming and jamming margin.

Jamming is a multitone or powerful broad band noise. It is the ratio of the average interference power and the signal power. Jamming margin in dB as the difference between the processing gain in dB and minimum SNR in dB**.**

19. What is meant by anti-jamming?

With the help of spread spectrum method, the transmitted signals are spread over the mid frequency band. Hence these signals appear as noise. Then it becomes difficult for the jammers to attack our signal. This method is called antijamming.

20.List the advantages and disadvantages of FH-SS.

Advantages of FH-SS: i. High processing gain than DS-SS. ii. Shorter acquisition time makes the system fast. Disadvantages of FH-SS: i. FH-SS requires large bandwidth. ii. Circuit used for FH-SS is complex. Expensive frequency synthesizers are required.

PART B

1.With diagram explain the system model for MIMO systems.

2. Discuss about the operation of spatial multiplexing systems.

3. Explain the operation of transmit precoding and receiver precoding schemes?

4. Why is beam forming important for wireless systems, With illustration explain transmit beam forming, receive beam forming and opportunistic beam forming.

5. Using diagrams explain transmit diversity and receive diversity.

6. Derive the capacity of a fading channel for information transmitted from a wireless system.

7. Derive the capacity of a Non fading channel for information transmitted from a wireless system.

8. What is channel state information? Explain the different kinds of channel state information.

9. What are smart antennas? Why are they required for and what are the different approaches for capacity gains?

10. Compare the capacity of a fading and a non fading channel for information transmitted from a wireless system.