EC2401- WIRELESS COMMUNICATION

UNIT I – SERVICES AND TECHANICAL CHALLENGES

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 is 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?

In CDMA system, MSC selects received signals from a variety of base stations with
the help of software. This is called as soft 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 between the distances 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 BCC system.

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 into smaller cells each
with its own base stations and a corresponding reduction in antenna height and
transmitter power. It increases the capacity of cellular system.

21. What is sectoring?

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

1. What is propagation model?

Propagation models that predict the mean signal strength for an arbitrary transmitter –receiver separation distance are useful in estimating the radio coverage area of a transmitter.

2. Define large scale propagation model?

The propagation models that characterize the signal strength over large T-R separation distance (several hundreds or thousands of meters.

3. What is small scale model?

The propagation models that characterize the rapid fluctuations of the received signal strength over very short travel distances (a few wavelengths) or short time duration.

4. What is free space propagation model?.

The free space propagation model is used to predict received signal strength, when unobstructed line-of-sight path between transmitter & receiver.

5. Define EIRP.

EIRP of a transmitting system in a given direction as the transmitter power that would be needed, with an isotropic radiator, to produce the same power density in the given direction EIRP=PtGt

      Where Pt-transmitted power in w

      Gt-transmitting antenna gain

6. Explain path loss?

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

7.What is intrinsic impedance& Brewster angle?

It is defined by the ratio of electric to magnetic field for a uniform plane wave in the particular medium. The Brewster angle is the angle at which no reflection occurs in the origin.

8. What is scattering?

When a radio wave impinges on a rough surface , the reflected energy is spread out in all directions due to scattering.

9. Define radar cross section?

Radar Cross Section of a scattering object is defined as the ratio of the power density of the signal scattered in the direction of the receiver to the power density of the radio wave incident upon the scattering object & has units of squares meters.

10. Name some of the outdoor propagation models?

Some of the commonly used outdoor propagation models are

      1. Longely-Rice model

      2. Durkin's model

      3. Okumura model.

11. What is the function of outdoor propagation models?

The outdoor propagation models aim to predict signal strength at a particular receiving point or in a specific local area.

12. Define indoor propagation models?

The indoor propagation models are used to characterizing radio propagation inside the buildings.

13. Mention some indoor propagation models?

Some indoor propagation models are

      1. Long –distance path loss model

      2. Ericession multiple break point model

      3. Attenuation factor model.

14. Explain small scale fading?

Small scale fading is used to describe the rapid fluctuations of the amplitudes, phases, or multipath delays of a radio signal over a short period of time or travel distance.

15. What are the factors influencing small scale fading?

Factors influencing small scale fading are

      1. Speed of surrounding objects

      2. Multipath propagation

      3. Speed of the mobile

      4.Transmission bandwidth of the signal.

16. Define Doppler shift?

The shift in received signal frequency due to motion is called the Doppler shift.

17. What 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.

18. 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.

19. Define fast fading channel?

The channel impulse response changes rapidly within the symbol duration. This type of a channel is called fast fading channel.

20. Define slow fading channel?

The channel impulse response changes at a rate much slower than the transmitted baseband signal. This type of a channel is called slow fading channel.

1. Write the advantages of MSK over QPSK.

(i) 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.

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

2. 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.

3. What is quadrature modulation?

Sometimes two or more quadrature carriers are used for modulation. It is called quadrature modulation.

4. What is QAM?

At high bit rates a combination of ASK and PSK is employed in order to minimize the errors in the received data. This method is known as "Quadrature Amplitude Modulation".

5. Define QPSK?

QPSK is a multilevel modulation in which four phase shifts are used for representing four different symbols.

6. 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 a constant envelope.

7. 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.

8. What is the need of Gaussian filter?

Gaussian filter is used before the modulator to reduce the transmitted bandwidth of the signal. It uses less bandwidth than conventional FSK.

9. Mention some merits of MSK

1. Constant envelope
2. Spectral efficiency
3. Good BER performance
4. Self-synchronizing capability
5. MSK is a spectrally efficient modulation scheme and is particularly attractive for use in mobile radio communication systems.

10. Give some examples of linear modulation?

    1. Pulse shaped QPSK

    2. OQPSK

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

    1. Equalization

    2. Diversity

    3. Channel coding

12. What is the need of equalization?

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

13. 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.

14. Define spatial diversity?

The most common diversity technique is 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 antenna may sees a signal peak, and the receiver is able to select the antenna with the best signals at any time.

15. 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.

16. Define adaptive equalization?

To combine Inter Symbol Interference, the equalizer coefficients should change according to the channel status so as to break channel variations. Such an equalizer is called an adaptive equalizer since it adapts to the channel variations.

17. 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 detection where the training sequence is a pseudo random binary signal or a fixed and prescribed bit pattern.

18. 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.

19. Write a short note on linear equalizers and non linear equalizers?

Linear equalizers: If the output d(t) is not used in the feedback path to adapt the equalizer. This type of equalizers is called linear equalizer.

Nonlinear equalizers: If the output d(t) is fed back to change the subsequent outputs of the equalizers is called non linear equalizers.

21. Why non linear equalizers are preferred?

The linear equalizers are very effective in equalizing channels where ISI is not severe. The severity of the ISI is directly related to the spectral characteristics. In this case that there are spectral noise 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 are used.

22. What is the nonlinear equalization methods used?

      1. Decision feedback equalization

      2. Maximum likelihood symbol detection

      3. Maximum likelihood sequence estimation

23. What are the factors used in adaptive algorithms?

      1. Rate of convergence

      2. Mis adjustments

      3. Computational complexity

24. Define MSE in equalizers

The mean square error is a error between the desired equalizer output and the actual equalizer output.LMS equalizers are used to minimize to MSE.

25. Write the advantages of LMS algorithm.

      1. The LMS equalizer maximizes the signal to distortion at its output within the constraints of the equalizer filter length.

      2. Low computational complexity

      3. Simple program

26. What are the advantages of RLS algorithm.

      1.Fast convergence.

      2.Good tracking ability. If smaller value of weighting coefficient The equalizer has better tracking ability.

27. Define diversity concept?

If one radio path undergoes a deep fade, another independent path may have a strong signal. By having more than one path to select from, both the instantaneous and average SNRs at the receiver may be improved often by as much as 20dB to 30dB.

UNIT-IV – SIGNAL PROCESSING IN WIRELESS SYSTEMS

1. What are the two types of linear predictive coders?

      i) Multipulse excited linear predictive coder

      ii) Stochastic or code excited linear predictive coder

2. What is the criterion for the selection of speech coders for mobile communication?

Because of the limited bandwidth, it is required to compress speech to maximize the number of users on the system. Other criterion includes end-to-end encoding delay, the algorithmic complexity of the coder, dc power requirements, compatibility, robustness.

3. What is multiple access?

Multiple access schemes are used to allow many mobile users to share simultaneously a finite amount of radio spectrum. It is required to achieve high capacity by simultaneously allocating the bandwidth to mulitple users.

4. What is frequency division duplexing?

It is duplexing done using frequency techniques.FDD provides two distinct bands of frequencies for every user. The forward band provides traffic from th base station to the mobile, and the reverse band provides traffic from the mobile to the base station.

5. What are the multiple access techniques?
   i) Frequency division multiple access
   ii) Time division multiple access
   iii) Code division multiple access

6. What is a wide band system?

In wideband system, the transmission bandwidth of a single channel is much larger than the coherence bandwidth of the channel. Thus multipath fading does not greatly vary the received signal power within a wideband channel.

7. What are the nonlinear effects in FDMA?

In FDMA, many channels share the same antenna at the base station. The power amplifiers are nonlinear which causes signal spreading in the frequency domain and generate inter modulation frequencies. It is undesirable and can result in interference.

8. What is time division multiple access?

Time division multiple access systems divide the radio spectrum into time slots and in each slot only one user is allowed to either transmit or receive.

9. What is fast and slow frequency hopping?

If the rate of change of the carrier frequency is greater than the symbol rate, then the system is referred to as fast frequency hopping. If the rate of change of the carrier frequency is lesser than the symbol rate, then the system is referred to as slow frequency hopping.

10. Define capacity of cellular systems.

It can be defined as the maximum number of channels or users that can be provided in a fixed frequency band.

11. Define forward channel interference.

For a particular subscriber unit, the desired base station will provide the desired forward channel while the surrounding co-channel base stations will provide the forward channel interference.

12. Define adaptive channel allocation.

Adaptive channel allocation in TDMA eliminates system planning since it is not required to plan frequencies for cells.

13. What are vocoders?

Vocoders are speech coders that are used for signal compression. Vocoders are based on priori knowledge about the signal to be coded, and hence are signal specific.

14. Define adaptive equalizer.

To combat ISI, the equalizer coefficients should change according to the channel status so as to track the channel variations. Such an equalizer is called an adaptive equalizer since it adapts to the channel variations.

15. Where is decision feedback equalizer used?

The decision feedback equalizer is particularly used for channels with severe amplitude distortions and has been widely used in wireless communications.

16. Write the basic algorithms used in adaptive equalization.

      i)Zero forcing algorithm

      ii)Least Mean square algorithm

      iii)Recursive Least square algorithm

17. What is EIRP?

Effective isotropic radiated power is referenced to an isotropic source. The difference between ERP and EIRP is 2dB ERP=EIRP-2dB

18. What is PHP?

PHP means Personal Handy Phone System. It is otherwise called PHS. PHP is a wireless communication TDD System which supports personal communication services (PCS). It uses small, low-complexity light weight terminals called Personal Stations (PSS).

UNIT-V – ADVANCED TRANCEIVER SCHEMES

1. What is narrow band system?

In narrow band multiple access system; the variable radio spectrum is divided into a large number of narrowband channels. The channels are operated using FDD.

2. Define SDMA

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

3. State some of the features of CDMA

      i) Users of CDMA share the same frequency.

      ii) CDMA has soft capacity limit.

      iii)Multipath fading may be substantially reduced

iv) Channel data rates are very high

4. Define efficiency of TDMA

The efficiency of a TDMA is a measure of the percentage of transmitted data that contains information as opposed to providing overhead for the access scheme.

5. What are the features of TDMA?

i) TDMA shares a single carrier frequency with several users, where each user makes use of non overlapping time slots.

ii) Data transmission occurs in bursts.

iii)Hand off process is much simpler

iv) Duplexers are not required, since transmission and reception occurs at different time slots.

6. What is time division multiplexing?

TDD uses time instead of frequency to provide both a forward and reverse link. Multiple users share a single radio channel by taking turns in the time domain.

7. What are the features of FDMA?

i) FDMA channel carries only one phone circuit at a time

ii) The bandwidth of FDMA channels are relatively narrow as each channel supports only one circuit per carrier.

8. Why the second generation was developed?

The second – generation systems have been developed to provide higher quality signals, higher data rate for support of digital services and greater capacity.

9. What are second generation are available?

  i)Global System Mobile (GSM) in Europe

  ii) Interim standard

  iii)Pacific Digital Cellular

  iv)Interim standard-95

10. Write advantages 2G over 1G.

  i) Natural integration with the evolving digital wireless network

  ii) Higher data rate

  iii) Flexibility for capacity expansion

11. What are services offered by GSM?

  i) Telephone services

  ii) Bearer or Data services

  iii) Supplementary services

12. What is the function of NSS in GSM?

The NSS managing the switching function of the systems and allows the MSCs to communicate with other networks such as PSTN and ISDN.

13. Define Abis Interface.

The interface which connects a Base Transceiver Station (BTS) to a Base Station Controller (BSC) is called the Abis Interface.

14. Define A Interface.

The interface between a BSC and a MSC is called the A interface , which is standardized within GSM

15. What is the function of VLR?

The VLR is a database which temporarily stores the IMSI and customer information for each roaming subscriber who is visiting the coverage area of a particular MSC.

16. What are the basic channels available in GSM?

     i) Traffic Channels (TCHs)

     ii)Control Channels (CCHs)

17. Define the bursts.

Data is transmitted small portions called bursts.

18. Write types of TCH channels of GSM?

     i)Full-rate TCH

     ii)Half-rate TCH

19. What is the need guard period (space)?

The guard period is used to avoid overlapping with other bursts due to different path delays and to give the transmitter time to turn on and off.

20. Why Dummy burst is used?

Dummy burst is used as filter information for unused time slots on the forward link.

21. Define burst formatting in GSM.

Burst formatting adds binary data to the ciphered blocks, in order to help Synchronization and equalization of the received signal.

22. What is the need of pilot channel?

The pilot channel is intended to provide a reference signal for all MSS within a cell Provides the phase reference for coherent demodulation.

23. What are the supervisory signals are used AMPS?

The supervisory signals are the supervisory audio tone(SAT) and signaling tone(ST).

24. What are the advantages of N-AMPS over AMPS?

N-AMPS provided three uses in a 30 kHz AMPS by using FDMA and 10 kHz channel and provided three times the capacity of AMPS.

25. Define Piconet.

The simplest Bluetooth networks called piconet can have from two to eight nodes. Piconet is a collection of Bluetooth devices which are synchronized to the same hopping sequence.

26. What is Bluetooth?

Bluetooth is an open specification for the short range wireless voice and data Communication that's was originally developed for cable replacement in personal area networking to operate all over the world.

27. What is Scatternet?

One Bluetooth devices can operate simultaneously on two piconet acting as a bridge between the two. A conglomeration of two or more piconet is called a scatter net.

PART-B

1. Explain in detail the evolution of wireless communication? (8 Marks)

- Explanation of different standards in different years
- Mobile radio system standards

2. Write short notes on different trends in cellular radio & personal communication.(8Marks)

- Explanation of different trends in cellular radio
- Explanation of different trends in personal communication

3. Write short notes on frequency reuse & channel assignment. (16 Marks)

- Concept of frequency reuse
- Fixed channel assignment
- Dynamic channel assignment

4. Explain the different hand off strategies used in wireless communication (8 Marks)

- Concept of Handoff
- Different types of handoff

5. Explain in detail the different techniques used to improve coverage &capacity of cellular system .(16 Marks)

- Explanation of cell splitting
- Explanation of sectoring
- Explanation of micro zone coverage

6.Explain the free space propagation model ?(8 Marks)

- Free space model & equation
- Path loss model explanation

7.What is reflection?. Explain in detail the reflection from dielectric and conductors. (16Marks)

- Explanation of reflection & reflection coefficient from dielectric.
- Explanation of reflection from conductors.

8. Write short notes on diffraction and scattering . (16 Marks)

- Explanation of diffraction & fresnel zone geometry
- Explanation of scattering.

9.Explain in detail the indoor & outdoor propagation model . (16 Marks)

- Outdoor propagation model – longley rice model ,durkin model explanation
- Indoor model – partition loss ,log distance path loss model.

10. Explain in detail the small scale multipath propagation and its different measurements. (16 Marks)
- Explanation of small scale multipath propagation
- Measurements –spread spectrum sliding channel sounding, frequency domain channel sounding.

11. Write short notes on small scale fading. (8 Marks)
- Explanation of small scale fading
- Flat fading, frequency selective fading types

12. Explain in detail the generation & detection of MSK technique? (16 Marks)
- Principle of MSK
- MSK transmitter block diagram &explanation
- MSK receiver block diagram &explanation

13. Explain in detail the generation & detection of GMSK modulation? (16 Marks)
- Principle of GMSK
- GMSK transmitter block diagram &explanation
- GMSK receiver block diagram &explanation

14. Write short notes on M-ary QAM & M-ary FSK. (16 Marks)
- Principle & generation of M-ary QAM
- Principle & generation of M-ary FSK

15. Explain the performance of digital modulation in slow flat fading channel.(16 Marks)
- Explanation & comparison of digital modulation
- Performance results for ASK,FSK,QPSK,MSK

16. Explain the working principle of RAKE Receiver ? (8 Marks)
- Block diagram of RAKE receiver
- Working principle

17. Explain the working principle of Linear predictive coder (16 Marks)
- Block diagram of Linear predictive coder
- Working principle
- Advantages

18. Explain the working principle of GSM codec with neat block diagram. (16 Marks)
- Block diagram of GSM codec
- Working principle
- Advantages

19. Explain in detail the TDMA & FDMA multiple access techniques. (16 Marks)
- TDMA working principle &advantages
- FDMA working principle &advantages

20. Explain in detail the CDMA multiple access technique. (16 Marks)

- CDMA working principle
- Advantages & comparison with other techniques.

21. Compare the performance of TDMA ,FDMA, CDMA ,SDMA techniques .
(8 Marks)

- Principles of TDMA ,FDMA, CDMA ,SDMA
- Comparison of above techniques.

22.Explain in detail the 1G,2G,3G generation systems & their standards .(16 marks)

- Explanation of generation models of 1G,2G,3G
- Explanation of their standards

23. Explain about AMPS with neat diagram. (16 marks)

- Structure of AMPS
- Explanation of AMPS

24. Explain forward & reverse channel parameters of IS-95 CDMA. (16 marks)

- Explanation of IS-95 system
- Different forward channels and details
- Different reverse channels and details

25. Draw the functional block diagram DECT system and explain its working
principle.(16 marks)

- Structure of DECT system
- Working principle –explanation

26. Write short notes on WLL. (8 marks)

- WLL working principle
- Explanation, advantages
- Applications