Subject Name: WIRELESS COMMUNICATION AND NETWORKS

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Year and Sem, Department: IV Year I Sem ECE Dept.

Important points / Definitions:

Unit-I

1. Frequency reuse in mobile cellular systems means that frequencies allocated to the service are reused in a regular pattern of cells, each covered by one base station. The repeating regular pattern of cells is called cluster.

2. When the mobile unit travels along a path it crosses different cells. Each time it enters into a different cell associated with f = different frequency, control of the mobile is taken over by the other base station. This is known as 'Hand off'.

3. There is a likelihood that a call is blocked if all the RF channels are engaged. This is called 'Grade of Service' "GOS".

4. A given cell/sector uses a number of RF channels. Because of imperfect receiver filters, which allow nearby frequencies to leak into pass band, adjacent channel interference takes place.

5. a cellular system having a cell radius "R" and Co-channel distance "D" and the cluster size "N". Since the cell size is fixed, co-channel interference will be independent of power.

co-chl interference is a function of "q" = D/R.Q = Co-chl interference reduction factor.

"q" is also related to cluster size (N) as q = 3N ,q = 3N = D/R.

6. Each cell is allocated a group of k channels, The S channels are divided among N cells. the total number of available radio channels S = K * N

7. The N cells which use the complete set of channels is called cluster. •

8. The cluster can be repeated M times within the system. The total number of channels, C, is used as a measure of capacity C = M k N.

9. The number of cells per cluster, N, can only have values which satisfy

$$N = i^2 + ij + j^2$$

Co-channel neighbors of a particular cell, ex, i=3 and j=2.

10.

Handoff margin $\Delta = P_{r,handoff} - P_{r,minimumusable}$ cannot be too large or too small.

If Δ is too large, unnecessary handoffs burden the MSC

If Δ is too small, there may be insufficient time to complete handoff before a call is lost.

11. Dwell time: the time over which a call may be maintained within a cell without handoff. Dwell time depends on – propagation – interference – distance – speed.

12. For hexagonal geometry with 7-cell cluster, with the mobile unit being at the cell boundary, the signal-to-interference ratio for the worst case can be approximated as

$$\frac{S}{I} = \frac{R^{-4}}{2(D-R)^{-4} + (D-R/2)^{-4} + (D+R/2)^{-4} + (D+R)^{-4} + D^{-4}}$$

13. Cell Splitting: subdividing a congested cell into smaller cells.

14. Sectoring: directional antennas to control the interference and frequency reuse.

15. Coverage zone : Distributing the coverage of a cell and extends the cell boundary to hard-to-reach place.

16. Cells with the same frequency band must have a minimum distance from each other, known as the reuse distance D:

$$D = \sqrt{3N}R$$

17.The carrier-to-cochannel-interferenceratio isexpressedas

$$\frac{C}{I} = \frac{1}{6}q^n = \frac{1}{6}\left(\frac{D}{R}\right)^n = \frac{1}{6}(3N)^{n/2}$$

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

Unit-I: The Cellular Concepts-Systems Design Fundamentals

1. Draw the block diagram of cellular system. [**May – 2019]**
2. Write short notes on GOS. [**May – 2019]**
3. What are prioritizing Handoffs [**May – 2017]**
4. Explain about Sectoring [**May – 2017]**
5. Define Co-channel Interference.**[June -2018]**
6. Define handoff. [**June -2018]**
7. What is intersystem handoff **[April-2018]**
8. Define Adjacent-channel Interference [**April-2018]**
9. Define Coherence time.**[May/June-2019]**
10. List out various methods of reducing co-channel interference.**[May/June-2019]**
11. Write short notes on channel sharing. **[May/June-2019]**
12. What is meant by handoff initiation? **[May/June-2019]**

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Explain frequency reuse concept. .[**May – 2019]** .[**May – 2017],[June – 2018]**
2. Discuss about trunking and Grade of service. .[**May – 2019]** .[**May – 2017],[April-2018]**
3. How we can improve coverage and capacity in cellular system? .[**May – 2019]**
4. Determine the number of cells in cluster for the following values of the shift Parameters i and j in a regular hexagon geometry pattern: (i) i=2 and j=4 (ii) i=3 and j=3. .[**May – 2019]**
5. Write short notes on Channel assignment strategies**. [May – 2017]**
6. Why Sectorization of cell is very important and writes its advantages **[May – 2016]**
7. What is Handoff process? Explain the hand off mechanism **[May – 2016]**
8. Prove that for a Hexagonal geometry, the co-channel reuse ratio is given by Q = √3 N, where $N = i^2 + ij + j^2$ **[May – 2016]**
9. Draw the block diagram of cellular system **[May- 2019]**
10. Define Co-channel Interference **[June-2018]**
11. Discuss different techniques used for improving coverage and capacity in cellular systems **[June- 2018]**
12. Write short notes on blocking probability **[June-2018]**
13. Explain the various types of Handoff processes available

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. Which of the following is/are the main part(s) of basic cellular system **[D]**
.a) A mobile Unit b) A cell Site
c) A mobile Telephone Switching Office d) All of the above

2. State whether True of False. i) The cells or subdivisions of a geographical area are always hexagonal. ii) A land to Mobile call originates through the Telephone exchange. **[B]**
a) True, False b) False, True
c) False, False d) True, True

3. Which mode is used for installing networks in wireless communication device characteristics? **[C]**
a) Fixed and wired. b) Mobile and wired.
c) Fixed and wired. d) Mobile and wireless.

4.A antenna which attempts to direct all its energy in a particular direction is called as **[D]**
a) Directional Antenna b) One to One Antenna
c) Propagation Antenna d) Single Direction Antenna

5. Which of the following is called an ideal antenna? **[C]**
a) Dipole antenna b) Directional antenna
c) Isotropic antenna d) Loop antenna

6.Which of the following antenna radiates power with unit gain uniformly in all directions **[A]**
a) Directional antenna b) Dipole antenna
c) Isotropic antenna d) Loop antenna

7. Why neighboring stations are assigned different group of channels in cellular system? **[A]**
a) To minimize interference b) To minimize area
c) To maximize throughput d) To maximize capacity of each cell

8. EIRP is abbreviated as ? **[A]**
a) Effective isotropic radiated power b) Effective isotropic radio power
c) Effective and immediate radiated power d) Effective and immediate ratio of power

9. What is a cell in cellular system? **[C]**
a) A group of cells b) A group of subscribers
c) A small geographical area d) A large group of mobile systems

10. What is frequency reuse? **[D]**
a) Process of selecting and allocating channels b) Process of selection of mobile users
c) Process of selecting frequency of mobile equipment d) Process of selection of number of cells

11. Why the shape of cell is not circle? **[C]**
a) Omni directionality b) Small area
c) Overlapping regions or gaps are left d) Complex design

12. What is the main reason to adopt hexagon shape in comparison to square and triangle? **[A]**
a) Largest area b) Simple design
c) Small area d) Single directional

13. Which type of antenna is used for center excited cells? **[D]**
a) Dipole antenna b) Grid antenna
c) Sectored antenna d) Omnidirectional antenna

14. Which type of antenna is used for edge excited cells? **[C]**
a) Omnidirectional antenna b) Grid antenna
c) Sectored directional antenna d) Dipole antenna

15. What is a cluster in a cellular system? **[B]**
a) Group of frequencies b) Group of cells
c) Group of subscribers d) Group of mobile systems

16. What is a borrowing strategy in fixed channel assignments? **[A]**
a) Borrowing channels from neighbouring cell b) Borrowing channels from neighbouring cluster
c) Borrowing channels from same cell d) Borrowing channels from other base station in same cell

17. What is the drawback of dynamic channel assignment**?** **[D]**
a) Decrease channel utilization b) Increase probability of blocked call
c) Cross talk d) Increase storage and computational load on system

18. Which of the following is not a source of interference? **[A]**
a) Base station in different cluster b) Another mobile in same cell
c) A call in progress in neighbouring cell d) Any BS operating on same frequency

19. What are co-channel cells? [D]
a) Cells having different base stations b) Cells using different frequency
c) Cells using adjacent frequency d) Cells using same frequency

20. Actual radio coverage of a cell is called _____ **[B]**
a) Fingerprint b) Footprint
c) Imprint d) Matrix

21. For a cellular system, if there are N cells and each cell is allocated k channel. Then _____ is the total number of available radio channels, S. **[A]**
a) S=k*N b) S=k/N
c) S=N/k d) $S=k^N$

22.The _____is not an objective for channel assignment strategies **[D]**
a) Efficient utilization of spectrum b) Increase of capacity
c) Minimize the interference d) Maximize the interference

23.In fixed channel assignment strategy, each cell is allocated a predetermined set of _____ **[A]**
a) Voice channels b) Control channels
c) Frequency d) base stations

24.A call in fixed channel strategy, if all the channels in a cell are occupied is called ____**[C]**
a) Queued b) Cross talk
c) Blocked d) Delayed

25. In dynamic channel assignment strategy, base station requests channel from ____ **[A]**
a) MSC b) Neighbouring cell
c) Neighbouring cluster d) Neighbouring base station

26. RSSI stands for _____ **[A]**
a) Radio System Signal Indicator b) Restricted Signal Strength Indicator
c) Radio Signal Strength Indication d) Restricted System Software Indicator

27. Interference on voice channels causes _____ **[B]**
a) Blocked calls b) Cross talk
c) Queuing d) Missed calls

28. Interference in control channel leads to _____ **[C]**
a) Cross talk b) Queuing
c) Blocked calls d) Voice traffic

29.Co-channel interference is a function of _____ **[A]**
a) Radius of cell b) Transmitted power
c) Received power d) Frequency of mobile user

30. Co-channel reuse ratio is define by _____ [B]
a) Q=D*R b) Q=D/R
c) Q=D^R d) Q=1/R

31. Co-channel ratio in terms of cluster size is defined as _____ **[A]**
a) √(3N) b)N
c) 3N d) √N

Important points / Definitions:

Unit-II

1. A simple approach to propagation modeling is to estimate the power ratio between transmitter and receiver as a function of the separation distance d, that ratio is referred to as path loss.

2. the Friis' power transmission formula in free space. A transmitted power source P_t radiates spherically, with an antenna gain G_t; the portion of that power impinging an effective area A_e at a distance d is $P_r = P_t G_t A_e / (4\pi d^2)$

3. The path loss for the Friis free-space equation in decibels is

$$P_r(d) = 20\log_{10}(d) + 20\log_{10}(4\pi) - G_t - G_r - 20\log_{10}(\lambda). \qquad (5.278)$$

4. The path loss reflects how much power is dissipated between transceiver and receiver antennas (without counting any antenna gain).

$$L(\text{dB}) = 32.45 + 20 \times \log(f/f_0) + 20 \times \log(d/d_0)$$

5. Ray tracing is a method that uses a geometric approach, and examines what paths the wireless radio signal takes from transmitter to receiver as if each path was a ray of light

6.An isotropic radiator is an ideal antenna which radiates power with unit gain uniformly in all directions ,the effective isotropic radiated power (EIRP) is defined as

EIRP = P_t * Gt

7. The Fraunhofer region of a transmitter antenna is defined as the region beyond the far-field distance d_f which is inversely proportional to wave length 'λ'

$$d_f = \frac{2D^2}{\lambda}$$

8. The relationship between electric field with received power at a distance d is

$$P_r(d) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2}$$

9. The **Reflection , Diffraction and Scattering** are the three mechanisms which impact propagation in a mobile radio communication system.

10. The Brewster Angle is the angle at which no reflection occurs in the medium of origin and it is expressed as

$$\text{Sin } \Theta_B = \frac{\sqrt{\epsilon_r} - 1}{\sqrt{\epsilon_r^2} - 1}$$

11. the path loss for the two-ray model to be expressed

$P_L(\text{dB}) = 40 \log d - (10 \log G_t + 10 \log G_r + 20 \log h_r + 20 \log h_t)$

12. *Scattering* is what happens when a wave impinges on an object that is rough

13..The most common extension of the free-space model is the log-distance path-loss model. This classic model is based on extensive channel measurements.

$$P_r(d) = \alpha + 10\beta \log_{10}(d) + \eta \qquad (5.281)$$

14. The Radar Cross Section is defined as the ratio of the power density of the signal scattered in the direction of a receiver to the power density of the radio waves.

15. Partition Losses' in Indoor propagation model is classified into two types such as hard partition and soft partition losses'.

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

Unit-II: Mobile Radio Propagation Large-Scale Path Loss

1. Discuss about Brewster angle. . [**May – 2019][April-2018]**
2. .Write a short note on signal reflections in a flat terrain. [**May – 2019]**
3. Discuss about Hata Model [**May – 2017]**
4. write about site specific modeling [**May – 2017]**
5. Explain knife Edge Diffraction Model **[June -2018]**
6. Discuss about Longley-Ryce Model **[April-2018]**
7. Discuss about Ericsson Multiple Breakpoint Model [**April-2018]**
8. What are basic propagation mechanisms? [**May/June-2019]**

9 Explain signal reflections in flat [**May/June-2019]**

10. Explain signal reflection in hilly terrain. [**May/June-2019]**

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Discuss in detail i) The propagation in near distance ii) Long distance propagation.[**May – 2019]**
2. Explain knife-edge diffraction model. .[**May – 2019],[April-2018]**
3. Explain the phase difference between direct and reflected paths in detail. .[**May – 2019]**
4. Discuss about indoor propagation models in detail.[**May – 2019]**
5. Discuss about Brewster angle. **[May – 2017]**
6. Explain about Longley-Ryce model. **[May – 2017]**
7. Explain in detail about Ground Reflection Model **.[May.– 2017]**
8. Derive the equation of the Path loss using Two-Ray Model with neat diagrams **[June-2018]**
9. How the received signal strength is predicted using the free space propagation Model? Explain. **[June-2018],[April-2018]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. Fading of the received radio signals in a mobile communication environment occurs because of **[B]**

A) Direct propagation B) Multipath Propagation
C) Bi-path Propagation D) None of the above

2, The mechanism behind electromagnetic wave propagation cannot be attributed to **[D]**

a) Reflection b) Diffraction
c) Scattering d) Sectoring

3. The propagation model that estimates radio coverage of a transmitter is called **[A]**

a) Large scale propagation model b) Small scale propagation model
c) Fading model d) Okumura model

4.Free space propagation model is to predict **[A]**

a) Received signal strength b) Transmitted power
c) Gain of transmitter d) Gain of receive

5. Which of the following do not undergo free space propagation? **[D]**

a) Satellite communication system b) Microwave line of sight radio links
c) Wireless line of sight radio links d) Wired telephone systems

6. The free space model predicts that received signal decays as a function of **[B]**

a) Gain of transmitter antenna b) T-R separation
c) Power of transmitter antenna d) Effective aperture of the antenna

7. Relation between gain and effective aperture is given by **[A]**

a) $G=(4\pi Ae)/\lambda 2$ b) $G=(4\pi \lambda 2)/ Ae$
c) $G=4\pi Ae$ d) $G=Ae/\lambda 2$

8. Fraunhofer distance is given by **[A]**

a) $2D2/\lambda$ b) $2D/\lambda$
c) D/λ d) $2D/\lambda 2$

9. Far field region is also known as **[B]**

a) Near field region b) Fraunhofer region
c) Erlang region d) Fresnel region

10. Path loss in free space model is defined as difference of **[D]**

a) Effective transmitted power and gain b) Effective received power and distance between T-R
c) Gain and received power d) Effective transmitter power and receiver power

11 Which of the following mechanism do not impact propagation in mobile communication system? **[D]**

a) Reflection b) Diffraction
c) Scattering d) Refraction

12 What is the dimension of object as compared to wavelength of propagating wave when reflection occurs? **[A]**

a) Large
b) Small
c) Same
d) Very small

13 The wave propagating from one medium to another gets partially reflection and partially transmitted is _____ **[B]**
a) Both mediums have same electrical properties b) Both mediums have different electrical properties
c) Both mediums have same magnetic properties d) Both mediums have different magnetic properties

14. The _____case of reflection, in course of second medium being a perfect dielectric **[C]**
a) Loss of energy during absorption b) Total energy reflected back to first medium
c) No loss of energy in absorption c) Total energy transmitted into second medium

15 Scattering occurs when medium consists of objects with dimensions _____ compared to wavelength**.** **[B]**
a) Same b) Small
c) Large d) Very large

16 The _____ relates the incident and reflected & transmitted wave **[D]**
a) Fresnel transmission coefficient b) Scattering coefficient
c) Diffraction coefficients d) Fresnel reflection coefficient

17 Reflection coefficient is not a function of _____ **[B]**
a) Material property b) Diffraction loss
c) Wave polarization d) Angle of incidence

18 Polarized wave can be mathematically represented as sum of _____ **[C]**
a) Four orthogonal components b) Two spatially adjacent components
c) Two spatially orthogonal components d) Six orthogonal components

19 Permittivity and conductivity are insensitive to _____ for a good conductor **[A]**
a) Operating frequency b) Polarization density
c) Electric field d) Property of material

20 Velocity of electromagnetic wave can be given by _____ **[A]**
a) $1/\sqrt{(\mu\in)}$ b) $\mu/\in$
c) $1/(\mu\in)$ d) $\mu\in$

21 The boundary condition at the surface of incidence obeys _____ **[D]**
a) Kepler's law b) Gauss law
c) Faraday law d) Snell's law

22 The angle at which no reflection occurs in the medium of origin is called _____ **[C]**
a) Azimuth angle b) Elevation angle
c) Brewster angle d) Inclination angle

Unit III
Important points / Definitions:

1.factors influencing small-scale fading •Rapid changes in signal strength over a small travel distance or time interval –Random frequency modulation → varying Doppler shift –Speed of the mobile or speed of surrounding objects.

2. Slow Fading •over large distances, due to gross changes in path •also called shadowing, log-normal fading ν Fast Fading •over distances on the order of a wavelength •also called Rayleigh fading.

3. Doppler spreading increases the signal bandwidth •fd : +moving toward, –moving away
•fd = cos(θ) ×(v/ λ).

4. Wideband signal : a very narrow pulse, p(t), does not fluctuate when a receiver is moved about a local area → The received power varies very little ν Narrowband signal : the CW signal strength will vary at a rate governed by the fluctuations of ai and θi → large signal fluctuations (fading) occur.

5. The impulse response is a wideband channel characterization and contains all the information to simulate or analyzer of radio transmission through the channel.

6. The channel impulse response is assumed to be time invariant or is at least wide sense stationary over small scale time interval is
$H_b(\tau) = \sum_{i=0}^{N-1} ai \exp(j\theta i)\, \delta(\tau - \tau i)$

7. The small scald fading behaves differently for two signals with different bandwidth in the identical multipath channel.

8. The instantaneous multipath power delay profile $\left|h_b{}^{(t0:\tau:}\right|^2$ of the channel is equal to the energy received over the timed duration of the multipath delay divided by τmax.
9. The average small scale received power is simply sum of the average power received in each multipath components.
10. The instantaneous received power is

$$|r(t)|2 = \left|\sum_{i=0}^{N-1} ai \exp(j\theta i 9t, \tau))\right|^2$$

11. The average power of a CW signal is equivalent to the average power of a wideband signal in a small scale region.

12. The multipath structure is determine the small scale fading effects by three techniques are direct pulse measurements, spread spectrum sliding corrector measurements, swept frequency measurements.

13. The multipath components are displayed on the CRO .The observed time scale on the CRO using sliding corrector is calculated by
Actual propagation time = $\frac{\text{Observed time}}{\gamma}$ where γ ism slide factor

14. The spread spectrum as compared to the direct pulse system is not a real time measurement.
15.There three parameters are used in multi path channel is mean excess delay, rms delay spread, and excess delay spread (XdB) which can be determined from a power delay profile.

16. The power delay profile is defined by

$$\frac{\sum_k p(\tau_k)\tau_k^2}{\sum_k p(\tau_k)}$$

17. The coherence bandwidth is the range of frequencies over which two frequency components have strong potential for amplitude correlation and it is approximately

$$B_c = \frac{1}{5\sigma_\tau}$$

18. The coherence time is defined as the time over which the time correlation function is above 0.5 is approximately

$$T_c = \frac{9}{16\pi fm}$$

19. After detection of the Doppler shifted signal the resulting baseband spectrum has a maximum frequency of 2fm is $S_{bbEZ}(f) = \frac{1}{8\pi fm} K \left[\sqrt{1} - \left(\frac{f}{2fm}\right)\right]^2$

20. The Level crossing rate is defined as the expected value at which the Rayleigh Fading envelope, normalized to the local rms signal level crosses a specified level in a positive going direction**.**

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

Unit-III: Mobile Radio Propagation Low-Scale fading and Multipath

1. Explain Doppler shift. [**May – 2019]**
2. Discuss about slow fading.[**May – 2019]**
3. Discuss about level crossing [**May – 2017]**
4. Write short notes on Doppler Spread [**May – 2017],[June-2018]**
5. Describe Direct Sequence Spread Spectrum **[June-2018]**
6. List out the types of small-scale multipath measurements techniques **[June- 2018]**
7. What are the Time Dispersion Parameters of Multipath channels? **[April-2018]**

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Explain Fading effects due to multipath time delay. .[**May – 2019]**
2. DiscussRicean distribution. .[**May – 2019]**
3. Explain different types of small scale fading. .[**May – 2019], [April-2018]**
4. Discuss about frequency selective fading in detail.[**May – 2019]**
5. Discuss in detail about factors that influence small Scale Fading Model **[May – 2017],[April-2018]**

6. Discuss in detail about Fast Fading Slow fading **[May – 2019]**

7. What is the difference between frequency selective fading and flat fading **[June – 2018**]

8**.** Derive the Impulse response model of a Multipath channel **[June-2018] [April-2018]**

9. Explain how the two-ray model is used when a single ground reflection dominates the multipath effect **[June – 2018]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1 .Which of the following is not an effect caused by multipath in radio channel **[C]**
a) Rapid changes in signal strength b) Random frequency modulation
c) Power of base station d) Time dispersion

2. Which of the following factor does not influence small scale fading **[B]**
a) Multipath propagation b) Power density of base station
c) Speed of mobile d) Speed of surrounding objects

3. What is a measure of the maximum frequency difference for which signals are strongly correlated in amplitude **[A]**
a) Coherence bandwidth b) Narrow bandwidth
c) Incoherent bandwidth d) Wide bandwidth

4. The Doppler shift for mobile moving with constant velocity, v is given by **[A]**
a) (v*cos θ)/λ b) v/λ
c) v*cos θ d) v*λ

5. The received local ensemble average power of wideband and narrowband signals are **[B]**
a) Different b) Equivalent
c) Not dependent d) Double

6. Which of the following is not a multipath channel parameter that can be determined from power delay profile **[D]**
a) Mean excess delay b) RMS delay spread
c) Excess delay spread d) Doppler spread

7. Which of the following is the first moment of the power delay profile **[D]**
a) Rms delay spread b) Excess delay spread
c) Mean excess delay d) Doppler spread

8. What is the order of typical values of rms delay spread in outdoor mobile radio channel **[A]**
a) Microseconds b) Nanoseconds
c) Seconds d) Minutes

9. Which of the following is not a statistical models for multipath fading channels **[D]**
a) Clarke's model for flat fading b) Saleh and Valenzuela indoor statistical model
c) Two ray Rayleigh fading model d) Faraday model

10. Which of the following is an important statistics of a Rayleigh fading useful for designing error control codes and diversity schemes? **[C]**
a) Mobile speed b) Doppler frequency
c) Level crossing rate (LCR) d) Power density

11. Who presented the first statistical model for multipath fading channel **[A]**
a) Ossana b) Rayleigh
c) Newton d) Faraday

12. Which of the following is equal to received power **[D]**
a) Square of complex voltage b) Complex voltage
c) Magnitude of complex voltage d) Magnitude squared of complex voltage

13.The level crossing rate (LCR) is defined as expected rate at which _____ fading envelope crosses a specified level**.** **[A]**
a) Rayleigh b) Saleh
c) Vanezuela d) Faraday

14. In urban areas, fading occurs due to height of mobile antenna _____ than height of surrounding structure**.** **[D]**
a) Same b) Smaller
c) Greater d) Very larger

15. Propagation model that characterize rapid fluctuation is called _____ **[B]**
a) Hata model b) Fading model
c) Large scale propagation model d) Okumura model

16 Small scale propagation model is also known as _____ **[A]**
a) Fading model b) Micro scale propagation model
c) Okumura model d) Hata model

17.The time dispersive properties of wideband multipath channel are quantified by _____ and _____ **[A]**
a) Mean excess delay, rms delay spread b) Doppler spread, rms delay spread
c) Doppler spread, coherence time d) Mean excess delay, Doppler spread

18. Small scale received power is ____ of average powers received in each multipath component. **[D]**
a) Log b) Exponential
c) Multiplication d) Sum

19. Received signal can be expressed as _____ of transmitted signal with channel impulse response**.** **[D]**
a) Addition b) Subtraction
c) Division d) Convolution

20. Apparent shift in frequency in multipath wave is caused due to relative motion between_____ **[D]**

a) Base station and MSC
b) Mobile and surrounding objects
c) Mobile and MSC
d) Mobile and base station

21. Signal will distort if transmitted signal bandwidth is greater than bandwidth of _____ **[C]**
a) Receiver
b) Radio channel
c) Multipath channel
d) Transceiver

22. Doppler shift is directly proportional to _____ **[A]**
a) Velocity
b) Height of antenna
c) Power of receiving antenna
d) Power of transmitter

23. Coherence bandwidth is a statistical measure of range of frequencies over which channel is considered _____ **[D]**
a) Time dispersive
b) Frequency selective
c) Time variant
d) Flat

24.Level crossing rate is a function of _____ **[C]**
a) Power transmitted by base station
b) Power density of receiver
c) Mobile speed
d) Bit error rate

25 Angular spread is a measure of how multipath concentrates about _____. **[C]**
a) Angle of arrival
b) Transmitted power
c) Single azimuthal direction of arrival
d) Received power

Unit-IV

Important points / Definitions:

1. Diversity techniques are used in wireless communications systems to primarily to improve performance over a fading radio channel.

2. An Equalization is used to compensate the inter symbol interference created by multipath within time dispersive channel. • Equalizer within a receiver compensates the amplitude variations and delay characteristics

3. Diversity is another technique used to compensate fast fading and is usually implemented using two or more receiving antennas

4. Channel coding improves mobile communication link performance by adding redundant data bits in the transmitted message.

5. Polarization diversity: It relies on the de-correlation of the two receive ports to achieve diversity gain

6. Equalization can be used to describe any signal processing operation that minimizes ISI.

7. There ae four types of diversities Spatial diversity : several antenna elements separated in space ➢ Temporal diversity: transmission of the signal at different times ➢ Frequency diversity: transmission of the signal at different frequencies ➢ Angular diversity: multiple antennas with different antenna patterns ➢ Polarization diversity: multiple antenna with different polarizations

8. Training mode in an adaptive equalizer • First a known fixed length training sequence is sent by the transmitter • Then the receiver's equalizer may adapt to a proper setting of minimum bit error detection.

9. The factors used in adaptive algorithm? ➢ Rate of convergence ➢ Mis-adjustments ➢ Computational complexity.

10. Need for diversity in multipath propagation ➢ Diversity is a technique used to mitigate the effects of fading. ➢ It provides wireless link improvement at relatively low cost.

11. Coding gain is the measure of difference between the signal-to-noise ratio (SNR) levels of uncoded system and coded system. • It is required to reach both the uncoded and coded systems with same bit error rate (BER) levels. 17. State the significance of linear and decision feedback.

12. RAKE receiver is a radio receiver designed to counter the effects of multipath fading. It uses several sub-receivers called fingers and each finger independently decodes a single multipath component; at the final stage, all the fingers are combined in order to get signal with high signal to noise ratio,

13. In spatial diversity, 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 sees a signal peak and the receiver is able to select the antenna with the best signals at any time.

14. The factors used in adaptive algorithm? ➢ Rate of convergence ➢ Mis-adjustments ➢ Computational complexity.

15. The need for diversity and equalization techniques • To reduce ISI, equalization technique is used. • Diversity is used to reduce fading effect

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)
Unit-IV: Equalization and Diversity

1. Discuss the significance of MLSE. .[**May – 2019]**
2. Give the differences between linear and non-linear equalizers.[**May – 2019]**
3. Explain about frequency diversity [**May – 2017]**
4. Discuss about Zero forcing algorithm [**May – 2017]**
5. What is meant by decision feedback equalization **[June -2018]**
6. List out the three types of dedicated control channels in GSM. **[June -2018]**
7. Give the fundamentals of equalization**. [June -2018]**
8. Define equalization [**April-2018]**
9. Define frequency diversity**.[May/June-2019]**

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Explain about time diversity and frequency diversity methods. .[**May – 2019]**
2. Discuss about equal gain and selection diversity techniques. .[**May – 2019]**
3. Explain in detail about non linear equalizers.[**May – 2019]**
4. Derive the LMS algorithm for an adaptive equalizer.[**May – 2019],[June-2018]**
5. Explain in detail about Decision Feedback equalizers **[May – 2019]**
6. Derive the expression for Maximal Ratio Combining Improvement **[May – 2019],[April-2018]**
7. What is the need for link calculation? Explain with suitable example**.[June-2018]**
8. Explain Maximum Likelihood Sequence Estimation (MLSE) Equalizer**.[June-2018]**
9. What are the different receiver diversity combining techniques? Explain **[June-2018]**
10. Explain LMS and Recursive Least Square algorithm **[April-2018]**
11. Explain the concept of space diversity with a neat diagram**[[May/June-2019]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1.Which of the following is not used to improve received signal quality over small scale times and distance**?** **[A]**
a) Modulation b) Equalization
c) Diversity d) Channel coding

2. Which of the following factor could not determine the performance of algorithm? **[A]**
a) Structural properties b) Rate of convergence
c) Computational complexity d) Numerical properties

3. Which of the following is an algorithm for equalizer? **[D]**
a) Zero forcing algorithm b) Least mean square algorithm
c) Recursive least square algorithm d) Mean square error algorithm

4. Which of the following is a drawback of zero forcing algorithm? **[B]**
a) Long training sequence b) Amplification of noise
c) Not suitable for static channels d) Non zero ISI

5. Which of the following is not a category of space diversity technique? **[B]**
a) Selection diversity b) Time diversity
c) Feedback diversity d) Equal gain diversity

6. Which of the factor does not determine the correlation coefficient? **[D]**
a) Polarization angle b) Cross polarization discrimination
c) Offset angle from the main beam direction d) Coherence time

7. Equalization is used to compensate? **[B]**
a) Peak signal to noise ratio b) Intersymbol interference
c) Channel fading d) Noises present in the signal

8. What is the operating modes of Training and tracking? **[C]**
a) Diversity techniques b) Channel coding techniques
c) Equalization techniques d) Demodulation technique

9. An equalizer is said to be converged when it is properly _____ **[A]**
a) Trained b) Tracked
c) Installed d) Used

10.Time for convergence of an equalizer is not a function of ____ **[D]**
a) Equalizer algorithm b) Equalizer structure
c) Time rate of change of multipath radio channel d) Transmitter characteristics

11. Equalizer is usually implemented in _____ **[B]**
a) Transmitter b) Baseband or at IF in a receiver
c) Radio channel d) Modulator stage

12. Equalizer is _____ of the channel. **[C]**

a) Opposite
b) Same characteristics
c) Inverse filter
d) Add on

13. Rate of convergence is defined by _____ of algorithm. **[B]**
a) Time span
b) Number of iterations
c) Accuracy
d) Complexity

14.Computational complexity is a measure of _____ **[C]**
a) Time
b) Number of iterations
c) Number of operations
d) Accuracy

15. LMS equalizer minimizes _____ **[C]**
a) Computational complexity
b) Cost
c) Mean square error
d) Power density of output signal

16. Diversity decisions are made by _____ **[A]**
a) Receiver
b) Transmitter
c) Channel
d) Adaptive algorithms

17. Small scale fades are characterized by _____ amplitude fluctuations. **[B]**
a) Large
b) Small
c) Rapid
d) Slow

18. _____ is used to prevent deep fade for rapidly varying channel. **[D]**
a) Modulation
b) Demodulation
c) Macroscopic diversity technique
d) Microscopic diversity technique

19. Large scale fading can be mitigated with the help of _____ **[C]**
a) Modulation
b) Demodulation
c) Macroscopic diversity technique
d) Microscopic diversity technique

20. Polarization diversity uses the _____ as the diversity element. **[C]**
a) Modulation index
b) Carrier frequency
c) Reflection coefficient
d) Coherence time

21. Frequency diversity is implemented by transmitting information on more than one ___ **[A]**
a) Carrier frequency
b) Amplitude
c) Phase
d) Modulation scheme

22. Frequency diversity uses _____ as a diversity element. **[C]**
a) Correlation coefficient
b) Coherence time
c) Coherence bandwidth
d) SNR

23.A RAKE receiver collects the _____-versions of the original signal. **[A]**
a) Time shifted
b) Amplitude shifted
c) Frequency shifted
d) Phase shifted

24. RAKE receiver uses separate _____ to provide the time shifted version of the signal**.[C]**

a) IF receiver
b) Equalizer
c) Correlation receiver
d) Channel

25. Each correlation receiver in RAKE receiver is adjusted in_____ **[D]**

a) Frequency shift
b) Amplitude change
c) Phase shift
d) Time delay

26.The range of time delays that a particular correlator can search is called _____ **[A]**

a) Search window
b) Sliding window
c) Time span
d) Dwell time

27. Interleaving is used to obtain _____ diversity. **[A]**

a) Time
b) Frequency
c) Polarization
d) Antenna

Unit-V

Important points / Definitions:

1.He original standard-defined 802.11 topologies: workgroup (ad hoc), infrastructure, and Extended Services Set.

2. A WLAN involves more than selecting the desired standard and selecting a security mechanism. Access point placement can have more effect on throughput than standards.

3. Ad hoc mode: Independent Basic Service Set (IBSS) is the ad hoc topology mode. Mobile clients connect directly without an intermediate access point

4. Infrastructure mode: In infrastructure mode, clients connect through an access point. There are two infrastructure modes

5. Extended Services Set (ESS): The wireless topology is extended with two or more BSSs connected by a distribution system (DS) or a wired infrastructure

6. WIFI uses radio technology to transmit and receive data at high speed. WIFI IEEE 802.11b WIFI IEEE 802.11a ϖ IEEE 802.11g

7. Limitations WIFI Interference ϖ Degradation in performance WIFI High power consumption WIFI Limited range

8. HIPERLAN stands for high performance local area network. It is a wireless standard derived from traditional LAN environments and can support multimedia and asynchronous data effectively at high data rates of 23.5 Mbps.

9. WPANs are used to convey information over short distances among a private, intimate group of participant devices

10. WiMAX would operate similar to WiFi, but at higher speeds over greater distances and for a greater number of users

11.The IEEE 802.16, the *Air Interface for Fixed Broadband Wireless Access Systems*, also known as the IEEE WirelessMAN air interface.

12.Wi-Fi works at 2.7 bps/Hz and can peak up to 54 Mbps in 20 MHz channel.

13.WiMAX works at 5 bps/Hz and can peak up to 100 Mbps in a 20 MHz channel.

IEEE 802 wireless network technology options

Network definition	*IEEE standard*	*Known as*
Wireless personal area network (WPAN)	IEEE 802.15.1	Bluetooth
Low-rate WPAN (LR-WPAN)	IEEE 802.15.4	ZigBee
Wireless local area network (WLAN)	IEEE 802.11	WiFi
Wireless metroplitan area network (WMAN)	IEEE 802.16	WiMAX

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)
Unit-V: Wireless networks

1. Discuss the differences between the 802.11a and HIPERLAN-2. [**May – 2019]**
2. State the challenges faced by WLAN industry..[**May – 2019]**
3. Discuss the significance of MLSE .[**May – 2019]**
4. Write about WLL [**May – 2017]**
5. List the advantages of WLAN [**May – 2017]**
6. What are the advantages of Wireless Local Area Networks**?[June – 2018]**
7. Discuss about advantages and disadvantages of WLAN **[April-2018]**
8. Write about hiper lan WLL **[April-2018]**

Long Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

1. Describe the services offered by MAC and MAC management sub layers of IEEE 802.11 wireless LAN.[**May – 2019]**
2. Explain the MAC management sub layer of IEEE 802.11.[**May – 2019]**
3. Write notes on HIPERLAN..[**May – 2019]**
4. Describe WPAN. Give its main features.[**May – 2019]**
5. Discuss in detail about WLAN Topologies **[May – 2019]**
6. Write shot notes on a). Wireless PANs b) Hyper LAN **[May – 2019]**
7. Mention the functional requirements of hyper LAN **[May – 2016]**
8. Explain the functioning of WATM with basic **structure [May – 2016]**
9. Draw the programming model for WAP and explain its functioning **[June-2018]**
10. Draw and explain the various fields in a IEEE 802.11 MAC frame **[June-2018]**
11. When does a WLAN become a personal area network (PAN)? Explain **[June-2018]**
12. Draw the configuration of IEEE802.11 architecture **[April-2018]**

13. Explain the physical layer specifications of IEEE802.11 using infrared **[April-2018]**

14**.** Compare and contrast IEEE 802.11 a, b, g and n standards **[April-2018]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. Term that is used for stationary or mobile wireless station and also have optional central base station is called **[D]**
a). Point to point. b). Multi point.
c). Network point. d). Access point.

2. In wireless LAN, there are many hidden stations so we cannot detect the **[B]**
a). Frames. b). Collision.
c). Signal. d). Data.

3. Specifications for a wireless LAN are called [**D]**
a). Standard 802.3z. b). Standard 802.3u. cC). Project 802.3.
d). IEEE 802.11.

4. Wireless LANs implement security measures in the **[B]**
a). System Layers. b). Data Link Layers.
c). Sub Layers. d). Multi Layers

5. IEEE 802.11 have three categories of **[A]**
a). frames b),fields
c).signals d).sequences

6. What is the full form of WLAN? **[B]**
a) Wide Local Area Network b) Wireless Local Area Network
c) Wireless Land Access Network d) Wireless Local Area Node

7. What is the name of 300 MHz of unlicensed spectrum allocated by FCC in ISM band **[A]**
a) UNII b) Unlicensed PCS
c) Millimetre wave d) Bluetooth

8. Which of the following specifies a set of media access control (MAC) and physical layer specifications for implementing WLANs? **[C]**
a) IEEE 802.16 b) IEEE 802.3
c) IEEE 802.11 d) IEEE 802.15

9. Which of the following is not a standard of WLAN? **[D]**
a) HIPER-LAN b) HIPERLAN/2
c) IEEE 802.11b d) AMPS

10. Which of the following is the 802.11 High Rate Standard? **[B]**
a) IEEE 802.15 b) IEEE 802.15.4
c) IEEE 802.11g d) IEEE 802.11b

11. Which of the following spread spectrum techniques were used in the original IEEE 802.11 standard? **[A]**
a) FHSS and DSSS b) THSS and FHSS
c) THSS and DSSS d) Hybrid technique

12. Which of the following WLAN standard has been named Wi-Fi? **[C]**
a) IEEE 802.6 b) IEEE 802.15.4
c) DSSS IEEE 802.11b d) IEEE 802.11g

13. Which of the following is developing CCK-OFDM? **[D]**
a) IEEE 802.11a b) IEEE 802.11b
c) IEEE 802.15.4 d) IEEE 802.11g

14. HIPER-LAN stands for _____ **[B]**
a) High Precision Radio Local Area Network b) High Performance Radio Local Area Network
c) High Precision Radio Land Area Network d) Huge Performance Radio Link Access Node

15.What is the range of asynchronous user data rates provided by HIPER-LAN? **[C]**
a) 1-100 Mbps b) 50-100 Mbps
c) 1-20 Mbps d) 500 Mbps to 1 Gbps c

16.What is the name of the European WLAN standard that provides user data rate upto 54 Mbps? [D]
a) UNII b) WISP
c) MMAC d) HIPERLAN/2

17. What is WISP**?** **[B]**
a) Wideband Internet Service Protocol b) Wireless Internet Service Provider
c) Wireless Instantaneous Source Provider d) Wideband Internet Source Protocol

18. Which of the following standard committee specifies Bluetooth and other Personal Area Networks (PAN)? [B]
a) IEEE 802.11b b) IEEE 802.15
c) IEEE 802.11g d) IEEE 802.16 b