

## **ECH501- COMMUNICATION SYSTEMS**

### **PART - A**

#### **UNIT I - TRANSMISSION LINES, WAVE PROPAGATION, ANTENNA**

1. **Which wave has the highest frequency?**

- A. Radio wave
- B. Microwave
- C. X-ray
- D. Gamma ray

**Answer: D**

2. **Which wave has the longest wavelength?**

- A. Gamma ray
- B. X-ray
- C. Radio wave
- D. Ultraviolet ray

**Answer: C**

3. **Characteristic impedance is the ratio of:**

- A. Voltage to current of a travelling wave
- B. Voltage to resistance
- C. Current to power
- D. Power to voltage

**Answer: A**

4. **Maximum power transfer occurs when:**

- A. Load impedance = Characteristic impedance
- B. Load impedance > Characteristic impedance
- C. Load impedance < Characteristic impedance
- D. Load impedance = 0

**Answer: A**

5. **Which is a type of transmission line?**

- A. Coaxial cable
- B. Optical fiber

- C. Waveguide
- D. All of the above

**Answer: D**

6. **Waveguide is mainly used at:**

- A. Low frequencies
- B. Microwave frequencies
- C. Audio frequencies
- D. DC

**Answer: B**

7. **Reflection on a transmission line is minimized by:**

- A. Increasing voltage
- B. Impedance matching
- C. Increasing current
- D. Using DC supply

**Answer: B**

8. **Ground wave propagation is mainly used for:**

- A. VHF communication
- B. UHF communication
- C. Low-frequency communication
- D. Satellite communication

**Answer: C**

9. **Sky wave propagation depends on:**

- A. Reflection from buildings
- B. Reflection from the ionosphere
- C. Reflection from water
- D. Reflection from mountains

**Answer: B**

10. **Sky wave propagation is mainly used for:**

- A. Long-distance HF communication
- B. Mobile communication

- C. Bluetooth communication
- D. Wi-Fi communication

**Answer: A**

**11. Space wave propagation requires:**

- A. Reflection from the ionosphere
- B. Line-of-sight path
- C. Ground reflection only
- D. Underground cables

**Answer: B**

**12. Satellite communication mainly uses:**

- A. Ground wave
- B. Sky wave
- C. Space wave
- D. Surface wave

**Answer: C**

**13. Communication beyond the horizon is possible by:**

- A. Ground wave
- B. Sky wave
- C. Space wave
- D. Optical wave

**Answer: B**

**14. The ionosphere mainly helps in:**

- A. Ground wave propagation
- B. Sky wave propagation
- C. Space wave propagation
- D. Optical communication

**Answer: B**

**15. An antenna is a device used to:**

- A. Store electrical energy
- B. Radiate and receive electromagnetic waves

- C. Amplify signals
- D. Convert AC to DC

**Answer: B**

**16. The radiation pattern of an antenna represents:**

- A. Antenna size
- B. Radiation in different directions
- C. Frequency range
- D. Power rating

**Answer: B**

**17. A narrow beamwidth indicates:**

- A. High directivity
- B. Low directivity
- C. High resistance
- D. Low efficiency

**Answer: A**

**18. Directivity indicates:**

- A. Ability to radiate energy in a particular direction
- B. Height of antenna
- C. Weight of antenna
- D. Frequency of antenna

**Answer: A**

**19. A microstrip patch antenna is mainly used in:**

- A. Mobile phones
- B. Electric motors
- C. Audio amplifiers
- D. Water pumps

**Answer: A**

**20. A horn antenna is mainly used in:**

- A. Microwave communication
- B. AM radio

- C. Telephone communication
- D. Audio systems

**Answer: A**

**21. Which antenna parameter determines the operating frequency range?**

- A. Beamwidth
- B. Radiation pattern
- C. Bandwidth
- D. Directivity

**Answer: C**

**Analytical based questions**

**22. Match the wave propagation with its frequency range and application.**

| List I (Wave Propagation) | List II (Frequency Range) | List III (Application)            |
|---------------------------|---------------------------|-----------------------------------|
| P. Ground wave            | 1. Above 30 MHz           | A. FM Broadcasting                |
| Q. Sky wave               | 2. 3 MHz – 30 MHz         | B. Long-distance HF Communication |
| R. Space wave             | 3. Below 3 MHz            | C. AM Broadcasting                |

**Choose the correct answer.**

- A. P–3–C, Q–2–B, R–1–A
- B. P–2–C, Q–3–B, R–1–A
- C. P–3–A, Q–2–C, R–1–B
- D. P–1–C, Q–2–A, R–3–B

**Answer A**

**23. A television station plans to transmit signals to nearby cities. The communication should be direct without ionospheric reflection. Which propagation is most suitable?**

- A. Ground wave

- B. Sky wave
- C. Space wave
- D. Surface wave

**Answer C**

**24. A company is designing a compact antenna for Wi-Fi equipment mounted on a PCB. Which antenna should be selected?**

- A. Horn antenna
- B. Loop antenna
- C. Patch antenna
- D. Yagi antenna

**Answer C`**

**25. Two antennas have the same operating frequency. Antenna A has a beamwidth of  $20^\circ$ , while Antenna B has a beamwidth of  $70^\circ$ . Which antenna has higher directivity?**

- A. Antenna A
- B. Antenna B
- C. Both have equal directivity
- D. Cannot be determined

**Answer A**

**26. A radar system requires an antenna that produces a narrow beam with high gain. Which antenna is most suitable?**

- A. Patch antenna
- B. Horn antenna
- C. Loop antenna
- D. Dipole antenna

**Answer B**

**27. Assertion (A): FM broadcasting uses space wave propagation.**

**Reason (R): Space waves travel mainly in line-of-sight.**

**Choose the correct option.**

- A. Both Assertion and Reason are true, and Reason is the correct explanation.

B. Both Assertion and Reason are true, but Reason is NOT the correct explanation.

C. Assertion is true, but Reason is false.

D. Assertion is false, but Reason is true.

**Answer A**

**28. Assertion (A):** Sky wave propagation is suitable for long-distance communication.

**Reason (R):** Radio waves are reflected by the ionosphere.

**Choose the correct option.**

A. Both Assertion and Reason are true, and Reason is the correct explanation.

B. Both Assertion and Reason are true, but Reason is NOT the correct explanation.

C. Assertion is true, but Reason is false.

D. Assertion is false, but Reason is true.

**Answer A**

**29. Assertion (A):** A horn antenna has high directivity.

**Reason (R):** It concentrates electromagnetic waves in one direction.

**Choose the correct option.**

A. Both Assertion and Reason are true, and Reason is the correct explanation.

B. Both Assertion and Reason are true, but Reason is NOT the correct explanation.

C. Assertion is true, but Reason is false.

D. Assertion is false, but Reason is true.

**Answer A**

**30. Assertion (A):** Patch antennas are widely used in mobile devices.

**Reason (R):** They are lightweight and occupy less space.

**Choose the correct option.**

A. Both Assertion and Reason are true, and Reason is the correct explanation.

B. Both Assertion and Reason are true, but Reason is NOT the correct explanation.

C. Assertion is true, but Reason is false.

D. Assertion is false, but Reason is true.

**Answer A**

## **UNIT – II CELLULAR COMMUNICATION**

**1. The primary purpose of the cellular concept is to:**

- A. Increase transmitter power
- B. Increase system capacity using frequency reuse
- C. Eliminate handoffs
- D. Use only one cell for the entire city

**Answer: B**

**2. In a cellular system, the term “cluster” refers to:**

- A. A group of mobile stations
- B. A group of cells using the complete set of available frequencies
- C. A group of base stations in one city
- D. A group of control channels

**Answer: B**

**3. The frequency reuse factor is defined as:**

- A.  $1/N$ , where  $N$  is cluster size
- B.  $N$
- C. Total bandwidth / number of users
- D. Number of cells  $\times$  channels per cell

**Answer: A**

**4. The GSM network element that stores permanent subscriber data is:**

- A. VLR
- B. HLR
- C. MSC
- D. BTS

**Answer: B**

**5. The main function of the MSC in GSM is to:**

- A. Modulate radio signals
- B. Switch calls between mobile and other networks

- C. Store temporary subscriber data
- D. Authenticate users only

**Answer: B**

6. **Handoff is primarily required when:**

- A. The mobile is switched off
- B. The mobile moves from one cell to another during a call
- C. The base station is overloaded
- D. The network is idle

**Answer: B**

7. **In which type of handoff does the mobile break connection with the old cell before connecting to the new cell?**

- A. Soft handoff
- B. Softer handoff
- C. Hard handoff
- D. Macro handoff

**Answer: C**

8. **Soft handoff is a characteristic feature of:**

- A. GSM
- B. CDMA-based 3G systems
- C. 1G analog systems
- D. Pure FDMA systems

**Answer: B**

9. **Cell splitting increases system capacity by:**

- A. Increasing transmitter power
- B. Reducing cell radius and reusing channels more often
- C. Using only one large cell
- D. Removing control channels

**Answer: B**

10. **Sectoring improves capacity mainly by:**

- A. Increasing cell radius
- B. Using omni directional antennas

- C. Using directional antennas to reduce co-channel interference
- D. Increasing cluster size

**Answer: C**

**11. If cluster size  $N$  is reduced (with same total bandwidth), system capacity:**

- A. Decreases
- B. Remains same
- C. Increases
- D. Becomes zero

**Answer: C**

**12. The main disadvantage of excessive cell splitting is:**

- A. Reduced capacity
- B. Increased handoff rate and signaling load
- C. Larger cell radius
- D. Lower co-channel interference

**Answer: B**

**13. The multiple access technique used in LTE downlink is:**

- A. CDMA
- B. OFDMA
- C. Pure TDMA
- D. Pure FDMA

**Answer: B**

**14. LTE handover is typically:**

- A. Soft handover
- B. Hard handover with break-before-make
- C. Softer handover only
- D. No handover

**Answer: B**

**15. Which of these is NOT a key feature of LTE?**

- A. All-IP core
- B. OFDMA in downlink
- C. Circuit-switched voice as primary service

D. Support for MIMO

**Answer: C**

**16. 5G New Radio (NR) primarily uses which multiple access in downlink?**

A. OFDMA

B. Pure TDMA

C. Pure FDMA

D. AMPS

**Answer: A**

**17. Typical peak data rate target for 5G (NR) is of the order of:**

A. 100 kbps

B. 10 Mbps

C. 1 Gbps

D. 10–20 Gbps

**Answer: D**

**18. Beam forming in 5G is mainly used to:**

A. Increase interference

B. Focus energy towards specific users and improve SNR

C. Reduce number of users

D. Eliminate need for base stations

**Answer: B**

**19. Which of the following is a key 5G use case category?**

A. EMBB (enhanced Mobile Broadband)

B. Only voice calls

C. Only SMS

D. Only paging

**Answer: A**

**20. In cell splitting, if the original cell radius is  $R$ , the new cell radius is typically:**

A.  $2R$

B.  $R$

C.  $R/2$

D.  $R/4$

**Answer: C**

**21. Arrange the following in increasing order of peak data rate capability:**

**2G (GSM)**

**3G (UMTS)**

**4G (LTE)**

**5G (NR)**

A. a-b-c-d

B. b-a-c-d

C. a-c-b-d

D. d-c-b-a

**Answer: A**

**Analytical based questions**

**22. Which of the following does NOT directly increase cellular system capacity?**

A. Cell splitting

B. Sectoring

C. Increasing cluster size  $N$

D. Microcell zone concept

**Answer: C**

**23. A cellular system has a total of 630 full-duplex channels and uses a 7-cell reuse pattern (cluster size  $N = 7$ ). Each cell is then divided into 3 sectors using  $120^\circ$  directional antennas, and the channels are equally divided among sectors. How many channels are available per sector?**

A. 30

B. 60

C. 90

D. 210

**Answer: A**

**24. Two cellular systems use the same total bandwidth and same cell radius.**

- **System X: Cluster size  $N = 7$**
- **System Y: Cluster size  $N = 12$**

**Which statement is correct?**

- A. System X has lower co-channel interference but higher capacity.
- B. System X has higher co-channel interference but higher capacity.
- C. System Y has higher co-channel interference and lower capacity.
- D. Both have same interference and capacity.

**Answer: B**

**25. The table below lists mobile communication generations, their typical peak downlink data rate range, and a representative standard/technology.**

| S.N | Generation<br>(Column I) | Typical Peak Downlink Data<br>Rate (Column II) | Representative<br>Standard/Technology<br>(Column III) |
|-----|--------------------------|------------------------------------------------|-------------------------------------------------------|
| 1   | P. 2G                    | (i) 100 Mbps – 1 Gbps                          | (A) GSM / GPRS /<br>EDGE                              |
| 2   | Q. 3G                    | (ii) Few kbps – tens of kbps                   | (B) LTE / LTE-<br>Advanced                            |
| 3   | R. 4G                    | (iii) 10 Gbps and above                        | (C) UMTS / HSPA                                       |
| 4   | S. 5G                    | (iv) 100 kbps – few Mbps                       | (D) 5G NR                                             |
| 5   | T. 1G                    | (v) Few tens of kbps – ~384<br>kbps            | (E) AMPS / NMT<br>(analog)                            |

**Choose the correct matching:**

- A. P–(iv)–A, Q–(v)–C, R–(i)–B, S–(iii)–D, T–(ii)–E
- B. P–(ii)–A, Q–(iv)–C, R–(i)–B, S–(iii)–D, T–(v)–E
- C. P–(iv)–A, Q–(v)–C, R–(i)–B, S–(ii)–D, T–(iii)–E
- D. P–(v)–A, Q–(iv)–C, R–(i)–B, S–(iii)–D, T–(ii)–E

**Answer: A)**

**26. Assertion (A):** Reducing the cluster size  $NNN$  in a cellular system increases the system capacity (number of channels per unit area).

**Reason (R):** A smaller cluster size allows the same set of frequencies to be reused more often within a given geographical area.

- A. Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
- B. Both Assertion and Reason are true, but Reason is NOT the correct explanation of Assertion.
- C. Assertion is true, but Reason is false.
- D. Assertion is false, but Reason is true.

**Answer: A**

27. **Assertion (A):** In CDMA-based 3G systems, soft handoff is preferred over hard handoff.

**Reason (R):** Soft handoff allows the mobile to communicate with multiple base stations simultaneously, reducing the probability of call drop during handoff.

- A. Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
- B. Both Assertion and Reason are true, but Reason is NOT the correct explanation of Assertion.
- C. Assertion is true, but Reason is false.
- D. Assertion is false, but Reason is true.

**Answer: A)**

28. **Match the cellular technique in List I with its primary purpose in List II.**

| List I (Cellular Technique) | List II (Primary Purpose)                                                |
|-----------------------------|--------------------------------------------------------------------------|
| P. Cell splitting           | 1. Reduce co-channel interference using directional antennas             |
| Q. Sectoring                | 2. Increase capacity by reusing frequencies more often in a given area   |
| R. Handoff                  | 3. Provide continuous call when mobile moves from one cell to another    |
| S. Frequency reuse          | 4. Increase capacity by reducing cell size and adding more base stations |

**Choose the correct matching:**

- A. P-4, Q-1, R-3, S-2
- B. P-2, Q-4, R-3, S-1
- C. P-4, Q-2, R-1, S-3
- D. P-1, Q-4, R-3, S-2

**Correct Answer: A**

**29. Match the cellular technology in List I with the key technique/feature in List II.**

| <b>List I (Cellular Technology)</b> | <b>List II (Key Technique / Feature)</b>             |
|-------------------------------------|------------------------------------------------------|
| P. GSM (2G)                         | 1. OFDMA in downlink, all-IP core                    |
| Q. 3G (UMTS/HSPA)                   | 2. FDMA + TDMA, circuit-switched voice               |
| R. 4G (LTE/LTE-Advanced)            | 3. CDMA-based air interface, soft handoff            |
| S. 5G (NR)                          | 4. OFDMA, massive MIMO, beamforming, network slicing |

**Choose the correct matching:**

- A. P-2, Q-3, R-1, S-4
- B. P-3, Q-2, R-1, S-4
- C. P-2, Q-1, R-3, S-4
- D. P-2, Q-3, R-4, S-1

**Correct Answer: A**

**30. Consider the following situation:**

- The mobile station is connected to Base Station A.
- It establishes a connection with Base Station B.
- The connection with A is maintained temporarily.
- After the connection with B becomes reliable, the connection with A is released.

**Which mechanism is illustrated?**

- A. Hard hand-off
- B. Soft hand-off

- C. Cell splitting
- D. Sectoring

**Answer: B**

### **UNIT – III SATELLITE COMMUNICATION**

**1. The speed of a satellite in an elliptical orbit is maximum at:**

- A. Apogee
- B. Perigee
- C. Equator
- D. North pole

**Answer: B**

**2. If the orbital radius of a satellite is increased, its orbital period generally:**

- A. Decreases
- B. Increases
- C. Remains constant
- D. Becomes zero

**Answer: B**

**3. A typical altitude range of Low Earth Orbit is approximately:**

- A. 100–2,000 km
- B. 10,000–20,000 km
- C. 35,786–42,164 km
- D. Above 100,000 km

**Answer: A**

**4. A major advantage of LEO satellites is:**

- A. Very large propagation delay
- B. Low propagation delay

- C. No requirement for tracking antennas
- D. Continuous coverage from one satellite

**Answer: B**

**5. A major disadvantage of LEO communication systems is:**

- A. High free-space loss only
- B. Need for satellite handover or constellation deployment
- C. Complete absence of Doppler shift
- D. Extremely long orbital period

**Answer: B**

**6. GPS satellites are primarily located in:**

- A. LEO
- B. MEO
- C. GEO
- D. Highly elliptical polar orbit only

**Answer: B**

**7. The approximate altitude of GPS satellites is:**

- A. 500 km
- B. 2,000 km
- C. 20,200 km
- D. 35,786 km

**Answer: C**

**8. Compared with a GEO satellite, an LEO satellite has:**

- A. Longer orbital period
- B. Smaller orbital velocity
- C. Lower propagation delay
- D. Larger coverage area per satellite

**Answer: C**

**9. The orbital period of a GEO satellite with respect to the Earth is approximately:**

- A. 90 minutes
- B. 12 hours

- C. 24 hours or one sidereal day
- D. 7 days

**Answer: C**

**10. A satellite is geosynchronous when its:**

- A. Orbital period equals the Earth's rotational period
- B. Orbital radius equals the Earth's radius
- C. Inclination is always  $90^\circ$
- D. Orbital speed is zero

**Answer: A**

**11. For an orbit to be geostationary, it must be:**

- A. Circular, equatorial and prograde
- B. Elliptical, polar and retrograde
- C. Circular, polar and retrograde
- D. Elliptical, equatorial and retrograde

**Answer: A**

**12. A geostationary satellite appears stationary to an observer on Earth because:**

- A. It has no orbital velocity
- B. Its angular velocity matches the Earth's rotational angular velocity
- C. It is located at the North Pole
- D. It continuously changes its frequency

**Answer: B**

**13. The most important limitation of GEO satellites for high-latitude users is:**

- A. Excessively low altitude
- B. Poor elevation angle and possible blockage near the poles
- C. No coverage over the equator
- D. Inability to transmit microwave signals

**Answer: B**

**14. In the conventional C-band, the commonly used uplink/downlink pair is approximately:**

- A. 1/0.5 GHz
- B. 6/4 GHz
- C. 14/12 GHz
- D. 30/20 GHz

**Answer: B**

**15. In the conventional Ku-band satellite service, the approximate uplink/downlink pair is:**

- A. 2/1 GHz
- B. 4/2 GHz
- C. 14/12 GHz
- D. 40/30 GHz

**Answer: C**

**16. The main reason for using different uplink and downlink frequencies is to:**

- A. Increase atmospheric pressure
- B. Prevent interference between the transmitted and received signals
- C. Reduce the satellite's orbital speed
- D. Eliminate the need for antennas

**Answer: B**

**17. Rain attenuation is generally more severe at:**

- A. Lower microwave frequencies
- B. Higher microwave frequencies such as Ku- and Ka-bands
- C. DC
- D. Audio frequencies

**Answer: B**

**18. Batteries in a satellite power subsystem are mainly used when:**

- A. The satellite is in sunlight
- B. The satellite enters eclipse or solar power is unavailable
- C. The transponder is switched off permanently
- D. The satellite is launched

**Answer: B**

**19. The altitude-control subsystem is primarily concerned with:**

- A. Maintaining the desired orbital altitude
- B. Encoding television signals
- C. Increasing antenna bandwidth
- D. Generating GPS timing codes

**Answer: A**

**20. Telemetry in a satellite system is used to:**

- A. Send status and measurement data from the satellite to the control station
- B. Increase the uplink frequency
- C. Receive television programmes at home
- D. Change the dish diameter

**Answer: A**

**21. A regenerative transponder differs from a transparent transponder because it:**

- A. Performs signal processing, demodulation and regeneration onboard
- B. Only changes the satellite's altitude
- C. Does not require a receiver
- D. Operates only at audio frequency

**Answer: A**

### **Analytical based questions**

**22. Two satellites have the same mass but different orbital altitudes. Satellite A is in LEO and Satellite B is in MEO. Which statement is generally correct?**

- A. Satellite A has a larger coverage area than Satellite B
- B. Satellite B generally provides a larger coverage area than Satellite A
- C. Both provide exactly the same coverage area
- D. Coverage area depends only on satellite mass

**Answer: B**

**23. A satellite communication link suddenly stops retransmitting an incoming signal, although the Earth station transmitter is functioning correctly.**

**Which satellite subsystem should be checked first?**

- A. Transponder
- B. Solar panel

- C. Station keeping system
- D. Attitude sensor

**Answer: A**

**24. A satellite's communication antenna is correctly positioned, but the satellite is gradually moving away from its assigned orbital position. Which function is required?**

- A. Altitude control
- B. Station keeping
- C. Telemetry
- D. Frequency conversion

**Answer: B**

**25. A DTH service provider wants to deliver television programmes directly to individual homes. Which arrangement is most appropriate?**

- A. Satellite → DTH dish → receiver → television
- B. Satellite → BTS → mobile phone
- C. Earth station → GPS receiver → television
- D. Satellite → radar → television

**Answer: A**

**26. Statement 1: According to Kepler's Third Law, satellites farther from Earth generally have longer orbital periods.**

**Statement 2: The orbital period is independent of the size of the satellite's orbit.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: C**

**27. A satellite transponder normally receives, amplifies, frequency-converts and retransmits signals.**

**Statement 2: A transponder is mainly responsible for maintaining the satellite's orbital position.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: C**

**28. Statement 1: Altitude control is concerned with maintaining the required orientation or attitude of a satellite.**

**Statement 2: Proper satellite orientation is important for correctly pointing antennas and other equipment.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: A**

**29. Increasing the orbital altitude generally increases the propagation delay of a satellite communication link.**

**Statement 2: A higher-altitude satellite requires signals to travel a longer distance between the Earth station and satellite.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: A**

**30. A satellite has the correct orbital position but its solar panels are not properly oriented toward the Sun. Which subsystem should primarily correct this condition?**

- A. Altitude control
- B. Station keeping
- C. Transponder
- D. Earth station

**Answer: A**

#### **UNIT- IV- Optical Communication**

**1. The principle of light transmission in an optical fiber is based mainly on:**

- A. Diffraction
- B. Total internal reflection
- C. Polarization
- D. Interference

**Answer: B**

**2. For total internal reflection to occur, the refractive index of the core must be:**

- A. Less than that of the cladding
- B. Equal to that of the cladding
- C. Greater than that of the cladding
- D. Zero

**Answer: C**

**3. Numerical aperture (NA) of an optical fiber indicates its:**

- A. Light-gathering ability
- B. Electrical resistance

- C. Mechanical strength only
- D. Operating temperature

**Answer: A**

**4. In an optical fiber, the acceptance angle is the:**

- A. Maximum angle at which light can enter the fiber and still be guided
- B. Angle between core and cladding
- C. Angle of reflection from the transmitter
- D. Angle between two connectors

**Answer: A**

**5. If the numerical aperture of an optical fiber increases, its light-gathering ability:**

- A. Decreases
- B. Increases
- C. Becomes zero
- D. Remains unchanged

**Answer: B**

**6. Which type of fiber has a sudden change in refractive index between core and cladding?**

- A. Graded-index fiber
- B. Step-index fiber
- C. Single-mode fiber only
- D. Plastic fiber only

**Answer: B**

**7. Compared with copper cables, optical fibers generally provide:**

- A. Lower bandwidth
- B. Higher bandwidth
- C. Higher electromagnetic interference
- D. Lower information capacity

**Answer: B**

**8. Single-mode fiber is preferred for:**

- A. Long-distance, high-bandwidth communication

- B. Very short-distance low-speed communication only
- C. Audio speakers
- D. Electrical power transmission

**Answer: A**

**9. In a graded-index fiber, the refractive index of the core:**

- A. Remains constant throughout
- B. Gradually decreases from the centre toward the cladding
- C. Is always zero
- D. Is greater at the outer surface than at the centre

**Answer: B**

**10. Which fiber reduces intermodal dispersion by using a gradually varying refractive index?**

- A. Step-index fiber
- B. Graded-index fiber
- C. Single-mode step fiber only
- D. Plastic cable

**Answer: B**

**11. Intermodal dispersion is mainly associated with:**

- A. Multimode fibers
- B. Single-mode fibers
- C. Copper wires only
- D. Coaxial cables only

**Answer: A**

**12. The principle of operation of an LED is based on:**

- A. Electroluminescence
- B. Total internal reflection
- C. Photoelectric effect only
- D. Magnetic induction

**Answer: A**

**13. A laser diode produces light that is:**

- A. Incoherent and broad spectrum

- B. Highly directional and coherent
- C. Only ultraviolet
- D. Always invisible

**Answer: B**

**14. The principle responsible for laser action is:**

- A. Stimulated emission
- B. Total absorption
- C. Scattering
- D. Refraction only

**Answer: A**

**15. Compared with an LED, a laser diode generally provides:**

- A. Higher optical power and narrower spectral width
- B. Lower speed and wider spectral width
- C. No optical output
- D. Only electrical output

**Answer: A**

**16. Which component is used to connect an optical fiber to another fiber or optical equipment in a detachable manner?**

- A. Connector
- B. Splice
- C. APD
- D. LED

**Answer: A**

**17. An optical connector is used to:**

- A. Provide a temporary/removable connection between optical fibers or equipment
- B. Generate optical signals
- C. Amplify optical signals
- D. Convert optical signals into electrical signals

**Answer: A**

**18. An optical splice is used to:**

- A. Permanently or semi-permanently join two optical fibers
- B. Generate light
- C. Detect optical signals
- D. Increase the refractive index

**Answer: A**

**19. Which of the following is a common method of joining optical fibers?**

- A. Fusion splicing
- B. Mechanical splicing
- C. Both A and B
- D. Neither A nor B

**Answer: C**

**20. A fiber-optic coupler is used to:**

- A. Split or combine optical power
- B. Generate electrical power
- C. Increase fiber diameter
- D. Detect only microwave signals

**Answer: A**

**21. Which combination is correctly matched?**

- A. LED – Optical source
- B. PIN – Optical detector
- C. APD – Optical detector
- D. All of the above

**Answer: D**

### **Analytical based questions**

**22. Assertion: An APD can provide higher sensitivity than a PIN photodiode.**

**Reason: APD provides internal avalanche multiplication of the photocurrent.**

- A. Both Assertion and Reason are true, and Reason is the correct explanation of Assertion
- B. Both Assertion and Reason are true, but Reason is not the correct

explanation of Assertion

C. Assertion is true, but Reason is false

D. Assertion is false, but Reason is true

**Answer: A**

**23. Match the following optical communication components with their characteristics and applications.**

| DEVICE            | Characteristic                       | Application                                |
|-------------------|--------------------------------------|--------------------------------------------|
| 1. LED            | P. Optical source                    | X. Short/medium-distance communication     |
| 2. Laser diode    | Q. Highly directional optical source | Y. High-speed, long-distance communication |
| 3. PIN photodiode | R. Optical detector                  | Z. Optical signal detection                |
| 4. APD            | S. Detector with internal gain       | W. Detection of weak optical signals       |

A. 1-P-X, 2-Q-Y, 3-R-Z, 4-S-W

B. 1-Q-Y, 2-P-X, 3-S-W, 4-R-Z

C. 1-R-Z, 2-S-W, 3-P-X, 4-Q-Y

D. 1-S-W, 2-R-Z, 3-Q-Y, 4-P-X

**Answer: A**

**24. Match the following fiber types with their characteristics and applications.**

| Fiber Type           | Characteristic                | Application                     |
|----------------------|-------------------------------|---------------------------------|
| 1. Single-mode fiber | P. One major propagation mode | X. Long-distance communication  |
| 2. Multimode         | Q. Multiple propagation modes | Y. Short-distance communication |

|                              |                                           |                                    |
|------------------------------|-------------------------------------------|------------------------------------|
| <b>fiber</b>                 |                                           |                                    |
| <b>3. Step-index fiber</b>   | <b>R. Abrupt refractive-index change</b>  | <b>Z. Simple fiber links</b>       |
| <b>4. Graded-index fiber</b> | <b>S. Gradual refractive-index change</b> | <b>W. Reduced modal dispersion</b> |

- A. 1-P-X, 2-Q-Y, 3-R-Z, 4-S-W  
 B. 1-Q-Y, 2-P-X, 3-S-W, 4-R-Z  
 C. 1-R-Z, 2-S-W, 3-P-X, 4-Q-Y  
 D. 1-S-W, 2-R-Z, 3-Q-Y, 4-P-X

**Answer: A**

**25. Match the following optical communication terms with their characteristics and functions.**

| <b>Term</b>                  | <b>Characteristic</b>                    | <b>Column III –<br/>Function/Application</b> |
|------------------------------|------------------------------------------|----------------------------------------------|
| <b>1. Numerical aperture</b> | <b>P. Light-gathering ability</b>        | <b>X. Determines acceptance capability</b>   |
| <b>2. Acceptance angle</b>   | <b>Q. Maximum angle for guided light</b> | <b>Y. Defines the input light cone</b>       |
| <b>3. Connector</b>          | <b>R. Detachable fiber joint</b>         | <b>Z. Temporary connection</b>               |
| <b>4. Splice</b>             | <b>S. Permanent/semi-permanent joint</b> | <b>W. Joining two optical fibers</b>         |

- A. 1-P-X, 2-Q-Y, 3-R-Z, 4-S-W  
 B. 1-Q-Y, 2-P-X, 3-S-W, 4-R-Z  
 C. 1-R-Z, 2-S-W, 3-P-X, 4-Q-Y  
 D. 1-S-W, 2-R-Z, 3-Q-Y, 4-P-X

**Answer: A**

**26. Statement 1: An optical connector provides a detachable connection between optical fibers or equipment.**

**Statement 2: A splice is normally used when a permanent or semi-permanent fiber joint is required.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: A**

**27. Statement 1: A laser diode is generally more suitable than an LED for high-speed, long-distance optical communication.**

**Statement 2: A laser diode produces a highly directional optical output with a relatively narrow spectral width.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: A**

**28. Statement 1: Total internal reflection enables light to propagate through the core of a conventional optical fiber.**

**Statement 2: The refractive index of the core is normally greater than that of the cladding.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: A**

**29. A long-distance optical communication link is experiencing severe pulse broadening due to different propagation paths. Which fiber would be the most appropriate replacement?**

- A. Multimode step-index fiber
- B. Multimode graded-index fiber

- C. Single-mode fiber
- D. Plastic optical fiber

**Answer: C**

**30. An optical receiver must detect very weak signals and provide internal gain without using an external electrical amplifier immediately after the detector. Which device is most suitable?**

- A. LED
- B. PIN photodiode
- C. APD
- D. Laser diode

**Answer: C**

#### **UNIT- V-Microwave Communication & RADAR**

**1. Which of the following is a major advantage of microwave communication?**

- A. Very low bandwidth
- B. Large antenna size
- C. High bandwidth capability
- D. No requirement for line-of-sight

**Answer: C**

2. **Which device is commonly used to generate high-power microwave signals?**

- A. Klystron
- B. Transformer
- C. Rectifier
- D. Transistor radio

**Answer: A**

3. **Which of the following is commonly used as a microwave oscillator?**

- A. Magnetron
- B. Crystal oscillator only
- C. Audio amplifier
- D. Transformer

**Answer: A**

4. **In an E-plane tee, the side arm is connected in the:**

- A. Electric field plane
- B. Magnetic field plane
- C. Horizontal plane only
- D. Vertical axis only

**Answer: A**

5. **In an H-plane tee, the side arm is connected in the:**

- A. Electric field plane
- B. Magnetic field plane
- C. Optical plane
- D. Ground plane

**Answer: B**

6. **A directional coupler is a device used to:**

- A. Couple a known amount of microwave power from a transmission line
- B. Generate DC voltage
- C. Convert microwave energy into mechanical energy
- D. Store microwave energy permanently

**Answer: A**

7. **An ideal directional coupler couples power:**

- A. Equally in all directions
- B. In one preferred direction
- C. Only to the ground
- D. Only to the transmitter

**Answer: B**

8. **The main purpose of a directional coupler in a microwave system is:**

- A. Sampling microwave power
- B. Generating high voltage
- C. Cooling the waveguide
- D. Changing DC into AC

**Answer: A**

9. **The process by which the electron velocity is varied in a klystron is called:**

- A. Velocity modulation
- B. Amplitude modulation
- C. Frequency modulation
- D. Phase modulation

**Answer: A**

10. **In a two-cavity klystron, velocity modulation takes place in the:**

- A. Input cavity
- B. Output cavity
- C. Collector
- D. Power supply

**Answer: A**

11. **In a klystron, electron bunching takes place mainly in the:**

- A. Drift space
- B. Cathode
- C. Output cavity only
- D. Power supply

**Answer: A**

**12. The output cavity of a two-cavity klystron is used to:**

- A. Extract microwave energy from the electron beam
- B. Produce electrons
- C. Supply heater voltage
- D. Focus the antenna beam

**Answer: A**

**13. RADAR stands for:**

- A. Radio Detection and Ranging
- B. Radio Direction and Receiving
- C. Radiation Detection and Radio
- D. Range Detection and Radiation

**Answer: A**

**14. The basic principle of RADAR is based on:**

- A. Reflection of electromagnetic waves
- B. Refraction of sound waves
- C. Diffraction of light only
- D. Absorption of radio waves

**Answer: A**

**15. RADAR is mainly used to determine the:**

- A. Position and movement of objects
- B. Temperature of a battery
- C. Voltage of a transmitter
- D. Resistance of an antenna

**Answer: A**

**16. Which component switches the radar antenna between transmitter and receiver in a pulse radar?**

- A. Duplexer
- B. Magnetron
- C. Klystron
- D. Detector

**Answer: A**

**17. The maximum detectable range of a radar is affected by:**

- A. Transmitter power
- B. Antenna gain
- C. Target radar cross-section
- D. All of the above

**Answer: D**

**18. If transmitter power is increased while other parameters remain constant, the radar detection capability generally:**

- A. Decreases
- B. Increases
- C. Becomes zero
- D. Remains unaffected

**Answer: B**

**19. The number of radar pulses transmitted per second is called:**

- A. Pulse repetition frequency
- B. Pulse width
- C. Echo frequency
- D. Carrier bandwidth

**Answer: A**

**20. If the time delay between transmission and reception of an echo increases, the target is:**

- A. Closer to the radar
- B. Farther from the radar
- C. Moving toward the radar necessarily
- D. Stationary necessarily

**Answer: B**

**21. The minimum distance at which a radar can detect a target is mainly determined by:**

- A. Pulse width
- B. Antenna gain
- C. Transmitter frequency

D. Target velocity

**Answer: A**

**Analytical based questions**

**22. Assertion: A two-cavity klystron can be used as a microwave amplifier.**

**Reason: Velocity modulation of electrons produces electron bunching, which enables energy transfer to the RF field in the output cavity.**

A. Both Assertion and Reason are true, and Reason is the correct explanation of Assertion

B. Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion

C. Assertion is true, but Reason is false

D. Assertion is false, but Reason is true

**Answer: A**

**23. The maximum detectable range of a RADAR decreases when the target range increases.**

**Reason: The received echo power decreases rapidly as the distance between the radar and target increases.**

A. Both Assertion and Reason are true, and Reason is the correct explanation of Assertion

B. Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion

C. Assertion is true, but Reason is false

D. Assertion is false, but Reason is true

**Answer: D**

**24. Match the following microwave devices with their characteristics and applications.**

| <b>– Device</b>               | <b>Characteristic</b>          | <b>Application</b>                |
|-------------------------------|--------------------------------|-----------------------------------|
| <b>1. Two-cavity klystron</b> | <b>P. Velocity modulation</b>  | <b>X. Microwave amplification</b> |
| <b>2. Magnetron</b>           | <b>Q. Microwave oscillator</b> | <b>Y. Radar transmitter</b>       |

|                               |                                   |                                         |
|-------------------------------|-----------------------------------|-----------------------------------------|
| <b>3. Directional coupler</b> | <b>R. Samples microwave power</b> | <b>Z. Power monitoring</b>              |
| <b>4. Waveguide</b>           | <b>S. Guides microwave energy</b> | <b>W. Microwave signal transmission</b> |

- A. 1-P-X, 2-Q-Y, 3-R-Z, 4-S-W  
 B. 1-Q-Y, 2-P-X, 3-S-W, 4-R-Z  
 C. 1-R-Z, 2-S-W, 3-P-X, 4-Q-Y  
 D. 1-S-W, 2-R-Z, 3-Q-Y, 4-P-X

**Answer: A**

**25. Match the following microwave components with their characteristics and applications.**

| <b>Component</b>              | <b>Characteristic</b>                             | <b>Application</b>                  |
|-------------------------------|---------------------------------------------------|-------------------------------------|
| <b>1. E-plane tee</b>         | <b>P. Series tee</b>                              | <b>X. Microwave power division</b>  |
| <b>2. H-plane tee</b>         | <b>Q. Shunt tee</b>                               | <b>Y. Microwave power division</b>  |
| <b>3. Magic tee</b>           | <b>R. Combination of E-plane and H-plane tees</b> | <b>Z. Microwave hybrid junction</b> |
| <b>4. Directional coupler</b> | <b>S. Directional power coupling</b>              | <b>W. Sampling microwave power</b>  |

- A. 1-P-X, 2-Q-Y, 3-R-Z, 4-S-W  
 B. 1-Q-Y, 2-P-X, 3-S-W, 4-R-Z  
 C. 1-R-Z, 2-S-W, 3-P-X, 4-Q-Y  
 D. 1-S-W, 2-R-Z, 3-Q-Y, 4-P-X

**Answer: A**

**26. A radar system transmits a pulse toward a target and receives the reflected signal after a measurable time delay. If the time delay increases, what can be concluded?**

- A. The target is closer to the radar
- B. The target is farther from the radar
- C. The transmitter power has increased
- D. The antenna gain has become zero

**Answer: B**

**27. Statement 1: A directional coupler can be used to sample a portion of microwave power.**

**Statement 2: A directional coupler completely blocks the main microwave signal path.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: C**

**28. Statement 1: A pulse RADAR determines target range using the time delay between the transmitted pulse and received echo.**

**Statement 2: A longer echo delay indicates a greater distance to the target.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: A**

**29. Statement 1: A magnetron is commonly used as a high-power microwave oscillator.**

**Statement 2: A two-cavity klystron primarily operates as a microwave amplifier.**

- A. Both statements are true
- B. Both statements are false
- C. Statement 1 is true and Statement 2 is false
- D. Statement 1 is false and Statement 2 is true

**Answer: A**

**30. A radar engineer needs to obtain a small portion of the microwave power travelling through a waveguide for measurement without significantly disturbing the main signal. Which component should be selected?**

- A. Magnetron
- B. Directional coupler
- C. Klystron
- D. Duplexer

**Answer: B**

### **PART – B**

#### **UNIT - I**

1. Explain the following antenna parameters with suitable diagrams:  
i) Directivity (5m) ii) Beamwidth (10 m)
2. Explain the following antenna parameters with suitable diagrams:  
i) Bandwidth (5m) ii) Radiation Pattern (10 m)

3. Explain the construction, working principle, characteristics and applications of a microstrip patch antenna with a neat diagram. (10m)
4. Explain the construction, working principle, characteristics and applications of a horn antenna with a neat diagram. (10m)
5. (i) Compare the different types of transmission lines based on their construction, characteristic impedance, operating frequency, losses, and applications. (5m)  
  
(ii) Compare ground wave, sky wave and space wave propagation based on frequency range, propagation mechanism, coverage distance and practical applications. (5m)

## **UNIT – II**

1. Draw the block diagram of a GSM system and explain the functions of its major components. (10m)
2. Explain the handoff mechanism in cellular communication and describe the different types of handoff. (10m)
3. Explain the methods used for improving coverage and capacity in cellular systems. (10)
4. (i) Analyze the evolution of cellular communication standards from 1G to 5G and compare their data rates, key features, and applications with suitable examples. (5m)  
  
(ii) Compare 4G LTE and 5G NR in terms of network architecture, multiple access techniques, bandwidth, latency, and capacity. Explain how 5G improves upon 4G LTE. (5m)

## **UNIT – III**

1. (i) Explain Kepler's three laws of planetary motion (5m)  
  
(ii) Compare LEO, MEO, geostationary orbit and Geostationary (GEO) orbits based on altitude, orbital period, coverage area, communication delay and applications. (5m)
2. Explain the Telemetry, Tracking and Command (TT&C) subsystem of a satellite and describe its major functions. (10m)

3. Explain the working of a satellite transponder with a suitable block diagram and mention its major functions. (10m)
4. Explain the working of a DTH receiver with a suitable block diagram. Describe the functions of the major components involved in receiving and processing the satellite signal. (10m)
5. Analyze how a satellite-based navigation system determines the accurate position of a user by utilizing signals from multiple satellites and coordinating the space, control, and user segments. (10m)

#### **UNIT – IV**

1. Explain the principle of light transmission through an optical fiber using ray theory. (10m)
2. (i) Compare single-mode and multimode optical fibers based on core diameter, modes of propagation, bandwidth, transmission distance and applications. (5m)  
(ii) Compare step-index and graded-index optical fibers based on refractive-index profile, modal dispersion, bandwidth and applications. (5m)
3. Explain the purpose of splicing in optical fiber communication and describe the different types of fiber splicing methods. (10 m)
4. Explain the principle and working of an optical fiber coupler. Mention its types and applications in optical communication systems. (10m)
5. Analyze the working of a communication system that uses light as the carrier and explain how the transmitter, transmission medium, and receiver work together to transmit and recover information. Draw a suitable block diagram. (10m)

#### **UNIT – V**

1. Explain the operation of a microwave communication link and explain the functions of the major blocks in its transmitter and receiver. Draw suitable block diagrams. (10m)
2. Explain the working of a pulse-based detection system and explain how the transmitted pulse, reflected echo and receiver are used to determine the target range. Draw a suitable block diagram. (10m)

3. (i) Explain the construction and working of an E-plane tee and describe its characteristics in microwave signal distribution. (5m)  
(ii) Explain the construction and working of an H-plane tee and describe its characteristics in microwave signal distribution. (5m)
4. (i) State the radar range equation and explain the significance of the parameters involved in determining the maximum detectable range of a radar system. (5m)  
(ii) Explain the working principle of a directional coupler and describe its important characteristics and applications. (5m)
5. Analyze the working of a microwave power-generating device and explain how velocity modulation and electron bunching contribute to the generation and amplification of microwave signals. (10m)