Q1. Differentiate between FDMA and TDMA with suitable diagrams.

- FDMA (Frequency Division Multiple Access):
  - Each user is allocated a separate frequency band.
  - Continuous transmission is possible.
  - Guard bands are required to prevent overlapping.
  - Less efficient in terms of bandwidth usage.
  - Example: Analog cellular systems (1G).
- TDMA (Time Division Multiple Access):
  - users share the same frequency channel but are allocated different time slots.
  - Transmission is not continuous (in bursts).
  - No guard bands, but guard time between slots.
  - More efficient bandwidth utilization compared to FDMA.
  - Example: GSM.

Diagram:

- FDMA → parallel frequency bands.
- TDMA → time slots on a single frequency.

Q2. Describe how MAC protocols help in avoiding collisions in wireless networks.

- MAC (Medium Access control) protocols manage access to the shared wireless medium.
- They avoid collisions using:

o Carrier Sense (CSMA/CA): Devices sense the medium before transmitting.
o Acknowledgments: Ensure successful delivery.
o Backoff Algorithms: Retransmission after random delay if collision detected.
o Reservation-based methods: Assign time/frequency slots.
· Thus, MAC protocols coordinate communication to reduce interference and maximize efficiency.

Q3. Describe the role of the Home Location Register (HLR) and Visitor Location Register (VLR) in localization.
· HLR (Home Location Register):
o Central database containing permanent subscriber details (IMSI, authentication, subscribed services).
o Stores current location of subscriber (MSC area).
· VLR (Visitor Location Register):
o Temporary database for subscribers currently roaming in its MSC area.
o Stores info like Temporary Mobile Subscriber Identity (TMSI), location area identity.
o Interacts with HLR during call setup, authentication, and mobility management.
Together: HLR + VLR ensure correct routing of calls/SMS and

efficient mobility tracking.

Q4. Illustrate the architecture of GPRS with a labeled diagram.

- GPRS Architecture components:
  - MS (Mobile Station): user device.
  - BSS (Base Station Subsystem): BSC + BTS.
  - SGSN (Serving GPRS Support Node): Mobility management, session management.
  - GGSN (Gateway GPRS Support Node): Interface to external packet-switched networks (e.g., Internet).
  - HLR/VLR: Subscriber data and mobility management.
  - PCU (Packet Control Unit): Packet switching between BSC and SGSN.

Diagram (in exam - draw a block diagram):

MS → BTS → BSC → SGSN → GGSN → Internet

Also connect HLR/VLR to SGSN.

Section B (2×4 = 8 Marks)

Q5. Compare the effectiveness of CDMA and TDMA in handling multiple users in a cellular system.

- CDMA (Code Division Multiple Access):
  - Users share same frequency and time, separated by unique codes.
  - Very high spectral efficiency.

- Handles multipath fading better.
- Soft capacity (can accommodate more users with graceful degradation).
- Complex system, requires power control.

• TDMA:

- Users separated by time slots on same frequency.
- Limited capacity (fixed no. of slots).
- Easier to implement but less efficient.
- More susceptible to delay and synchronization issues.

Conclusion: CDMA is more effective for high user density and efficient spectrum use; TDMA is simpler but less scalable.

Q6. Compare the GSM and GPRS architectures in terms of efficiency, scalability, and data handling.

• GSM (Global System for Mobile Communication):

- Primarily circuit-switched (voice calls, SMS).
- Inefficient for data (dedicated circuit for entire session).
- Scalability limited by fixed channels.
- Low data rates (9.6–14.4 kbps).

• GPRS (General Packet Radio Service):

- Packet-switched data transmission.
- Efficient use of bandwidth (resources used only when data is sent).

- Higher scalability (supports more users dynamically).
- Higher data rates (up to 171.2 kbps theoretical).
- Enables mobile internet, MMS, and always-on connectivity.

Conclusion: GSM → best for voice; GPRS → optimized for data, more efficient and scalable.