**1) Describe a complex general system.**

**Example:** **Smart City Traffic Management System**

* **Hierarchy of Systems:**
  + **City Traffic Control Center**
    - Regional Traffic Hubs
      * Road Sensor Networks
      * Smart Traffic Lights
      * Surveillance Camera Systems
      * Public Transport Tracking
    - Mobile Applications & Citizen Dashboards
* **Models to Reduce Complexity:**
  + **Subsystem Decomposition:** Dividing by region (sector 1, sector 2) and by function (traffic lights, public transport).
  + **Layered Architecture:**
    - Data Collection Layer: IoT sensors, cameras.
    - Data Processing Layer: Traffic analytics, AI predictions.
    - Application Layer: User apps, control dashboards.
  + **Microservices Architecture:** Different services (accident detection, route optimization, public announcements).

**2) What are the CMM levels? Find 5 software companies at level 3 CMM.**

**CMM Levels:**

1. Initial — Processes are chaotic and undefined.
2. Repeatable — Basic project management is established.
3. Defined — Processes are documented and standardized.
4. Managed — Quantitative performance data is collected.
5. Optimizing — Focused on continuous process improvement.

**Five companies certified at CMM Level 3:**

* **IBM** (USA)
* **Microsoft** (USA)
* **Accenture** (Ireland/USA)
* **Siemens** (Germany)
* **Thales Group** (France)

**3) What is the difference between incremental and iterative software processes?**

* **Incremental Model:**  
  Development happens in **fully functional sections (increments)**; each increment adds a new feature to the product.
* **Iterative Model:**  
  The same feature is **repeatedly refined** based on testing and feedback until it meets final requirements.

**Key Point:**  
Incremental = "add new parts."  
Iterative = "polish existing parts."

**4) Describe the most complex software product you were personally involved with.**

**Project Name:** **Monitor.IoT** – End-to-End IoT Monitoring and Control Platform

**a) Information System that embeds it:**

Monitor.IoT is a cloud-based Internet of Things (IoT) system that enables users to monitor and control smart devices such as cameras, RGB lights, and environmental sensors through a real-time web/mobile app. It connects ESP32-based devices with a Node.js backend on Heroku and stores data in MongoDB Atlas.

**b) Product Purpose and Desired Objectives:**

* Remote monitoring and control of IoT devices worldwide.
* Easy-to-use platform with minimal setup.
* Multi-user simultaneous access to devices.

**c) Organization of the Team:**

| **Team Member** | **Responsibilities** |
| --- | --- |
| **Sakka Mohamad-Mario** | Cloud server development, client app development, firmware coding |
| **Zafar Azzam** | Cloud server development, firmware development, project documentation |

**d) Stages in the Lifecycle and Activities Performed:**

* **Requirement Gathering:** Identify the need for easy IoT device control remotely.
* **System Design:** Design architecture (Microcontrollers ⇄ Cloud ⇄ App).
* **Implementation:** Develop firmware, backend, and client apps.
* **Testing:** Test real-time communication, multi-user scenarios.
* **Deployment:** Launch server on Heroku, database on MongoDB Atlas.
* **New Devices: Made more devices com**

**e) Process Model Similarity and Differences:**

* **Similar Model:** Incremental Model
* **Difference:** Some stages evolved iteratively as requirements became clearer.

**f) How the Project Process Could Have Been Improved:**

* Introduce automated testing and CI/CD pipelines.
* Perform early load testing and optimize Redis usage.
* Enhance security with multi-factor authentication (MFA).

**5) Which software engineering paradigm is most effective?**

**Answer:**  
The **Agile Paradigm** is the most effective because it:

* Welcomes changing requirements even late in development.
* Encourages frequent, small software deliveries.
* Promotes close, daily cooperation between business people and developers.
* Fits modern IoT and cloud systems where adaptability is crucial.

**6) Provide three examples of projects amenable to prototyping or spiral models.**

**Examples:**

* **Smart Home Security System** — needs prototypes to refine camera and alarm functionalities.
* **Hospital Remote Patient Monitoring System** — requires risk handling with the spiral model (especially security risks).
* **Smart Agriculture Monitoring System** — sensors and remote controls need to be tested through prototyping to ensure reliability under different environmental conditions.

**7) Propose a specific software project amenable to the incremental model.**

**Project:** **University E-Learning Platform**

**Scenario Applying the Incremental Model:**

* **Increment 1:** Develop secure user login and registration features.
* **Increment 2:** Build course catalog and enrollment modules.
* **Increment 3:** Add live video lecture streaming and quiz modules.
* **Increment 4:** Integrate certification and progress tracking features.

Each new increment adds complete, usable features while preserving system stability and enhancing user experience gradually.