## **📘 National Exam Structured Question – C++ Hospital Network Management System**

### **Question Title:**

Develop a Hospital Network Management System using C++ with file handling and graph-based relationships.

### **Background:**

In a health infrastructure project, six hospitals (H1 to H6) operate in different locations and must be digitally managed. Each hospital should be registered with its details, and connections between hospitals represent patient referral paths.

### **Task:**

You are required to write a C++ program that performs the following operations:

### **Part A: CRUD Operations [30 Marks]**

1. **Create**: Allow users to add hospital details one at a time. Each hospital must include:  
   * Hospital ID (must be unique, e.g., H1, H2, ...)
   * Hospital Name
   * Location
   * Number of Patients (must be a number)
2. **Read**: Display all hospitals in a tabular format with the following columns:  
   * ID, Name, Location, Number of Patients
3. **Update**: Allow the user to edit any hospital’s information using its ID.
4. **Delete**: Allow removal of a hospital by its ID. If removed, also update related connections.

All data should be stored in a CSV file (e.g., hospitals.csv) with column titles.

### **Part B: Graph Connectivity [40 Marks]**

1. **Bidirectional Links**:  
   * Allow the user to create **two-way** (bidirectional) links between hospitals.
   * Each link must include a **description** (e.g., "emergency support", "ambulance path", etc.)
   * Validate that both hospital IDs exist before creating a link.
   * If either hospital ID is missing, show an appropriate error.
2. **Storage**:

Store connections in a plain text file (e.g., graph.txt) with this format:  
  
 less  
CopyEdit  
H1,H6:Emergency backup,H4:Referral support

H2,H3:Standard route

...

1. **Display**:  
   * Show a **relationship table** with the following columns:  
     + **Hospital Center** | **Connected Hospitals** | **Hospital Description**
   * Display all hospitals, even if they have no links.
   * Ensure all bidirectional links are shown from both ends.

### **Part C: Predefined Scenario [10 Marks]**

Initialize your program to allow the user to manually enter the following setup via terminal:

* **Hospitals**: H1, H2, H3, H4, H5, H6
* **Connections**:  
  + H1 ↔ H6
  + H1 ↔ H4
  + H2 ↔ H3
  + H6 ↔ H5
  + H5 ↔ H4
  + H4 ↔ H1
  + H2 ↔ H3

Let users enter these through the menu system.

### **Part D: Validation & Error Handling [20 Marks]**

Your program must:

* Prevent duplicate hospital IDs
* Prevent non-numeric input for patient numbers
* Display meaningful messages for errors (e.g., "Hospital ID not found", "Connection already exists", etc.)
* Include confirmation messages when actions succeed

### **Bonus [Optional, +5 Marks]**

Export the hospital relationship table to a new CSV file (relationships.csv) with headings:  
  
 scss  
CopyEdit  
Hospital Center, Connected Hospitals, Description

### **Submission Requirements:**

* Complete C++ source code (main.cpp)
* Sample data files:  
  + hospitals.csv
  + graph.txt
  + (optional) relationships.csv