

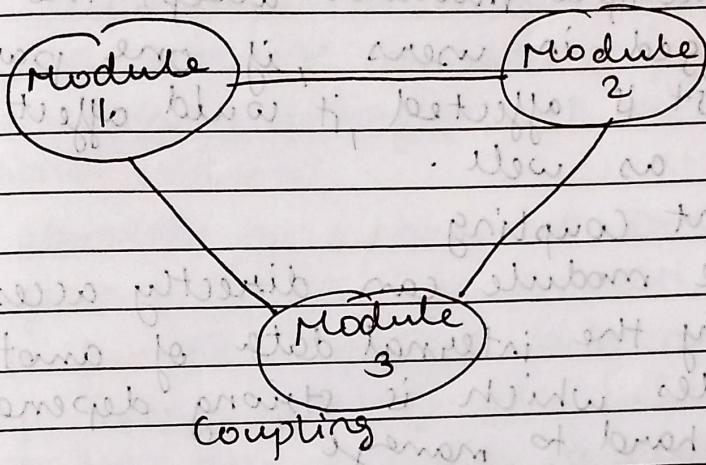
4. Software Design

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Q1) Explain Cohesion and Coupling?

⇒ **Coupling**

(i) Coupling refers to the degree of interdependence between software modules.

(ii) 

(iii) High coupling means that modules are closely connected and changes in one module may affect other modules.
Low coupling means that modules are independent and changes in one module may have little impact on other modules.

(v) Types of coupling.

(a) Data coupling

(1) Modules only pass necessary data back and forth without interfering in each other's details.

(2) Eg: A billing system only sends the total price to a payment module.

(b) Stamp coupling

(1) One module sends entire data structure even only part of it is needed.

(2) Eg: A user profile with name, age, address

Best : Data Coupling

Worst : Content Coupling

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is sent to a module that only needs address, but the entire profile is passed.

(c) Common Coupling

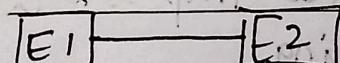
- ① Modules share the same global data i.e. if one module changes its data then all other modules are affected.
- ② Eg: Multiple modules accept the same list of logged-in users, if one part of the list is affected, it would affect other parts as well.

(d) Content Coupling

- ① One module can directly access or modify the internal data of another modules which is strong dependency and hard to manage.

2. Cohesion

- ① Cohesion measures how well the elements within a module work together to achieve a single purpose.



cohesion

- ③ When a module has high cohesion, it means all parts of the module work together to do one specific job.

- ④ Low cohesion means a module tries to do many different things, which can make it confusing and harder to update.

High : Functional cohesion
Low : Coincidental cohesion

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V Types of cohesion

(a) Coincidental cohesion

- (1) The elements have no meaningful relationship but are placed together in the same module by coincidence.
- (2) Eg : A module that contains unrelated tasks like checking the battery of a device and another function to sort the list of names.

(b) Functional cohesion

- (1) All elements in a component work together to perform a single, specific task.
- (2) Eg : A function that calculates sum of an array. Every line of code contributes to finding the sum & serves a single purpose.

(c) Sequence cohesion

- (1) One element's output becomes the input for the next element, creating a sequence.
- (2) Eg : A process where data is validated, then processed and finally saved to a database.

(d) Temporal cohesion

- (1) Elements are related by timing, so they need to run at the same time.
- (2) Eg : A module that handles the tasks like closing the open files, saving user preferences and logging off when the program shuts down.

(e) Communication cohesion

- (1) Elements work on the same data and are focused on the same output.
- (2) Eg : A module that reads data from a file, updates it, then sends it to printer and databases both.

(Q2) Explain software design principles.

- ⇒ (1) Software design principles are the idea on the principle behind the design.
- (2) It is the logic or thinking about how you will design the software.
- (3) Software design principles are as follows:
- (a) Abstraction
- (i) Abstraction means showing only the important data and hiding the complex inner workings.
- (ii) Eg: In a banking application, a transferFunds() function might allow the transfer of the funds. The user doesn't need to see the how the transfer processes the database instead only interact with the user interface for the task completion.
- (b) Architecture
- (i) Architecture is the high-level structure of a software system, defining how different parts interact and work together.
- (ii) Eg: In a web application, the architecture might follow a MVC pattern where the model handles the data, the view handles what the users see and the controller connects the two.
- (c) Design Patterns
- (i) Design patterns are solutions to problems in software design which are used to improve code organization & reusability.

- (ii) Eg: The singleton pattern ensures a class has only one instance.
- (i) Modularity means dividing a program into separate parts, or 'modules,' each responsible for a specific functionality.
- (ii) Eg: In an e-commerce site, there might be a separate module for payment and separate module for authentication.
- (e) Information Hiding
- (i) It restricts access to the certain part of code, protecting the rest of the program from unnecessary or harmful changes.
- (ii) Eg: In an authentication system, the password checking logic must be hidden from other parts of the program.
- (f) Functional independence
- (i) Functional independence means each module or function performs their task independently.
- (ii) Eg: In a text editor, there could be separate function for open-file, save-file, edit-file.
- (g) Refactoring
- (i) Refactoring involves improving code structure without changing its functionality.
- (h) Refinement
- (i) Refinement is a process of starting with high level idea and breaking it down into smaller, more specific steps.
- (i) Object oriented design
- (i) It is a way of combining data, actions using objects, making code organized, reusable and easy to maintain.

(Q3) Explain how user interface design helps web technology or IT industry?

⇒ (1) User interface design is essential in web technology and IT because it makes websites and apps easy to use and visually appealing.

(2) The following points show how UI design helps:

(a) Makes app easier to use

(i) In a shopping website, users can quickly find categories, search for items, and add products to their cart because the design is clear and simple.

(b) Saves time and increases productivity.

(i) In a customer support dashboard, having all tools and options clearly labelled helps agents assist customers more efficiently, reducing the time spent per query.

(c) Strengthens Brand Recognition

(i) Consistent colors, logos and styles create a recognizable look, building trust with users.

(d) Lowers development cost

(i) A clear UI design plan reduces the need for later fixes & redesigns, saving money.

(e) Increases conversions

(i) A user-friendly UI can guide users to make desired actions like making a purchase or signing up.

- (f) Increases accessibility
(i) Thoughtful UI design considers accessibility standards, ensuring that application is used by people with disabilities.
- (g) Reduces user errors
(i) In a banking app, clear instructions and confirmations help users avoid errors like sending money to the wrong person.

Aspect	Cohesion	Coupling
Definition	Cohesion refers to the degree to which elements within a module work together to fulfill a single, well-defined purpose.	Coupling refers to the degree of interdependence between software modules. High coupling means that modules are closely connected and changes in one module may affect other modules.
Module Dependency	Cohesion is the concept of an intra-module.	Coupling is the concept of inter-module.
Purpose	Cohesion represents the relationship within a module.	Coupling represents the relationships between modules.
Quality	Increasing cohesion is good for software.	Increasing coupling is avoided for software.
Focus	Cohesion represents the functional strength of modules.	Coupling represents the independence among modules.
Relationship	Highly cohesive gives the best software.	Whereas loosely coupling gives the best software.
Example	In cohesion, the module focuses on a single thing.	In coupling, modules are connected to the other modules.
Creation	Cohesion is created between the same module.	Coupling is created between two different modules.
Types	<p>Types of Cohesion</p> <ol style="list-style-type: none"> 1. Functional Cohesion. 2. Procedural Cohesion. 3. Temporal Cohesion. 4. Sequential Cohesion. 5. Layer Cohesion. 6. Communication Cohesion. 	<p>Types of Coupling</p> <ol style="list-style-type: none"> 1. Data Coupling 2. Stamp Coupling 3. Control Coupling 4. External Coupling 5. Common Coupling 6. Content Coupling

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