# Design Thinking & Innovation

## Unit I: Design Thinking Foundations & Empathy

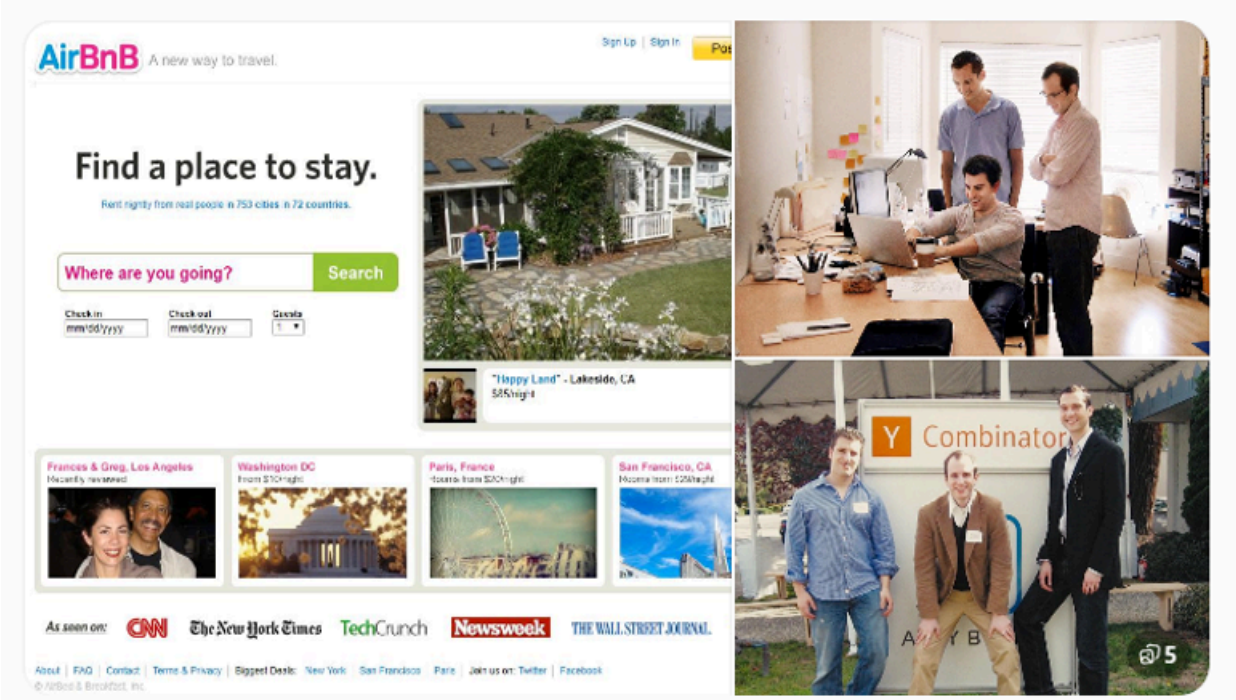
B.Tech (AI & DS) | R26 Regulations

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### 1. Introduction to Design Thinking

Design Thinking is a way of solving problems by starting with **people**, not with technology. Instead of asking "What can I build?", we ask "Who has a problem, and what do they really need?". It is a hands-on, step-by-step approach: understand people, define the problem, brainstorm ideas, build quick models, test them, and improve.

**Real-life example:** In 2009 the founders of Airbnb were struggling. Bookings were low (Not enough people were booking rooms through the website). What was Airbnb?




Airbnb is a platform where people can rent out their homes, apartments, or spare rooms to travelers.

Instead of changing the website code, they travelled to New York, met hosts, and saw that the listing photos were poor.



**Listing A**

Dark, blurry photo. You cannot clearly see the room.



**Listing B**

Bright, clear photo. You can see the bed, space, and condition.

Which room would you feel more comfortable booking?

Most people would find it easier to trust Listing B because they can see what they are paying for.

They took good photos themselves, and bookings improved. The fix came from observing real users, not from more programming.

**What happened after they improved the photos?**

**Before**

Poor-quality photos made the rooms difficult to evaluate, so potential guests were less likely to book.

**Action**

The founders photographed the properties themselves and improved the appearance of the listings.

**Result**

The founders reported that Airbnb's weekly revenue in New York increased from about $200 to $400 after their intervention. This was an important early sign of progress.

**Try it (5 minutes):** Think of one small problem you face daily in college (long queue at the canteen, hard-to-find parking, slow Wi-Fi). Write: *Who faces it? When? Why does it happen?* You have just started thinking like a design thinker.

**Remember:** Design Thinking = people first, ideas next, solution last.

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**2. Design Thinking Mindset and Principles**

A mindset is the attitude you carry while solving problems. The main parts are:

| Mindset | Meaning |
|---|---|
| **Empathy** | Feel and understand what the user feels |
| **Curiosity** | Keep asking "why?" |
| **Optimism** | Believe a better solution exists |
| **Experimentation** | Try quickly, learn from failure |
| **Collaboration** | Work with different people and ideas |
| **Bias towards action** | Build and test instead of only talking |

**Key principles:** focus on the human, show don't tell (use sketches and models), start small and test early, accept that failure is feedback, and iterate (repeat and improve).

**Real-life example:** The Mumbai dabbawala system delivers about 200,000 lunch boxes daily with very few errors.

What is dabbawala system?




A *dabbawala* is a person who collects home-cooked lunch boxes and delivers them to workers, usually in offices, across Mumbai, India.

For example, imagine you work in an office in Mumbai, but your home is 15 kilometres away. Your family prepares lunch at home, and you want to eat that food at your office.

You cannot go home during your lunch break. A dabbawala solves this problem by collecting your lunch box from your home, transporting it through Mumbai, and delivering it to your workplace in time for lunch.

The network is famous for handling an enormous number of deliveries every working day with a very low reported error rate.The team wins only if everyone performs their part and makes the handoffs correctly.

The dabbawala system works similarly:

- One worker collects the lunch box.
- Another helps sort and transport it.
- Another takes it from the destination station to the correct office.
- Workers coordinate their timing so the box keeps moving toward its destination.

It works because of teamwork, simple colour codes, and constant on-the-ground improvement, not because of expensive technology.

**Try it (10 minutes, in groups of 4):** Each group gets 10 sheets of paper and tape. Build the tallest freestanding tower in 8 minutes. After the first try, discuss what failed and rebuild in 4 minutes. Notice how the second tower is better. That is experimentation and iteration.

**Remember:** Be curious, be empathetic, try fast, fail early, learn quickly.

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### 3. Design Thinking vs. Conventional Engineering Problem-Solving

Conventional engineering usually starts with a defined problem and a technical requirement, then follows a fixed path to the solution. Design Thinking starts by questioning whether we have the *right* problem, and it keeps looping back when we learn something new.

| Point | Conventional Engineering | Design Thinking |
|---|---|---|
| Starting point | Technical specification | User's real need |
| Focus | Does it work technically? | Does it work for people? |
| Process | Mostly linear | Iterative (loops back) |
| Failure | Avoided | Used as learning |
| Testing | Late in the process | Early and often |
| Question asked | "How do we build it?" | "What should we build and for whom?" |

**Real-life example:**

Engineers could build a very accurate digital blood pressure machine with 20 buttons. Design thinkers visit elderly patients and find they cannot read small screens or press many buttons. The better product has one large button and spoken results. Both are technically correct, but only one fits the user.




**Machine A: Technically advanced**

- 20 small buttons
- Tiny screen
- Many settings
- Accurate blood pressure readings

Problem: Difficult for some elderly users to operate.




**Machine B: User-friendly**

- One large start button
- Easy-to-read display
- Spoken results
- Accurate blood pressure readings

Advantage: Easier to use independently.

Both machines can measure blood pressure accurately. The difference is how easily a person can operate them.

**Try it (10 minutes):** Take the problem "Design a better water bottle for students." Group A writes technical specs (capacity, material, weight). Group B interviews 3 students first and writes what they really complain about (leaks, hard to clean, cannot fit in bag side pocket). Compare the two lists.

**Remember:** Engineering asks "Can we build it?" Design Thinking first asks "Should we build it, and for whom?"

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**4. Human-Centered Design (HCD)**

Human-centered design places the user at the centre of every decision. We design **with** users, not just **for** them. A good design should be **desirable** (people want it), **feasible** (technically possible), and **viable** (can be sustained financially).

**Real-life example:** Aravind Eye Hospital (Madurai) studied how rural patients behave and what stops them from getting cataract surgery: cost, travel and fear. They created eye camps in villages, low-cost surgery, and an assembly-line style process so more patients are treated. The system was shaped by patient reality.

**Try it (10 minutes):** Look at the college entrance gate or a classroom door. List 3 ways it is *not* human-friendly (for example: heavy to open for a person with a bag, no ramp, poor lighting). For each, write who suffers.

**Remember:** Desirable + Feasible + Viable = a successful human-centered solution.

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**5. Five-Stage Design Thinking Process**

The process has five stages. They are not strictly one-way; you can go back at any stage.

1. **Empathize:** understand users by observing and talking to them.
2. **Define:** state the problem clearly (problem statement).
3. **Ideate:** generate many possible solutions.
4. **Prototype:** build a quick, cheap model.
5. **Test:** show it to users, get feedback, improve.

**Real-life example (college canteen):**

- *Empathize:* You watch students and find that most leave the queue because it is too long.
- *Define:* "Students with a 30-minute break need a faster way to get food because long queues make them skip meals."
- *Ideate:* Pre-order on phone, separate counter for snacks, token system, combo meals.
- *Prototype:* A paper token system or a simple Google Form for pre-orders.

- *Test:* Try it for one week and ask students what worked.

**Try it (15 minutes):** Pick the problem "Students are always late to the first class." Write one line for each of the five stages. Share with a partner.

**Remember:** Empathize, Define, Ideate, Prototype, Test, and loop back when needed. In this course we also add a final step: Innovate and Communicate Value.

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**6. Creativity, Curiosity and Observation**

- **Creativity:** the ability to come up with new, useful ideas. Everyone has it; it grows with practice.
- **Curiosity:** the habit of asking "Why?", "What if?", "How come?".
- **Observation:** carefully watching what people actually *do*, not what they *say* they do.

**Real-life example:** The Oral-B kids' toothbrush. Designers observed children brushing and noticed that kids have small hands and grip with the whole fist. Adult brushes with thin handles were hard for them to hold. A thick, chunky handle fixed it. The insight came from watching, not from asking.

**Try it (observation walk, 15 minutes):** Go to the college bus stop, library or canteen. For 10 minutes, quietly note down 10 things people do (like workarounds, struggles, shortcuts). Do not judge. Mark the three most surprising ones.

**Try it (curiosity, 5 minutes):** Pick any everyday object (a pen, a plug point). Ask "Why" five times about its design. Example: Why does the plug have 3 pins? Why is the earth pin longer? Keep going.

**Remember:** Curiosity asks the question, observation finds the clue, creativity builds the answer.

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**7. Understanding Users and Stakeholders**

- **User:** the person who directly uses the product or service.

- **Stakeholder:** anyone affected by, or who can affect, the solution. This includes users, but also owners, staff, regulators, families, and the community.

The same problem looks different from each stakeholder's side. A good designer considers all of them.

**Real-life example (a food-delivery app):**

- *Customer:* wants fast, hot food at a fair price.
- *Delivery partner:* wants fair pay and safe routes.
- *Restaurant:* wants orders, low commission and clear timing.
- *Local traffic police and residents:* want less congestion. If you design only for the customer, the delivery partner may leave and the system fails.

**Try it (15 minutes):** Choose "A new college library borrowing system." Draw a stakeholder map: write the system in the centre and place users (students) closest, then librarians, faculty, management, and vendors around it. Mark who has high influence and who has high interest.

**Remember:** User is the one who uses it; stakeholder is anyone touched by it.

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**8. Empathy and User Research**

Empathy means putting yourself in someone else's shoes and understanding how they think and feel. It is different from **sympathy** (feeling sorry for someone). User research is the planned way of collecting that understanding through talking, watching and experiencing.

**Real-life example:** A team designing a better wheelchair-friendly ramp for a college spent a day moving around the campus in a wheelchair. They discovered that small door lips, wet floors and heavy doors were bigger problems than the ramp itself. They only found this by experiencing it.

**Try it (20 minutes, "Walk in their shoes"):** Do one of these for 15 minutes and write what you felt:

- Use your phone only with your non-dominant hand.

- Use the college app with the screen brightness at minimum and font size at maximum.
- Navigate the campus with your eyes mostly closed while a partner guides you safely.

**Remember:** Sympathy says "I feel sorry for you." Empathy says "I understand what you are going through."

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### 9. Interviews, Observation and Contextual Inquiry

These are the three main ways to do user research.

#### 9.1 User Interviews

A one-to-one conversation to learn about the user's experiences, feelings and habits.

**Good interviewing tips:**

- Ask **open-ended** questions ("Tell me about the last time you...") instead of yes/no questions.
- Ask for **stories**, not opinions.
- Keep asking "Why?" and "Can you give an example?".
- Listen more than you talk. Stay silent for a moment so the person continues.
- Never lead the person (do not say "Don't you think the canteen is too slow?").

| Weak question | Better question |
|---|---|
| Do you like the canteen? | Tell me about the last time you went to the canteen. |
| Is the Wi-Fi bad? | Describe what happened when you last needed the internet on campus. |

**Real-life example:** A team building a study-planner app asks students "Would you use a planner?" and most say yes. When they instead ask "Tell me how you prepared for your last exam", they discover students rely on friends' notes and

WhatsApp groups, and nobody uses planners. The second question reveals the truth.

### 9.2 Observation

Watching users in their natural setting without interfering. People often do things differently from what they say.

**Real-life example:** Observing students at the library you notice many circle around looking for a free charging point and sit near it, even if the seat is uncomfortable. No student mentioned this in an interview.

### 9.3 Contextual Inquiry

A mix of observing and interviewing. You go to the user's real place (home, workplace, shop floor), watch them do the real task, and ask questions *while* they work. The user is the "master" and you are the "apprentice".

**Real-life example:** To improve a vegetable vendor's billing, a team sits beside a vendor in the market for a morning. They see him doing mental math, handling cash with wet hands and shouting weights to a helper. A mobile billing app that needs clean hands and a small screen would clearly fail here. This insight would never emerge in a classroom.

**Try it (Activity: 3-person interview practice, 20 minutes):** One person is the *interviewer*, one is the *interviewee*, one is the *note-taker*. Topic: "How do you travel to college each day?" Interview for 7 minutes, then rotate roles. Note-takers write exact quotes and emotions.

**Remember:** Interview = what they say. Observation = what they do. Contextual inquiry = both together, in their real setting.

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## 10. Empathy Mapping

An empathy map is a simple one-page chart that summarizes what you learned about a user. It has four quadrants around the user:

| Quadrant | Question it answers |
|---|---|
| **Says** | What does the user say out loud? (quotes) |

| Quadrant | Question it answers |
|---|---|
| **Thinks** | What might they be thinking but not saying? |
| **Does** | What actions and behaviours did you see? |
| **Feels** | What emotions do they show (fear, anger, hope)? |

Some versions also add **Pains** (frustrations) and **Gains** (what they hope to achieve).

**Real-life example (final-year student looking for a job):**

- *Says:* "I'm applying everywhere but getting no calls."
- *Thinks:* "Maybe my resume is not good enough. Everyone else seems ahead."
- *Does:* Sends the same resume to 50 companies, watches many YouTube videos, avoids talking about it at home.
- *Feels:* Anxious, left behind, pressured.
- *Pain:* No feedback on rejections. *Gain:* A clear path to a first job.

From this map, a designer can see the real problem is not "finding job posts" but "getting feedback and confidence".

**Try it (20 minutes):** Use your interview notes from the previous activity. Draw a big cross on a chart paper, write Says / Thinks / Does / Feels, and stick sticky notes in each quadrant. Circle any contradiction (what they *say* vs what they *do*), because contradictions hold insights.

**Remember:** An empathy map turns raw notes into understanding. Look for gaps between Says and Does.

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## 11. Personas and User Journeys

### 11.1 Personas

A persona is a **fictional but realistic character** that represents a group of real users, built from your research. It helps the team keep one real person in mind while designing.

**A persona contains:** name, age, photo/sketch, occupation, background, goals, frustrations, habits, and a short quote.

**Real-life example (Persona for a campus food-ordering app):**

- **Name:** Ravi, 19, second-year B.Tech student, hostel resident
- **Goals:** Eat quickly between classes within a 30-minute break, stay within a ₹100 daily budget
- **Frustrations:** Long queues, running out of favourite items, no cash on him
- **Habits:** Uses UPI for everything, checks WhatsApp groups for updates
- **Quote:** "By the time I get my food, the break is over."

Now, instead of arguing about "what students want", the team can ask "Would Ravi use this?".

**Rule:** Base a persona on real research. A persona made from imagination alone is only a stereotype.

### 11.2 User Journey Map

A journey map shows, step by step, what a user goes through while trying to achieve a goal, along with what they do, think and feel at each step. It highlights **pain points** and **opportunities**.

**Structure:**

| Stage | Action | Thought | Emotion (😊/😐/😞) | Pain point | Opportunity |
|---|---|---|---|---|---|
| Arrive at canteen | Walks to counter | "Hope it's not crowded" | 😐 | Crowd at entrance | Separate entry and exit |
| Wait in queue | Stands 15 minutes | "I'll miss my class" | 😞 | Long wait | Pre-order option |
| Pay | Looks for cash/QR | "Where is the QR?" | 😞 | Only cash accepted at one counter | Multiple UPI points |
| Eat | Eats quickly | "I must run" | 😐 | Rushed | Faster serving |

The lowest emotion points show where design can help the most.

**Try it (Activity, 25 minutes):** Choose your own journey: "Getting a bonafide certificate from the college office." Break it into 5-6 steps. For each step write Action, Thought, Emotion and Pain point. Draw the emotion line (up and down) across the steps. Circle the lowest point.

**Remember:** Persona tells you *who*. Journey map tells you *what they go through*.

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**12. Explicit and Latent (Unarticulated) Needs**

- **Explicit need:** what users clearly say they want.
- **Latent (unarticulated) need:** a deeper need the user cannot or does not express, often because they don't realise it or are used to the problem.

A famous way to understand this: if people only said what they wanted, they might ask for "a faster horse", while the real need was faster, easier travel.

**Real-life examples:**

- *Explicit:* A shopkeeper says "I want a bigger bill book." *Latent:* He actually needs to stop making calculation mistakes and track credit given to customers.
- *Smartphone cameras:* People said they wanted a better phone camera (explicit), but the latent need was to capture and share moments instantly with friends.
- *Cab apps:* Riders said "get me a cab faster" (explicit). The latent need was to feel safe and know exactly when and where the cab is coming.

**How to find latent needs:**

1. Watch behaviour: look for workarounds (things people do to get around a problem).
2. Look for emotions: frustration, embarrassment, anxiety.
3. Notice contradictions between what people say and do.
4. Keep asking "Why?" until you reach the root need.

**Try it (Activity, 15 minutes):** Interview a classmate about "how they take notes in class". Write what they *say they need* (explicit). Then write what you *noticed* (they photograph the board but never look at it again, they struggle to find old notes) and infer the latent need (a way to find and revisit notes quickly). Use the format: "*User needs a way to* _____ *because* _____."

**Remember:** Explicit needs are on the surface; latent needs are underneath. The best innovations come from latent needs.

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**13. Ethical Considerations in User Research**

Since we study real people, we must treat them with respect, honesty and care. Ethical research protects the user's dignity, safety and privacy.

**Key rules:**

1. **Informed consent:** Tell people who you are, why you are researching, and how their answers will be used. Take permission before interviewing, recording or photographing.
2. **Voluntary participation:** People can refuse or stop at any time without pressure.

3. **Privacy and confidentiality:** Do not reveal names or personal details. Use a persona name or code instead.
4. **No harm:** Avoid questions or tasks that may embarrass, hurt or put someone at risk, especially with vulnerable people (children, elderly, patients).
5. **Honesty:** Do not mislead people or twist their words to match your idea.
6. **Respect and cultural sensitivity:** Be aware of language, gender, religion and local customs.
7. **Data protection:** Store recordings and notes safely and delete them when no longer needed.
8. **Avoid bias:** Do not only interview people who agree with you or are easy to reach.

**Real-life example:** A group of students researching how patients feel in a hospital waiting area photographed the patients without asking. This breached privacy and could have caused real distress. The correct way would be to take permission from the hospital, explain the purpose to each patient, avoid faces in photos, and give people the choice to say no.

**Try it (10 minutes):** Write a short **consent script** (3 lines) you will read before every interview. Example: "*Hi, I'm ___, a student at LBRCE. I'm doing a class project on ___. Your answers will be kept private, and you can stop any time. Is it okay if I take notes?*" Practise it with a partner.

**Remember:** Ask, explain, respect, protect. If in doubt, ask permission.

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**Practical Activities (Lab Work)**

These five activities follow the order of the unit. Do them for **one real problem** of your choice (for example, canteen queue, hostel laundry, library seating, bus timing, parking, or lab equipment access). By the end, you will have one complete empathy package.

**Activity 1: Observation of a Real-Life Problem**

**Goal:** Learn to see problems that others ignore.

**Steps:**

1. Choose a place on campus or nearby (canteen, bus stop, library, market).
2. Observe for 20-30 minutes without disturbing people.
3. Note down what people **do**, what they struggle with, workarounds, and anything surprising.
4. Take photos only with permission, and no faces.
5. Write 5 problem observations and pick the most interesting one.

**Output:** Observation sheet with 5 findings and 1 selected problem area.

**Activity 2: Conducting User Interviews**

**Goal:** Learn to ask the right questions and listen.

**Steps:**

1. Prepare 8-10 open-ended questions.
2. Read the consent script and take permission.
3. Interview at least **3-5 users** (and, if possible, one other stakeholder).
4. Record exact quotes and emotions.
5. Thank the user and summarise what you learned.

**Output:** Question list, interview notes, and 5 key insights.

**Activity 3: Preparing an Empathy Map**

**Goal:** Convert research into understanding.

**Steps:**

1. Take your interview and observation notes.
2. Draw the four quadrants: Says, Thinks, Does, Feels (plus Pains and Gains).
3. Place sticky notes in each section.
4. Highlight contradictions and strong emotions.
5. Write 2-3 insights at the bottom.

**Output:** One-page empathy map with insights.

**Activity 4: Developing a Persona**

**Goal:** Represent your users as a realistic character.

**Steps:**

1. Look for common patterns across your interviewees.
2. Create one persona: name, age, role, goals, frustrations, habits, a quote.
3. Add a simple sketch or icon.
4. Make sure each detail comes from your research.

**Output:** One-page persona card.

**Activity 5: Preparing a User Journey Map**

**Goal:** See the whole experience and find where design can help.

**Steps:**

1. Define the persona's goal (for example, "Get lunch in the 30-minute break").
2. List 5-8 stages from start to finish.
3. For each stage write action, thought, emotion and pain point.
4. Draw the emotion curve and mark the lowest points.
5. Write 3 opportunities for improvement.

**Output:** Journey map with highlighted pain points and opportunities.

**Final Step: From Observations to Design Opportunity**

From your five activities, complete this sentence, which prepares you for Unit II:

> ***"[Persona name] needs a way to [need] because [insight]."***

Example: "*Ravi needs a way to get food quickly within his 30-minute break because long queues and cash-only counters make him skip meals.*"

Turn it into a question: **"How might we help Ravi get food within his break time?"** This is called a **How Might We** question, and it is the doorway to the next unit.

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**Summary**

| Topic | One-line summary |
|---|---|
| Design Thinking | A people-first way to solve problems |
| Mindset | Curious, empathetic, optimistic, experimental, collaborative |
| DT vs Conventional | Conventional is linear and spec-led; DT is iterative and user-led |
| Human-centered design | Desirable + Feasible + Viable |
| Five stages | Empathize, Define, Ideate, Prototype, Test |
| Creativity, curiosity, observation | Ask why, watch carefully, create new ideas |
| Users vs stakeholders | Users use it; stakeholders are anyone affected |
| Empathy | Understand how others feel, not just feel sorry |
| Research methods | Interviews (say), observation (do), contextual inquiry (both in context) |
| Empathy map | Says, Thinks, Does, Feels |
| Persona | A research-based fictional user |
| Journey map | Step-by-step experience with emotions and pain points |
| Explicit vs latent needs | Spoken needs vs hidden needs |
| Ethics | Consent, privacy, respect, no harm |

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**Practice Questions**

**Short answer**

1. Define Design Thinking and name its five stages.
2. Differentiate between empathy and sympathy with an example.

3. What is the difference between a user and a stakeholder?
4. What is an empathy map? List its four quadrants.
5. Differentiate between explicit and latent needs with one example.

**Long answer**

6. Compare conventional engineering problem-solving with Design Thinking.
7. Explain interviews, observation and contextual inquiry with examples.
8. What is a persona? Explain how a persona and a journey map help a designer.
9. Discuss the ethical considerations in user research with examples.

**Application**

10. Choose a problem in your hostel or college. Write a 3-line observation, one open-ended interview question, one latent need, and one "How Might We" question.