K. K. Wagh Institute of Engineering Education and Research, Nashik
(An Autonomous Institute from A. Y. 2022-23)

Exam Seat No.:
End-Sem Examination-I — Winter 2025
Academic Year: 2025-26 — Sem: I
Class: F.Y — Program: MCA
Branch Code:09 — Pattern: 2022
Name of Course: UI/UX Design — Course Code: MCA222005
Max. Marks: 60 — Duration: 2:30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.
(*keep space*)
1. This question paper contains 2 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome.

Q. No.	Details	Max. Marks	CO No.	BT Level
Q.1	Define usability in interactive systems. List its main goals and measures. What is universal usability? Ans: **Definition:** Usability of an interactive system is the degree to which specified users can use the system to achieve specified goals with **effectiveness** (correctness & completeness), **efficiency** (resources or time used), and **satisfaction** (comfort and acceptability) in a given context of use. **Main goals:** • **Effectiveness:** Users complete tasks correctly and completely (success rate). • **Efficiency:** Tasks are completed with minimal time, steps, or effort (time-on-task, clicks). • **Satisfaction:** Users find the system pleasant and would choose to use it again (surveys, SUS). • **Learnability:** New users can achieve proficiency quickly (time to competency). • **Memorability:** Infrequent users can re-establish proficiency after absence. • **Low error rate & recoverability:** Few user errors occur, and if they do, recovery is simple. **Measures:** • **Objective / performance measures:** task completion rate, task time, error counts, number of help requests,	[6]	CO1	L1

	keystrokes/clicks. • **Subjective measures:** questionnaires (System Usability Scale, Likert scales), interviews, satisfaction ratings. • **Behavioral measures:** navigation paths, hesitation, mouse/eye tracking, abandonment rates. Using a combination of these (triangulation) gives a reliable picture. **Universal usability:** Designing systems that are usable by the **widest possible range** of people — differing in age, language, physical/ cognitive abilities, culture, device types and contexts. It implies accessible design (WCAG), adaptable interfaces (responsive layouts, localization), and inclusive practices (alternative input/output, adjustable complexity).			
Q.2	Analyze practical and objective measures of usability and show how they can be used to evaluate the effectiveness of an interactive system. Ans: **Practical measures** are hands-on, often qualitative methods that reveal real user difficulties and context-of-use issues: • **User observations / think-aloud testing:** Watch users perform representative tasks and note confusions, workarounds, and pain points. • **Heuristic evaluation / expert review:** UX experts inspect the interface against known usability heuristics (consistency, feedback, error prevention). • **Contextual inquiry / field studies:** Observe users in their environment (mobile, noisy workplace) to discover situational constraints. • **Surveys/interviews:** Collect perceptions, expectations, and perceived difficulties. **Objective measures** are quantitative metrics that can be compared over time or across designs: • **Task success rate (completion %)** — whether users achieve the goal. • **Time on task** — speed to complete; shorter usually better if accuracy is preserved. • **Error rate / types of errors** — frequency and severity. • **Number of clicks/keystrokes / navigation depth** — efficiency proxies. • **Abandonment or retry rates**. **Using them to evaluate effectiveness:**	[6]	CO4	L4

	1. **Select representative tasks** that map to real goals. 2. **Collect objective data** (completion, time, errors) during moderated usability tests. These give clear performance indicators. 3. **Collect practical/qualitative data** (observations, think-aloud, user comments) to explain *why* metrics are high/low. 4. **Benchmark** against prior designs or target thresholds (e.g., 95% completion for critical tasks). 5. **Triangulate**: e.g., if time-on-task is high and observers note confusing labels, fix labeling and re-test. Objective metrics show magnitude; practical measures reveal causes and guide fixes. 6. **Report effect size and real-world impact** (e.g., reducing time on checkout by 30% reduces abandonment and increases conversions).			
Q.3	a) Examine how menu structure, function, and content affect effective navigation. (8 Marks) Ans: **Structure:** Good menu structure organizes choices logically—group related items together, use meaningful categories, and decide depth vs breadth. **Shallow, broad** menus reduce deep search but risk clutter; **narrow, deep** hierarchies reduce immediate clutter but increase travel time. Use consistent placement and persistent menus to reduce orientation costs. **Function:** Menus should support user tasks: provide **affordances** (visual hints that options are clickable), **shortcuts** for power users (keyboard accelerators, recently used items), **progressive disclosure** (show advanced options only when needed), and **contextual menus** for object-specific actions. Predictable behavior (opening on hover vs click) reduces errors. **Content:** Use concise, unambiguous labels using user language (avoid jargon), group by task rather than function when appropriate, and order items by frequency or importance (primary tasks first). Icons enhance recognition but must be well-known. Include search/filter in large menu systems. **Overall impact:** A well-structured, functional, and clearly worded menu reduces cognitive load, shortens search time, lowers error rates, and improves satisfaction. Example: an e-commerce site that groups “Orders”, “Returns”, “Payment” under “Account” and provides recent orders as quick links makes it faster for users to perform common tasks. **OR**	[16]	CO3	L4

	b) Analyze direct manipulation in virtual environments and how it improves user interaction. (8 Marks) Ans: **Definition & principles:** Direct manipulation means interacting with on-screen objects by acting on them directly (drag, drop, rotate) rather than issuing abstract commands. Key principles: **continuous representation** of objects, **rapid/observable feedback**, **physical actions & gestures**, and **reversible operations**. **In virtual environments (VEs):** VEs use spatial metaphors where users reach for and manipulate virtual objects using VR controllers, hand tracking, or touch gestures. Interfaces replicate real-world interactions (grab, throw, scale) and present continuous visual/ haptic feedback. Objects maintain persistence and respond immediately to user input. **Benefits:** • **Intuitiveness & learnability:** Users map real-world skills to the virtual world, reducing learning time. • **Engagement & immersion:** Tactile-like interactions increase presence and satisfaction. • **Precision for spatial tasks:** Manipulating 3D models directly supports tasks like assembly, design, medical simulation. • **Error recovery:** Seeing the object move immediately and being able to undo reduces costly errors. **Example:** A VR interior-design app where users pick up furniture, place it, rotate, and resize it directly — this is faster and more understandable than typing coordinates.			
	c) Analyze graphical menus, form fill-ins, and dialog boxes and their role in user interaction. (8marks) Ans: **Graphical menus:** Use icons, dropdowns, ribbon bars, and visual grouping to allow **recognition** rather than recall. Strengths include quick scanning, compact presentation, and support for visually guided tasks. Design considerations: clear labels alongside icons, consistent iconography, avoid too many levels, and ensure accessibility (keyboard navigation, contrast). **Form fill-ins:** Critical for data capture (signup, checkout, surveys). Usability practices: logical field order aligned to user mental model, clear labels and inline examples/placeholder text, input masks for formatting (dates, phone), concise error messaging near the affected field, and real-time validation that		CO3	L4

	helps but does not block. Minimize required fields and use progressive disclosure for advanced options. **Dialog boxes:** Serve as confirmations, warnings, modal choices, or information prompts. Use sparingly — overuse disrupts flow. Modal dialogs should be for important decisions; non-modal inline notices can be used otherwise. Provide clear action buttons (primary action emphasized), concise explanatory text, and keyboard shortcuts/esc behavior. **Role in interaction:** Together, these elements structure user workflow: menus provide navigation, forms capture data and intent, and dialogs confirm critical decisions. Well-designed versions reduce errors, speed tasks, and guide users through flows. **OR** d) Outline interaction devices, collaboration, and social media participation in supporting user engagement. (8 marks) Ans: **Interaction devices:** The hardware used shapes possible interactions: **keyboard & mouse** for precision; **touchscreens** for direct, finger-based input; **stylus** for drawing/annotation; **voice assistants** for hands-free tasks; **gesture/VR controllers** for spatial manipulation; **sensors** (accelerometer, camera) enable context-aware interactions. Device choice affects speed, accuracy, accessibility, and satisfaction. **Collaboration:** Tools such as shared documents, collaborative whiteboards, version control, presence indicators, and in-app chat enable teamwork. **Synchronous** tools (video calls, co-editing) support real-time coordination; **asynchronous** tools (comments, task trackers) support distributed teams. Design features (conflict resolution, history, role permissions) increase trust and reduce friction. **Social media participation:** Social features (likes, comments, sharing, UGC) increase engagement by enabling social validation, distributed discovery, and community support. Feedback mechanisms help designers iterate (ratings, reviews), and social traces guide new users (trending items). However, moderation and privacy controls are necessary to prevent abuse. **Combined effect:** Properly supported devices, collaboration features, and social participation drive sustained engagement, richer interaction, and social learning; they also influence retention and virality of applications.			
Q.4	a) Examine the key elements of windowing systems and their	[16]	CO3	L4

	design principles. (8 marks) Ans: **Key elements:** A windowing system includes: **windows** (resizable frames for content), **title bars** (identify content & provide drag handles), **borders/resize handles**, **minimize/maximize/close controls**, **scrollbars**, **menus/toolbars**, **icons** (represent apps/files), and a system area (taskbar, dock) to manage running windows. Window management features include tiling, stacking (z-order), snapping, and virtual desktops. **Design principles:** • **Visibility of system status:** Users should know which window is active, where it is, and its state. Visual cues (highlighted title bar, focus ring) help. • **Consistency & predictability:** Window controls should behave the same across apps. • **Affordance & feedback:** Resize handles and drag cursors communicate possibility; resizing shows live content or outline depending on performance. • **Minimize cognitive load:** Provide mechanisms like tabs or grouped windows to avoid clutter. • **Focus & attention management:** Handling popups/modals so they don't steal or obscure necessary information; friendly defaults for focus and keyboard navigation. • **Multitasking support:** Design for switching, arranging, and comparing windows (split view, snap). **Example:** In productivity apps, detachable panels and resizable panes allow users to customize workspace; clear title bars and color coding allow quick identification. **OR** b) Investigate the role of natural language and NLP in improving user interaction. (8 marks) Ans: **Role & basics:** Natural language interfaces let users express intent via speech or text. **NLP** involves tokenization, parsing, intent recognition, entity extraction, sentiment analysis, and language generation. Recent improvements use machine learning (especially deep learning) and large language models for more fluent interaction. **Applications:** • **Voice assistants / smart speakers** (Alexa, Siri):			

	hands-free control, home automation. • **Chatbots and virtual agents** for customer service and help desks. • **Search and question answering** using natural query phrases. • **Machine translation** and multilingual interfaces for global users. • **Accessibility aids**: speech-to-text for users with motor impairments, text summarization for cognitive load reduction. **Benefits:** • **Lowered learning barrier:** Users speak naturally rather than learn commands. • **Accessibility:** Enables people with visual or motor impairments to interact. • **Personalization:** NLP enables contextual, conversational flows and personalization. • **Efficiency:** Complex queries can be expressed in plain language. **Limitations & challenges:** • **Ambiguity & context sensitivity:** Natural language is vague; systems must resolve ambiguity using context. • **Errors from noisy input / accents / slang.** • **Privacy concerns** (captured voice data). • **Dependence on training data** — biases and language coverage issues.			
	c) Distinguish different operable controls and explain how they enhance user experience. (8marks) Ans: **Controls & characteristics:** • **Buttons:** Discrete actions (submit, cancel). Should have clear labels, appropriate size, and visual feedback on press. Primary/secondary styling indicates priority. • **Sliders:** Continuous input (volume, brightness) where fine granularity or immediate feedback is useful. Show current value and allow keyboard adjustments. • **Tabs:** Organize related views without navigating away; useful for switching contexts quickly; active state must be clear. • **Scrollbars:** Support navigation through overflow content, indicate position and length; modern UIs may hide them but must keep accessibility in mind		CO3	L4

(keyboard scroll, touch gestures).

- **Clear text & messages:** Error messages, confirmations, inline tips — concise, actionable, and placed near the source of error. Use plain language and suggest fixes.

How they enhance UX:

- **Affordance & discoverability:** Controls visually indicate their use.
- **Efficiency:** Appropriate control choice speeds interaction (button for toggle vs slider for range).
- **Feedback:** Immediate visual change confirms action, reducing uncertainty.
- **Accessibility:** Keyboard focus order, ARIA roles, and text alternatives ensure use by assistive tech.
- **Error prevention & recovery:** Clear messages guide users to correct mistakes.

Example: A form that uses sliders for range selection with numeric display, tabs to separate sections, and clear inline validation reduces errors and completion time.

OR

d) Evaluate presentation controls and their role in user interfaces.(8marks)
Ans:

Presentation controls:

- **Static text fields / labels:** Convey information; should be concise, legible, and positioned close to related controls.
- **Group boxes / panels:** Visually group related elements to show relationships (e.g., billing vs shipping address).
- **Column headings / table headers:** Provide context for tabular data and enable sorting/filtering.
- **Tooltips / help text / microcopy:** Offer contextual help without cluttering the UI.

Impact:

- **Readability & scanning:** Proper typography, spacing, and headings let users scan pages quickly and find relevant content.
- **Cognitive grouping:** Group boxes and consistent layout reduce mental mapping costs and error likelihood.
- **Context & guidance:** Tooltips and headings orient

	users; dynamic help (inline) reduces need for full documentation. • **Accessibility:** Semantic headings and ARIA attributes enable screen readers to navigate effectively. **Evaluation example:** In a data dashboard, clear column headings and grouped panels let analysts find trends faster; tooltips on complex metrics provide immediate clarification and reduce misinterpretation.			
Q.5	a) Explain QoS in response time and describe models that affect user experience. (8 marks) Ans: **Definition:** Quality of Service (QoS) encompasses performance attributes a system guarantees — most relevant here is **response time** (latency) between user action and system reaction. Response time directly affects perceived speed and user satisfaction. **Models influencing response time:** • **Human performance models:** Predict how response time affects perception and behavior (e.g., <0.1s feels instantaneous; 0.1–1s feels immediate; >1s breaks flow; >10s loses attention). These thresholds guide UI responsiveness targets. • **System/network models:** Processing delays (CPU, I/O), database latency, and network latency add to response time. CDN and caching strategies help reduce network lag. • **Queuing & concurrency models:** Under load, request queues and contention increase wait times; queuing theory helps size resources and predict delays. **Effects on UX & mitigation:** • **Slow response** causes frustration, task abandonment, and perceived poor quality. **Variability** (jitter) is worse than consistently slow but predictable responses. • **Mitigations:** local optimistic UI updates, progressive loading indicators, asynchronous operations with background processing, caching, load balancing, and graceful degradation. Also provide feedback (spinners, progress bars) and estimated wait where meaningful. **Example:** A search UI that returns results incrementally (progressive rendering) feels faster and retains user engagement versus waiting for all results. **OR**	[16]	CO2	L2

	b) Discuss how function and fashion relate in UI design, focusing on messages and layouts. (8 marks) Ans: **Function:** The functional aspect of UI is about usability—clear affordances, legible typography, meaningful layout, precise error messages, and efficient workflows. Function answers: *Can the user do what they need?* Messages must be actionable and succinct; layouts should prioritize primary tasks and minimize distractions. **Fashion (aesthetics):** Aesthetics include color palette, typography, spacing, iconography, and visual polish. Fashion impacts first impressions, trust, and emotional engagement. Good visual design can increase perceived usability even if performance is similar. **Relationship & balance:** Overemphasizing fashion can obscure function (beautiful but confusing layouts). Overemphasizing function can make interfaces utilitarian and less engaging. The goal is *functional aesthetics* — attractive design that enhances clarity, not obscures it. For messages: ensure visibility (use color & contrast) but also clear wording. For layout: use white space and visual hierarchy to guide users to important elements without ornamentation that distracts. **Examples / Practices:** • Error messages should combine clear language (function) with visual emphasis (fashion) — e.g., brief headline + explanation + corrective action button. • Web pages should use consistent grid systems to balance aesthetics and scannability. • Maintain accessible color contrast and avoid purely decorative icons that reduce clarity.			
	c) Describe key challenges in information visualization and how they affect user understanding. (8marks) Ans: **Challenges & effects:** • **Large/complex data volume:** Too much information can overwhelm; users miss patterns. *Mitigation:* aggregation, filtering, drill-down, sampling. • **Poor choice of visual encodings:** Using inappropriate chart types or encodings (e.g., pie charts for many categories) leads to misinterpretation. *Mitigation:* choose encodings that match data (bar for		CO2	L2

	comparisons, line for trends). • **Clutter & occlusion:** Overplotting hides relationships. *Mitigation:* use aggregation, opacity, small multiples. • **Color misuse:** Poor palettes or reliance on color alone excludes color-blind users. *Mitigation:* colorblind-friendly palettes, redundant encodings (shape, labels). • **Scale & axes distortion:** Manipulating axes can mislead. *Mitigation:* use honest scales, clearly label axes. • **Lack of context/annotation:** Without labels or units, charts are ambiguous. *Mitigation:* provide titles, labels, and brief interpretations. • **Interactivity complexity:** Too many controls or hidden interactions confuse users. *Mitigation:* progressive disclosure and sensible defaults. **Effect on understanding:** These issues lead to misreading trends, false conclusions, cognitive overload, and loss of trust. Good visualization design focuses on clarity, appropriate abstraction, and user-centered interaction to reveal insights rather than hide them. **OR** d) Explain how user interfaces influence society, individuals, and accessibility. (8 marks) Ans: **Societal impacts:** UIs shape how information is distributed (newsfeeds, algorithms), how people communicate (messaging platforms), and how services are accessed (e-government, banking). Well-designed UIs can democratize access to services, boost civic participation, and increase economic opportunity. Poor design, however, can create digital divides, misinformation spread, or exclusion of marginalized groups. **Individual impacts:** Interfaces influence individual behavior (habit formation, attention allocation), productivity (streamlined interfaces speed work), and emotional wellbeing (friction causes frustration; persuasive design can increase engagement, sometimes to the point of overuse). Good UI reduces task friction and cognitive load, improving satisfaction and reducing errors. **Accessibility:** UI design determines whether people with disabilities can use technology. Accessible features (keyboard navigation, screen-reader support, captions, high contrast modes, voice input) enable independence. Laws and standards (e.g., WCAG) and ethical design practices require inclusion. Accessibility not only benefits users with permanent disabilities but also temporary or situational impairments (e.g.,			

	one-handed use, noisy environments).			