INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

EXPERIENTIAL ENGINEERING EDUCATION (EXEED) – PROTOTYPE / DESIGN BUILDING

III Semester: AE / ME / CE / ECE / EEE / CSE / CSE (AI & ML) / CSE (DS) / CSE (CS) / IT								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
ACSD12	Skill	L	T	P	C	CIA	SEE	Total
		0	0	2	1	40	60	100
Contact Classes: NIL	Tutorial Classes: NIL	Practical Classes:45				Total Classes: 45		
Prerequisite: Essentials of Innovation.								

I. COURSE OVERVIEW:

This course provides an overall exposure to the various methods and tools of prototyping. This course discusses Low- Fidelity, paper, wireframing and tool-based prototyping techniques along with design principles and patterns.

II. COURSES OBJECTIVES:

The students will try to learn

I. The basic principles and design aspect of prototyping.
II. The various techniques, design guidelines and patterns.
III. The applications of prototyping using various tools and platforms.

III. COURSE CONTENT:

Module 1: An Introduction to Prototyping

Objective: Understand the basics of prototyping and its importance in the design process.
Exercise:

1. Introduction Lecture (10 minutes): Overview of prototyping and its types.
2. Brainstorming Session (20 minutes): Brainstorm simple app ideas.
3. Sketching Session (20 minutes): Create initial design sketches on paper.
4. Paper Prototyping (40 minutes): Build a low-fidelity paper prototype of the app's user interface.
5. Presentation and Feedback (20 minutes): Present prototypes and receive feedback.
   Materials and Tools: Paper, pencils, rulers, scissors, glue.

Module 2: Low-Fidelity Prototyping and Paper Prototyping

Objective: Learn concepts and techniques of low-fidelity and paper prototyping.
Exercise:

1. Lecture (10 minutes): Concepts of low-fidelity prototyping.
2. Hands-On Session (40 minutes): Build paper prototypes of the app's screens and user flow.
3. Peer Review (30 minutes): Exchange prototypes with peers for feedback.
4. Iteration (30 minutes): Refine prototypes based on feedback.

Materials and Tools: Paper, pencils, rulers, scissors, glue.

Module 3: Wireframing and Tool-Based Prototyping

Objective: Create wireframes and digital prototypes using software tools.
Exercise:

1. Lecture (10 minutes): Introduction to wireframing and digital prototyping tools.
2. Wireframing (30 minutes): Design wireframes of the app's user interface using tools like Figma or Sketch.
3. Tool-Based Prototyping (50 minutes): Create a digital prototype of the app.
4. Presentation and Feedback (20 minutes): Share digital prototypes and gather feedback. **Materials and Tools:** Wireframing tools, computers.

Module 4: Physical Low-Fidelity Prototyping and 3D Printing

Objective: Build simple physical prototypes using basic materials and introduce 3D printing.
Exercise:

1. Lecture (10 minutes): Importance of physical prototyping.
2. Prototype Building (30 minutes): Create a physical representation of the app's main interface using materials like cardboard and foam.
3. **Introduction to 3D Printing (20 minutes):** Overview of 3D printing technology and its applications in prototyping.
4. Testing (20 minutes): Test the physical prototypes for basic functionality.
5. Feedback Session (30 minutes): Present and discuss prototypes.

Materials and Tools: Cardboard, foam, clay, scissors, glue, 3D printer.

Module 5: Tool-Based Prototyping and Circuit Design

Objective: Develop advanced digital prototypes using specialized tools and introduce basic circuit design concepts.
Exercise:

1. Lecture (10 minutes): Advanced prototyping tools and techniques, introduction to circuit design.
2. Hands-On Session (40 minutes): Use tools like Figma, Adobe XD, or Android Studio to create an interactive prototype of the app.
3. **Circuit Design (20 minutes):** Design simple circuits that could be integrated into the app's hardware prototype.
4. User Testing (20 minutes): Conduct user tests and document feedback.
5. Feedback and Iteration (20 minutes): Refine prototypes based on user feedback.

Materials and Tools: Advanced prototyping software, computers, circuit design tools (e.g., breadboards, resistors, LEDs).

Module 6: Design Principles and Patterns - Graphic Design

Objective: Apply graphic design principles to create visually appealing app interfaces.
Exercise:

1. Lecture (10 minutes): Graphic design principles (contrast, alignment, repetition, proximity).
2. Design Session (50 minutes): Create a graphic design layout for the app's interface.
3. Peer Review (30 minutes): Exchange designs for feedback.
4. Refinement (20 minutes): Refine designs based on peer feedback.

Materials and Tools: Graphic design software, computers.

Module 7: Interaction Design and Arduino Integration

Objective: Apply interaction design principles to create intuitive app interfaces and introduce Arduino for hardware interactions.
Exercise:

1. Lecture (10 minutes): Basics of interaction design and Arduino integration.
2. Design Session (40 minutes): Develop interactive wireframes or prototypes for the app's user interactions.
3. **Arduino Integration (20 minutes):** Connect simple Arduino circuits to the app prototype to simulate interactions (e.g., button presses, LED responses).
4. User Testing (20 minutes): Conduct usability tests with peers.
5. Iteration (20 minutes): Improve designs based on test results.

Materials and Tools: Interaction design tools, computers, Arduino kits.

Module 8: Commercial Design Guidelines and Standards

Objective: Design according to industry standards and guidelines.
Exercise:

1. Lecture (10 minutes): Overview of commercial design guidelines
2. Design Session (50 minutes): Develop a prototype of the app following specific design guidelines.
3. Review (30 minutes): Evaluate prototypes against the guidelines.
4. Presentation and Discussion (20 minutes): Present prototypes and discuss adherence to guidelines.

Materials and Tools: Design guidelines documents, design software, computers.

Module 9: Universal Design: Sensory and Cognitive Impairments

Objective: Create app designs accessible to users with sensory and cognitive impairments.
Exercise:

1. Lecture (10 minutes): Principles of universal design.
2. Design Session (50 minutes): Develop an accessible design for the app.
3. User Testing (20 minutes): Test designs with peers simulating impairments.
4. Feedback Session (30 minutes): Present and discuss accessibility features.

Materials and Tools: Design software, computers, accessibility guidelines.

Module 10: Universal Design: Tools, Limitations, and Standards

Objective: Understand tools and limitations in universal design, and adhere to standards.
Exercise:

1. Lecture (10 minutes): Tools and limitations in universal design.
2. Hands-On Session (50 minutes): Use tools to create universally designed app prototypes.
3. Testing (20 minutes): Evaluate prototypes for accessibility and adherence to standards.
4. Iteration (30 minutes): Refine designs based on testing outcomes.

Materials and Tools: Universal design tools, computers.

Module 11: Mobile UI Design, CNC, and Arduino

Objective: Design user interfaces for mobile and wearable devices, create related hardware prototypes using CNC tools, and integrate Arduino for interactions.
Exercise:

1. Lecture (10 minutes): Principles of mobile UI and wearable design, introduction to CNC lathe and mill, and Arduino for wearable interactions.
2. Design Session (30 minutes): Develop a UI prototype for a mobile app or wearable device.
3. **CNC Prototyping (20 minutes):** Create physical components of the wearable device using CNC lathe and mill.
4. **Arduino Integration (20 minutes):** Program Arduino for basic interactions (e.g., motion detection, feedback via LEDs).
5. User Testing (20 minutes): Conduct usability tests on the prototype.
6. Feedback Session (30 minutes): Present and discuss usability findings.

Materials and Tools: Mobile UI design tools, computers, mobile devices, CNC lathe, CNC mill, Arduino kits.

Module 12: Automotive User Interface, Laser Engraving, and Arduino Integration

Objective: Design user interfaces for automotive applications, integrate laser engraving for UI elements, and use Arduino for sensor-based interactions.

Exercise:

1. Lecture (10 minutes): Fundamentals of automotive UI design, overview of laser engraving, and Arduino for sensor integration.
2. Design Session (30 minutes): Create a prototype for an automotive interface (e.g., dashboard layout).
3. **Laser Engraving (20 minutes):** Use laser engraving to create high-precision UI elements for the automotive interface.
4. **Arduino Integration (20 minutes):** Implement Arduino to simulate sensor-based interactions (e.g., temperature control, obstacle detection).
5. Testing (20 minutes): Test the prototype for usability and functionality.
6. Feedback Session (30 minutes): Present and discuss design improvements.

Materials and Tools: Automotive UI design tools, computers, laser engraving machine, Arduino kits.

IV. REFERENCE BOOKS:

1. Chee Kai Chua, Kah Fai Leong, "3D Printing and Additive Manufacturing: Principles and Applications".
2. Simon Knight, "Arduino for Beginners: Step-by-Step Guide to Arduino (Arduino Hardware & Software)".
3. Peter Smid, "CNC Programming Handbook".
4. Steven Wolfe, "Laser Cutting and Engraving".
5. Charles Platt, "Make: Electronics: Learning Through Discovery".