

Prototyping

Course Organization

Google Classroom code [n6cbqq](#) (Click on the code to join the classroom)

Weekly Schedule

Lecture Every Monday - 8.30 AM - 9:50 AM Practical sessions Weekdays (in sections) - 2.00 PM to 5.00 PM

Instructors

Manasi Kanetkar es115dip@gmail.com (all course related communication)
manasi.kanetkar@iitgn.ac.in

Rakesh Singhai rakesh.singhai@iitgn.ac.in

Trainers

Ashish Pandey
Aniruddh Mali
Tarun Sharma
Sajidhusen Rathod
Nirav Bhatt
Aman Tripathi
Babloo Sharma

Primary Textbook

Product design and development by Ulrich, Karl T. Publisher: Chennai: McGraw-Hill India, 2024

Useful Reference Books

- Design of Everyday Things, Don Norman, Basic Books
- Fundamentals of Manufacturing Engineering, D. K. Singh, Ane Books Pvt. Ltd.
- Elements of Manufacturing Processes, B. S. Nagendra, P. & R.K. Mittal, PHI Learning
- Introduction to Manufacturing Processes, John A. Schey, McGraw-Hill

Course objectives

- Introduction to design process and avenues of innovation
- Introduction to various prototyping trades and skill development for the same
- Introduction to workshop/ shop floor practices and safety standards

Understanding the journey of an idea to a feasible product

- Identifying opportunities for value addition by engineering and design •

Understanding material properties; design and engineering detailing for prototyping

- Application of design process as an iterative and creative problem solving. Using design tools and methods to offer value added solutions for specific needs

Course Schedule

Week	Lecture	Lab session
1	Introduction	Design activity [AB1/101]
2	Drivers of innovation + PRODUCT	Prototyping Trade 1 [Machine Shop/TL/Maker Bhavan]
3	Design process	Prototyping Trade 1 [Machine Shop/TL/Maker Bhavan]
4	Forming a project brief	Test : Prototyping Trade 1
5	Human factors	[Machine Shop/TL/Maker Bhavan/Wood workshop] Techno-aesthetic detailing
6	Presentation and representation	Design Activity [AB1/101]
7	Nuances of design	Prototyping Trade 2 [Machine Shop/TL/Maker Bhavan]
8	Responsible design	Prototyping Trade 2 [Machine Shop/TL/Maker Bhavan]
9	Case studies	Test : Prototyping Trade 2
10	IPR	Final Project

11 Guidelines for final submission Final Project

12 TBD Final Project

Note:

- The topics highlighted in red will be shared as recorded lectures (Week 2 and Week 5) since they fall on holidays.
- The schedule may change in case required. The changes will be informed to the students well in advance.
- If there are any holidays on the lab sessions, the compensatory sessions will be organized on Saturdays of the same or the consecutive week.

Grading Policy

Important instructions

- A student is required to PASS all three verticals (Assignments, Trade practice, Design

project). Even a single FAIL will result in the student FAILING the course, regardless of how well the student does in the remainder of the course.

- Templates, guidelines and evaluation Rubric for assignments and stages of the design project will be shared on **Google Classroom** for each project stage.

Peer Review

Peer review will happen within a team in the following manner:

- The peer review will be based on all activities declared as team activities
- Further instructions will be shared at the time of the review.

Schedule of submissions and % weightage

Distribution	%)	Submission Week	Deliverables
Assignments	25	Week 1	Report on design activity (5 marks)
		Week 5	Techno-aesthetic design of joinery (15 marks)
		Week 11	Reflective essay + Visual notes (5 marks)
Trade Certification	30	Week 4	Trade 1 (15 marks)
		Week 8	Trade 2 (15 marks)
Design project	30	Week 4	Phase 1: Project brief (Value Proposition) (5 marks)
		Week 7	Phase 2: Multiple ideas (Evaluated with phase 3)
Peer Review	10	Week 10	Phase 3: Concept sketches + Low fidelity mockups (10 marks)
		Week 12	Final Concept presentation (15 marks)
		Week 11/12	10 marks

TOTAL 95

Assignments

The assignments are planned on building contextual understanding of design and innovation. These will strengthen the understanding of important concepts that contribute to design practice, ability to observe and empathize.

Details of deliverables and evaluation matrix will be provided on Google Classroom as per the submission schedule.

- **Report on design activity 1 (5 marks):** The activity will be conducted during the lab session and a report will be submitted at the end of the session.
- **Techno-aesthetic design of joinery (15 marks):** Students will work in groups and have to design and manufacture a contraption based on Trade 1. Attention to engineering details and

finishing is of utmost importance. 'Decoration' is highly discouraged. • **Visual notes (5 marks):**
 Reflective excerpt on learnings from the course

Trade Certification Policies

1. **Objective:** The objective of certification is to enable the student to become skillful in a trade. Once certified, the student will be able to work independently with little help or support.
2. This is analogous to getting a driving license, without the help of a broker. 3. Each student will be **allotted two trades** and is expected to complete certifications as per the schedule & at least 1 certification by mid semester exam in case of failure in first attempt.
4. **Change in trade** will be a VERY RARELY done for a valid reason such as health issue / physical limitation / conflict of trade allotment within the group. The change will not be offered as a personal choice.
5. Each student MUST secure **TWO trade certifications** (as per the trades allotted to him/her) from the following trades:

S. No.	Trade Name	Instructor Name	Location
1	Power Tool Metal	Mr. Ashish Pandey	AB 11/219
2	Power Tool Wood		
3	3 D printing (Resin)	Mr. Aniruddh Mali	AB 11/101 (Maker Bhavan)
4	PCB Milling		
5	Silicon Molding		
6	Sheet Metal Bending	Mr. Tarun Sharma	AB 4/101
7	Laser Cutting	Mr. Sajidhusen Rathod	AB 11/216
8	3 D Printing (FDM)		
9	CNC Metal Turning	Mr. Nirav Bhatt	AB 6/106

10 CNC Metal Milling Mr. Aman Tripathi AB 6/106 11 CNC Wood Turning Mr.
 Babloo Sharma AB 11/218 12 CNC Wood Milling

6. What do I need to do to get certified?

- I. **Submit** a workshop safety undertaking.
- II. **Watch the demonstration** video of the respective trade.
- III. **Read:** students are expected to read trade specific manuals, along with demonstrations. **IV. Practice:** A student is expected to spend around minimum 6 scheduled hours on each trade to become skillful in a particular trade.
- V. **Clear viva voce** based on the demonstrations and reading materials. ▪

Should be given before the first practice session starts

- It tests your preparedness for operating the machine under supervision. ▪ Clearly highlight that you understand the safety – Both general shop safety as well as trade specific safety
- Required to get a PASS before you can practice – AKA learner's license ▪ Points on a scale to 1-4 will be assigned if you PASS the exam and will count towards the grade.
- If you FAIL, you can reappear again with a gap of at least 1 day.

VI. Practice more: Reserve a 2-hour slot for the respective trade to gain practice. Details of the reservation process will be shared separately.

VII. Final Test

- AKA driving test
- You will be eligible to give the test after completing at least 6 hours of supervised training/practice.
- You will be asked to make a component based on an assigned drawing and a desired finish.
- You will have to make the part as per given specification without any help from staff or TAs or friends.
- Among many factors, safety, part quality and cleanliness will be the primary criteria for evaluation.
- If you FAIL, you will have to practice/train for at least 4 hours before appearing for the test.

VIII. Grading Scheme (applicable only if you PASS):

- Viva voce 30 %
- Final test 50 %
- Safety norms 10 %
- Organized and clean use of workshop facilities (machines and tools) 10 %

Design project guidelines

The project will have to bring in 'innovation' by taking care of usability (ergonomics); a strong value proposition and product detailing.

A continuous evaluation process will be implemented to ensure regular checks. The students from each batch (on each week day) will be divided into **SIX groups**, each containing roughly 13 students. They will each know two trades and collectively will have two experts in each prototyping trade.

Details of deliverables and evaluation matrix will be provided on Google Classroom as per the submission schedule.

Value proposition (5 marks): A statement that clearly defines the target user, the purpose and intended design opportunities

Multiple ideas (5 marks): This stage ensures that the students explore various directions without restricting themselves to solutions early in the process. This stage will be evaluated with the concept sketches.

Concept sketches + Low fidelity mockups (10 marks): It is important to have good variation and

different approaches to address the design opportunities. The three mock-ups should help the student groups to visualize the interaction between the solution and the intended users.

Students will present their solutions in a format that will be declared.

Final Concept (15 marks): This is the culmination of all the learnings from the manufacturing trades and design detailing. The solution needs to be well rounded with design and manufacturing details.

Usability details: Detailing for ergonomics and overall appearance of a finished product

Manufacturing details: understanding of materials and manufacturing

Students will present and submit their solutions in a format(s) that will be declared well in advance.

Honor Code

The student honor code applies to all aspects of the course. All submissions are expected to be your own responsibility. However, discussions with each other are strongly encouraged for the course project. It is expected that students will follow ethical norms defined by the institute and work with each other cordially.