

Introduction to Biomedical Engineering

Introduction to Biomedical Engineering Capstone Project

Capstone Project

Key concepts, typical structure, and best practice guidelines

1. What Is a Capstone Project?

Aspect	Description
Purpose	Integrates knowledge from coursework, labs, and internships into a real-world engineering solution.
Scope	Usually 1-2 semesters (12–24 weeks) of design, development, testing, and documentation.
Outcome	A functional prototype or validated concept, accompanied by a technical report, presentation, and (often) a poster.
Stakeholders	Students, faculty advisors, industry sponsors, clinical partners, and institutional review boards (IRB) when human subjects are involved.

2. Typical Project Lifecycle

1. Problem Identification
2. Feasibility Study
3. Requirements Definition
4. Concept Generation
5. Design Specification
6. Detailed Design
7. Prototype Development
8. Testing & Validation
9. Iteration/Optimization
10. Documentation
11. Presentation & Defense
12. Reflection & Future Work

2.1. Phase Details

Phase	Main Activities	Deliverables
Problem Identification	Literature review, clinical need assessment, interviews with clinicians.	Problem statement, preliminary market/clinical gap analysis.

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Phase	Main Activities	Deliverables
Capstone Project		
Feasibility Study	Technical, regulatory, economic, and ethical feasibility.	Feasibility report, risk matrix, IRB/ethics check if required.
Requirements Definition	Functional, performance, safety, usability, and regulatory requirements (e.g., FDA 21?CFR?820).	Requirements specification (REQ?DOC).
Concept Generation	Brainstorming, sketching, trade?off studies, selection criteria matrix.	Concept list, concept ranking, selected concept justification.
Design Specification	System architecture, block diagrams, interface definitions, Bill of Materials (BOM).	Design specification document, preliminary CAD/Simulink models.
Detailed Design	Component sizing, material selection, detailed schematics, software algorithms.	Detailed CAD drawings, PCB layouts, software flowcharts, simulation results.
Prototype Development	Fabrication, assembly, firmware/software integration.	Physical prototype, firmware build, test fixtures.
Testing & Validation	Bench testing, benchtop validation, pre ?clinical testing (e.g., tissue phantoms, animal models).	Test plan, raw data, statistical analysis, validation report.
Iteration/Optimization	Design tweaks based on test feedback, repeat testing as needed.	Updated design files, version control logs.
Documentation	Technical report (IEEE format or university template), design history file (DHF).	Final report, design history file, user manual.
Presentation & Defense	Oral presentation, poster session, Q&A with faculty and industry panel.	Slide deck, poster, recorded defense (if required).
Reflection & Future Work	Lessons learned, scalability assessment, potential commercialization path.	Reflection essay, roadmap for next development phase.

3. Core Content Areas for Biomedical Engineering

Domain

Typical Topics to Address

Introduction to Biomedical Engineering

Biomechanics

Modeling of tissues, load analysis, ergonomic

Biomaterials

analysis.

Capstone Project

Biocompatibility, degradation, sterilization methods.

Medical Imaging & Signal

Sensor selection, image acquisition, filtering, feature

Processing

extraction