



National University of Engineering (UNI)
School of Civil Engineering
Syllabus 2027-I

1. COURSE

CE3T9. Research Workshop (Mandatory)

2. GENERAL INFORMATION

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|-----------------------------------|---|--|
| 2.1 Course | : | CE3T9. Research Workshop |
| 2.2 Semester | : | 10 th Semester. |
| 2.3 Credits | : | 4 |
| 2.4 Hours | : | 3 HT; 2 HP; |
| 2.5 Duration of the period | : | 16 weeks |
| 2.6 Type of course | : | Mandatory |
| 2.7 Learning modality | : | Face to face |
| 2.8 Prerequisites | : | <ul style="list-style-type: none">• BMI201. Methodology of Engineering Research. (8th Sem)• CE3T8. Professional Competencies Workshop - Transportation. (8th Sem) |

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Research Workshop introduces students to the fundamentals of engineering research methodology in preparation for capstone-level research work in the Vialidad, Geomática y Transporte (DAVG) track of Civil Engineering. Building on the methodology established in Research Methodology in Engineering (BMI201) and the professional competencies developed in the Professional Competencies Workshop - Vialidad (CE3T8), students learn to identify a research idea and formulate a research problem drawn from roadway design, pavement engineering, traffic and transportation engineering, or geomatics; build the theoretical and conceptual framework that supports a study; formulate testable hypotheses and operationalize the variables involved; select and justify an appropriate type and design of research; and collect and analyze data to answer a transportation or geomatics engineering research question. The course also reinforces the professional ethics and technical communication skills required to conduct and disseminate engineering research responsibly.

5. GOALS

- Formulate a well-defined research idea and problem statement in Vialidad, Geomática, or Transporte engineering grounded in a real technical need.
- Build a theoretical framework through systematic literature review and critical synthesis of prior research in roadway, pavement, traffic, transportation, or geomatics engineering.
- Formulate testable research hypotheses and operationalize the variables of a transportation or geomatics engineering study.
- Select and justify an appropriate type and design of research (quantitative, qualitative, or mixed methods) for a given research problem.
- Collect and statistically analyze data to answer a Vialidad, Geomática, or Transporte engineering research question.
- Apply engineering ethics and produce clear technical communication throughout the research process.
- The deliverables for this course are:

Midterm: Research idea, problem statement, and theoretical framework document.

Final: Complete research proposal including hypotheses, variables, research type and design, and a preliminary data collection and analysis plan.

6. COMPETENCES

ABET-3) An ability to communicate effectively with a range of audiences. (Usage)

ABET-4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. (Usage)

ABET-6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (Usage)

7. TOPICS

Unit 1: Research Design and Methodologies (28 hours)	
Competences Expected: ABET-6	
Topics	Learning Outcomes
• Formulating research questions in architecture: descriptive, relational, causal; turning design problems into researchable questions • Choosing a research methodology: quantitative (hypothesis testing, statistical), qualitative (interpretive, case study), mixed methods, • Validity and reliability in architectural research: internal validity, external validity (generalizability), construct validity, • Research ethics in architectural research: informed consent, privacy (anonymization of building users), institutional review board (IRB) protocols, • Mixed methods research: sequential (qualitative then quantitative) and concurrent designs; integrating qualitative findings (user interviews) with quantitative data (occupancy)	• Describe the main research methodologies in architecture - quantitative, qualitative, mixed methods, practice-based - and explain their appropriate applications [Familiarity] • Develop a research design for an architectural inquiry, including research question, literature review, methodology selection, data collection protocol, and analysis plan [Usage] • Evaluate the research design of a published architectural study for validity, reliability, and ethical soundness, identifying methodological strengths and weaknesses [Assessment]
Readings : [Creswell2018], [LeedyOrmrod2019]	

Unit 2: Theoretical Framework and Literature Review (16 hours)	
Competences Expected: ABET-6	
Topics	Learning Outcomes
• Systematic search of scientific and technical literature: specialized databases (Scopus, Web of Science, ASCE Library), keywords, and Boolean operators • Critical reading and synthesis of scientific articles, technical standards, and prior research reports • Building the conceptual and theoretical framework: defining key concepts, relationships between variables, and reference theoretical models • Identifying knowledge gaps (research gap) and justifying the originality of the proposed contribution • Bibliographic reference management and citation styles (APA, IEEE) using tools such as Zotero or Mendeley	• Explain the structure and purpose of a theoretical framework within a civil engineering research project [Familiarity] • Conduct a systematic search of scientific and technical literature on a chosen research topic using specialized databases [Usage] • Synthesize the state of the art of a research topic into a coherent theoretical framework that identifies a knowledge gap [Assessment]
Readings : [BoothColombWilliams2016], [Creswell2018]	

Unit 3: Research Hypotheses and Variables (16 hours)	
Competences Expected: ABET-6	
Topics	Learning Outcomes
• Types of hypotheses: null, alternative, directional, and non-directional, and their relationship to research questions • Classification of variables: independent, dependent, control, and confounding • Operationalizing variables: defining measurable indicators and measurement scales (nominal, ordinal, interval, ratio) • Relationship between hypotheses, variables, and statistical significance tests: significance level, Type I and Type II error • Graphical representation of the relationship between variables through conceptual or operational models	• Distinguish between null and alternative hypotheses, and between independent, dependent, and control variables, in a civil engineering research problem [Familiarity] • Formulate a testable research hypothesis and operationalize its variables for a specific problem in the chosen specialization area [Usage] • Evaluate the consistency between the theoretical framework, the stated hypothesis, and the proposed data-collection design [Assessment]
Readings : [MontgomeryRunger2018], [Kumar2019]	

Unit 4: Quantitative Methods in Architectural Research (12 hours)	
Competences Expected: ABET-6	
Topics	Learning Outcomes
• Survey design for architectural research: sampling methods (probability, convenience), questionnaire design (Likert scales, semantic differential), response rate optimization, • Experimental designs: true experiments (random assignment, control group), quasi-experiments (non-randomized, pre-post, time series), • Descriptive statistics: measures of central tendency (mean, median, mode), dispersion (standard deviation, range, interquartile range), • Inferential statistics: hypothesis testing (t-test, ANOVA, chi-square), correlation and regression (linear, multiple), and interpretation of p-values • Instrumentation for quantitative data collection: environmental sensors (temperature, light, CO_2), occupancy counters, objective performance measures (task completion time)	• Describe the main quantitative methods in architectural research - surveys, experiments, quasi-experiments - [Familiarity] • Design a survey or experiment to test a hypothesis about the effect of a design variable (lighting, color, layout) on user satisfaction, task performance, or behavior [Usage] • Evaluate a quantitative architectural study for sampling validity, statistical analysis appropriateness, and correct interpretation of p-values and effect sizes [Assessment]
Readings : [MontgomeryRunger2018], [Creswell2018]	

Unit 5: Engineering Ethics and Professional Responsibility (4 hours)	
Competences Expected: ABET-4	
Topics	Learning Outcomes
• Ethical theories: utilitarianism, duty ethics, virtue ethics • Professional codes of conduct (e.g., ASCE, NSPE) and their fundamental canons • Engineer's paramount responsibility to public safety, health, and welfare • Ethical dilemmas in practice: conflicts of interest, whistleblowing, gift-giving • Ethical decision-making frameworks and case study analysis • Global engineering ethics and cross-cultural challenges • Ethical obligations for sustainable development and environmental stewardship • Ethical implications of emerging technologies (AI, automation, data privacy) • Ethical conduct in dispute resolution and litigation	• Explain the primary tenets of the engineer's code of ethics [Familiarity] • Apply an ethical decision-making framework to a hypothetical engineering scenario [Assessment] • Identify conflicts of interest and other common ethical pitfalls in project work [Familiarity] • Analyze a historical engineering failure case from an ethical perspective [Assessment] • Evaluate the ethical dimensions of a project with significant social or environmental impacts in a different cultural context [Assessment] • Articulate the ethical argument for incorporating sustainability into all engineering work [Familiarity] • Discuss the ethical responsibilities related to data collection and use in smart infrastructure projects [Assessment] • Describe the role of ethics in alternative dispute resolution processes [Familiarity]
Readings : [HarrisEthics2013], [FleddermannEthics2020]	

Unit 6: Written and Technical Communication (3 hours)	
Competences Expected: ABET-3	
Topics	Learning Outcomes
• Audience analysis and adaptation of technical content • Written communication: technical reports, memos, emails, and specifications • Visual communication: graphs, charts, diagrams, and effective slide design	• Write a clear, concise, and well-organized technical report on a laboratory experiment or design project [Usage] • Create effective graphs and diagrams to present engineering data [Assessment]
Readings : [GurakLannon2013]	

Unit 7: Oral Presentation and Professional Communication (3 hours)	
Competences Expected: ABET-3	
Topics	Learning Outcomes
• Oral presentations: structure, delivery techniques, and handling Q&A • Proposal writing: technical approach, management plan, and cost estimating • Executive summaries and communicating with non-technical stakeholders	• Deliver a structured oral presentation on a technical topic using appropriate visual aids [Usage] • Outline the key sections of a competitive engineering proposal [Familiarity] • Develop an executive summary that conveys key project findings to a senior management audience [Usage]
Readings : [GurakLannon2013]	

Unit 8: Digital and Collaborative Communication (2 hours)	
Competences Expected: ABET-3	
Topics	Learning Outcomes
• Collaborative writing and document management in team settings • Digital communication: web content, social media guidelines for engineers • Persuasive communication and negotiation techniques	• Manage a collaborative document (e.g., on Google Docs or SharePoint) for a team project [Assessment] • Explain the professional risks and opportunities associated with engineers using social media [Familiarity] • Employ basic negotiation tactics to resolve a simulated conflict over project scope [Usage]
Readings : [GurakLannon2013]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY