

MAT7200 RESEARCH METHODS

References and Additional Reading Materials

1. Thiel, D. V. (2014). *Research methods for engineers*. Cambridge University Press.
2. Walliman, N. (2017). *Research methods: The basics*. Routledge.
3. McNeill, P., & Chapman, S. (2005). *Research methods*. Psychology Press.
4. Laurel, B. (2003). *Design research: Methods and perspectives*. MIT press.
5. Fellows, R. F., & Liu, A. M. (2015). *Research methods for construction*. John Wiley & Sons.
6. Groat, L. N., & Wang, D. (2013). *Architectural research methods*. John Wiley & Sons.
7. Pickard, A. J. (2013). *Research methods in information*. Facet publishing.
8. Robertson, D. G. E., Caldwell, G. E., Hamill, J., Kamen, G., & Whittlesey, S. (2013). *Research methods in biomechanics*. Human kinetics.
9. Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. London: Merrill, Prentice Hall.
10. Creswell, J. W. (2003). *Research design: Qualitative, quantitative and mixed method approaches*. Thousand Oaks: SAGE
11. Easterby Smith, M., Thorpe, R., & Lowe, A. (2002). *Management Research: an introduction (2nd edition)*. London: Sage.
12. Saunders, M., Lewis, P., & Thornhill, A. (2003). *Research methods for business students (3rd edition)*. Harlow: Pearson Education.

Topics	Learning Outcomes	Discussant (s)
Topic 1: Introduction to Research: A Scientific and Engineering Approach	Upon completion of this study unit, you should be able to: <ol style="list-style-type: none"> 1. analyze the importance of research 2. evaluate the purpose of research: why take on a research project 3. assess why engineering and scientific research is done 4. classification of research 5. describe what next step is in research 6. analyze research questions 7. apply the ethics in engineering and scientific research 8. discuss what constitutes conclusive proof 9. make a conclusion of Topic 1 	Dr. Mundu
Topic 2: Research Problem	Upon completion of this study unit, you should be able to: <ol style="list-style-type: none"> 1. discuss what a research problem is 2. select a research problem 3. explain the necessity of defining the problem 4. describe the technique involved in defining a problem 5. give illustrations on typical research problems 6. make a conclusion of topic 2 	Team of three students

Topic 3: Developing a Research Plan	Upon completion of this study unit, you should be able to: <ol style="list-style-type: none"> 1. find a suitable research question 2. discuss the elements of a research proposal 3. present the design for outcomes: one to several dimensional data 4. describe the research tools: experimental measurements, numerical modelling, theoretical derivations and calculations, curve matching 5. make a conclusion of Topic 3 	Team of three students
Topic 4: Literature Review and Technical Reading	Upon completion of this study unit, you should be able to: <ol style="list-style-type: none"> 1. discuss new and existing knowledge 2. carryout analysis and synthesis of prior art 3. search Bibliographic Databases: Web of Science, Google and Google Scholar 4. apply effective search: the way forward 5. carry out introduction to technical reading 6. describe the process of conceptualizing research 7. apply critical and creative reading 8. take notes while reading 9. read mathematics and algorithms 10. read a datasheet 11. make a conclusion of Topic 4 	Team of three students
Topic 5: Research Design	Upon completion of this study unit, you should be able to demonstrate competence in: <ol style="list-style-type: none"> 1. Research Design: What it is? 2. Why we need research design? 3. Some basic concepts 4. Different research designs 5. Experimental designs 6. Important experimental designs 7. Design of experimental setup 8. Use of standards and codes 	Team of three students
Topic 6: Mathematical Modelling	Upon completion of this study unit, you should be able to demonstrate competence in: <ol style="list-style-type: none"> 1. Models in general 2. Mathematical model 3. Model classification 4. Steps in modeling 5. Model complexity 6. Model evaluation 	Team of three students
Topic 7: Simulation	Upon completion of this study unit, you should be able to demonstrate competence in: <ol style="list-style-type: none"> 1. Importance of simulation 2. System simulation 3. Steps in simulation study 4. Simulation softwares 	Team of three students

	<ul style="list-style-type: none"> 5. Major applications 6. Dimensional analysis and Similitude 	
Topic 8: Sample Design and Sampling	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ul style="list-style-type: none"> 1. Sample design <ul style="list-style-type: none"> a. Sampling b. Sample design aspects 2. Types of sample designs <ul style="list-style-type: none"> a. Non-Probability sampling b. Probability sampling c. Complete random sample design d. Systematic sampling e. Stratified sampling f. Multistage sampling 3. Sample size determination to simulation experiments <ul style="list-style-type: none"> a. Prior determination approach b. Use of automatic stopping rule 	Team of three students
Topic 9: Hypothesis Testing and ANOVA	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ul style="list-style-type: none"> 1. Testing of Hypothesis 2. Hypothesis: What it is? 3. Null & alternative hypothesis 4. Level of significance 5. Type I & II errors 6. Two tailed & One tailed tests 7. Steps involved in testing hypothesis 8. Limitations of test of hypothesis 9. Analysis of variance: What is ANOVA? 10. One way analysis of variance 11. Two way analysis of variance 	Team of three students
Topic 10: Design of Experiments And Regression Analysis	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ul style="list-style-type: none"> 1. Design of experiments 2. Planning of experiments 3. Experiments using orthogonal arrays 4. Multivariate analysis 5. Correlation analysis 6. Multiple regression and correlation 7. Non-linear regression models 	Team of three students
Topic 11: Analysis And Interpretation Of Data	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ul style="list-style-type: none"> 1. Introduction 2. Data checking 3. Data analysis: Statistical analysis, Graphical data analysis, Numerical data analysis 	Team of three students

	<ol style="list-style-type: none"> 4. Interpretation of results: Meaning of Interpretation, Need for interpretation, Correlation with scientific facts 5. Precautions in Interpretation 	
Topic 12: Accuracy, Precision and Error Analysis	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ol style="list-style-type: none"> 1. Definition of terms 2. Repeatability and Reproducibility 3. Error analysis: Definition and classification of error, Measuring error 4. Definition of terms 5. Identification of limitations 	Team of three students
Topic 13: Use Of Optimization Techniques	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ol style="list-style-type: none"> 1. Concepts of optimization 2. Optimal design point 3. Optimization techniques: Scope of search and optimization techniques, Traditional methods, Common difficulties with traditional methods 4. Evolutionary Optimization techniques: Genetic Algorithm: Particle Swarm Optimization 	Team of three students
Topic 14: Writing Papers And Synopsis	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ol style="list-style-type: none"> 1. Introduction 2. Audience Analysis: Audience for papers and articles, Audience for synopsis, Audience for research report 3. Preparing paper for journals 4. Preparation of synopsis of Research Work 	Dr. Mundu
Topic 15: Thesis Writing And Defence	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ol style="list-style-type: none"> 1. Steps in Writing the report: Plan of writing, Outline of the report, Writing the report 2. Mechanics and Writing: Style and tense, Organization of sentences, Paragraph structure, Choice of words 3. Presentation of graphs, figures and tables 4. When to end writing the thesis? 5. Editing and Rewriting the thesis 6. Structure of thesis 7. Oral presentation and Defense 	Dr. Mundu
Topic 16: Intellectual Property Rights And	<p>Upon completion of this study unit, you should be able to demonstrate competence in:</p> <ol style="list-style-type: none"> 1. The Intellectual Property 2. Ugandan Copyrights Act: Ownership and assignments, Rights and infringements 	Dr. Mundu

Research Ethics	<ol style="list-style-type: none"><li data-bbox="487 191 1218 262">3. Ugandan Patent Law: Item which are not Inventions, Granting of Patent rights, Rights of patentee<li data-bbox="487 262 1218 340">4. Research ethics: Integrity in research, scientific misconducts.	
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