NAZARBAYEV UNIVERSITY
SCHOOL OF ENGINEERING AND DIGITAL SCIENCES

Dept. of Mechanical & Aerospace Engineering

Program Handbook

Master of Science in Mechanical & Aerospace Engineering

Academic year 2018-19 and onwards

Welcome Note

Dear Learners,

On behalf of the Department of Mechanical & Aerospace Engineering (MAE), it is my great pleasure to welcome you to Nazarbayev University and the Master of Science in Mechanical & Aerospace Engineering program. I wish you all, the greatest success and thank you for making NU your choice of postgraduate studies.

There are several reasons for students choosing to continue on to a postgraduate level of studies. Many do so for career advancement, while others do so for self-gratification. Whatever your reason, our diverse and experienced staff at Nazarbayev University will provide you with first-rate education and research knowledge. Just as you pride yourselves on the high quality of professional work that we know you are capable of, we pride ourselves on the continuing success and reputation of our programs. As such, our department has aligned the courses you are about to undertake with the recommendation of higher education accrediting bodies and both local and international engineering companies to meet research expectations.

Your Master's degree program will run over 4 semesters in 2 years duration where you are required to complete 120 ECTS credits. A master thesis begins in the 3rd semester (1st semester of the 2nd year) and completes in the final semester of the Master's course where you will be asked to demonstrate your familiarity with the current literature in the field; defend your thesis proposal; analyze and evaluate results; support your findings in a scholarly manner according to disciplinary norms and finally, defend your thesis work. Along these lines, it is recommended that you begin to plan and interact with your supervisors of choice early in the program so that you'll be able to discuss your research topic, arrange supervised meetings, and receive guidance to successfully complete your thesis on-time.

Wishing you a successful endeavor in your Master of Science program!

Yours Sincerely,

Professor Essam Shehab, CEng, FIET, FACostE, FHEA

Head of MAE Department

Contents

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Program Overview

The Master of Science in Mechanical & Aerospace Engineering (MSc-MAE) degree program is a specialized degree program offered by School of Engineering and Digital Sciences (SEDS) at Nazarbayev University (NU). Students are required to complete 120 ECTS credits, in 4 semesters, which satisfies requirements stipulated by the Bologna Process and the European Credit Transfer and Accumulation System (ECTS) for Master's Degrees. The program is focusing on research and has been designed to provide advanced skills and a detailed knowledge base at the graduate level for individuals working in academia, industry, or research settings in Kazakhstan or throughout the world.

The MSc-MAE provides a comprehensive technologic and scientific preparation for engineers in 3 (three) key areas of Mechanical and Aerospace Engineering:

(1) Applied Mechanics;
(2) Energy and Thermofluids; and
(3) Engineering Design, Materials and Manufacturing,

in perfect alignment with today´s technological challenges. A set of mandatory core courses guarantees competence in advanced mathematics, the 3 (three) key areas of the program, classic and novel research methods and effective oral and written communication in the science and technology domain.

By delivering an MSc at an international standard level, we are offering our master's students future opportunities in terms of PhD and positions in research centers, locally or abroad

Aims and Objectives

The mission of the School of Engineering and Digital Sciences at Nazarbayev University is to contribute to the development of Kazakhstan in terms of:

- Educating students with engineering expertise to lead organizations and provide innovative solutions for complex technical issues of enterprises.
- Conducting innovative and pioneering basics of applied research that evolve the body of knowledge in Engineering through interdisciplinary collaboration with other schools and research centers at Nazarbayev University and leading universities worldwide.
- Advancing the professional development in engineering through our service to the professional community and providing lifelong learning opportunities for practitioners.

The M.Sc. (MAE) program aims to reflect the mission of the School of Engineering and Digital Sciences and accomplishes this by pursuing the following objectives:

1. To enable mechanical and aerospace engineers to make critical decisions based on uncertain and complex data, so that they can lead multidisciplinary teams within a modern organization;
2. To train mechanical and aerospace graduates in scientific research, so that they can effectively organize and manage engineering-research projects at mid-managerial level in a modern industrial environment;
3. To prepare the engineers for their professional practice with strictest and highest ethical standards, taking into consideration economic, environmental, safety and social responsibility; and

4. To support the economic development of Kazakhstan by empowering the new generation of Mechanical and Aerospace Engineers who can facilitate the creation of innovative and highly technological goods and services.

Graduate Attributes

The MSc-MAE program immerses the student within a scientific and technological ecosystem to favor their professional growth according to NU Graduate Attributes, which are very well aligned with the vision and mission of NU. These attributes are listed as:

1) Possess an in-depth and sophisticated understanding of their domain of study;
2) Be intellectually agile, curious, creative, and open-minded;
3) Be thoughtful decision makers who know how to involve others;
4) Be entrepreneurial, self-propelling and able to create new opportunities;
5) Be fluent and nuanced communicators across languages and cultures;
6) Be cultured and tolerant citizens of the world;
7) Demonstrate high personal integrity;
8) Be prepared to take a leading role in the development of their country.

The MSc program delivers these attributes by providing the students opportunities to be involved in: (a) working on individual and group assignments; (b) team-building exercises for developing decision-making skills; (c) designing tasks for developing creativity; (d) delivering and attending project-research presentations to polish their communication skills; and (e) engaging on group discussions among students and faculty in order to develop personal integrity and cultural tolerance. The same attributes are also addressed by the program learning outcomes that follow.

Program Learning Outcomes

On successful completion of the program, graduates will be able to:

1) Investigate mechanical and aerospace engineering concepts at an advanced level;
2) Critically analyze existing scientific literature and develop personal research skills;
3) Conduct innovative research utilizing acquired skills and appropriate methodology;
4) Communicate effectively about accomplished research work to the general public as well as to experts.

Program's Learning Outcomes alignment to NU Graduate attributes is summarized in the following table:

		Program Learning Outcomes			
		1	2	3	4
NU Graduate Attributes	1	☑	☑	☑	
	2		☑	☑	
	3				☑
	4		☑	☑	☑
	5				☑
	6				☑
	7		☑	☑	☑
	8				☑

Program Duration

The nominal MSc program duration is **two years**, while the maximum allowable duration can be extended up to **two and half years** (excluding leave of absence and deferment of admission; see "*ACADEMIC POLICIES AND PROCEDURES FOR GRADUATE PROGRAMS OF THE AUTONOMOUS ORGANIZATION OF EDUCATION 'NAZARBAYEV UNIVERSITY'*" for further details).

Assessment

Assessment is aligned with the learning outcomes of the program and of those of each course. Course assessment tasks are performed during and at the end of each course. Types of assessment vary form successful completion of integrated coursework, assignments, and project work to evaluation of performance of case studies, interviews, and deliverance of presentations.

The following table summarizes assessment and evaluation points for all stages of the MSc program:

Stage of Program	***Significance***	***Possible Results***	***Evaluation Point***
ADMISSION TO PROGRAM	Initial Evaluation	Admission Admission with Conditional Status, Subject to Satisfactory Completion of Conditions Rejection	***Key Evaluation Point*** Admission is handled on a case-by-case basis by evaluating the student's undergraduate curriculum, English proficiency and letters of recommendation among other documents and interview (only for shortlisted candidates)

COURSEWORK	Determination of Student Competence in Fundamentals of Discipline	Continue in Program Continue on Probation Dismissed from Program	***Continuous Evaluation*** The coursework component for the Master of Science is assessed by the module instructor. It is enforced that all faculty provide a module descriptor to students at the start of the course outlining the weight of each assessment.
DEGREE CANDIDACY	Demonstration of Student's Mastery of Content Knowledge and Skills in the Discipline	Pass and Continue in Program Required to Re-Take Some Courses Dismissed from Program	***Key Evaluation Point***
COMPLETION OF THESIS PROJECT	Demonstration of Student's Mastery of Content Knowledge and Skills Needed to Graduate	Pass Recommend Changes with or without re-defense Fail and dismissal from Program	***Key Evaluation Point***

Coursework Assessment methods by course & correspondence to Program Learning outcomes are summarized in the following table:

Program Learning Outcome	***Where addressed*** *(course)*	***How addressed*** *(L&T Methods)*
1.	Advanced Applied Mathematics, Modern Control Engineering, Advanced Manufacturing Processes and Strategies, Finite Element Methods, Advanced CFD and Heat Transfer in Mechanical Engineering and Electives (It is compulsory to take 4 -four- Electives chosen from a set listed in 4-four- research areas of the program).	1. Lectures 2. Workshops 3. Individual and Group Presentations 4. Individual and Group Projects 5. Paper writing and presentation. 6. Exams 7. Flipping/Blending Learning in which on-line and in-class classes are combined resulting in an effective technique to improve the process of learning.
2.	Research Methods and Ethics, and Technical Communication	
3.	Technical Communication, Research Seminar and MSc thesis	
4.	Technical Communication and MSc thesis	

MASTER OF SCIENCE - PROGRAM CALENDAR YEAR-1

Course-type key

Program Core courses

Program Elective courses

SEMESTER 1 FALL August – December		
TYPE	**COURSE CODE & TITLE**	**ECTS**
Program core	**MSC 601, TECHNICAL COMMUNICATION**	6
	MSC 602, ADVANCED APPLIED MATHEMATICS	6
	MCEE 603, FINITE ELEMENT METHODS	6
	MMAE 603, MODERN CONTROL ENGINEERING	6
	MMAE 605, ADVANCED MANUFACTURING PROCESSES AND STRATEGIES	6

SEMESTER 2 SPRING January – May		
TYPE	**COURSE CODE & TITLE**	**ECTS**
Program Core	**MSC 600, RESEARCH METHODS AND ETHICS**	6
	MMAE 600, RESEARCH SEMINAR	6
	MMAE 604, ADVANCED COMPUTATIONAL FLUID DYNAMICS (CFD) AND HEAT TRANSFER IN MECHANICAL ENGINEERING	6
Elective	**ELECTIVE 1 (**PICK ON FROM ELECTIVES POOL**)**	6
Elective	**ELECTIVE 2 (**PICK ON FROM ELECTIVES POOL**)**	6

MASTER OF SCIENCE - PROGRAM CALENDAR YEAR-2

SEMESTER 3 FALL August-December		
TYPE	**COURSE CODE & TITLE**	**ECTS**
Program core	**MMAE 601, MASTER THESIS I**	24
Elective	**ELECTIVE 3 (**PICK ON FROM ELECTIVES POOL**)**	6

SEMESTER 4 SPRING January-May		
TYPE	**COURSE CODE & TITLE**	**ECTS**
Program core	**MMAE 602, MASTER THESIS II**	24
Elective	**ELECTIVE 4 (**PICK ON FROM ELECTIVES POOL**)**	6

Academic Policies and Procedures

All academic policies and procedures that are not explicitly covered in this handbook are conformant with the corresponding items described in "*SCHOOL OF ENGINEERING AND DIGITAL SCIENCES MASTERS STUDENT HANDBOOK"*, which covers School of Engineering and Digital Sciences Master Programs, and the "*ACADEMIC POLICIES AND PROCEDURES FOR GRADUATE PROGRAMS OF THE AUTONOMOUS ORGANIZATION OF EDUCATION "NAZARBAYEV UNIVERSITY" (APP-Graduate Programs-NU)"*, which covers all graduate programs in Nazarbayev University. These policies and procedures include, among others, the following:

1. Admissions
2. Registration
3. Credits (Requirements, awarding & transfers)
4. Grading issues such as: administrative grades, grade appeals
5. Course re-takes
6. Degree withdrawals
7. Academic code of behavior
8. Leaves of absence, including medical reasons, immediate family member issues and others
9. Dismissal & voluntary withdrawal.

Every student participating in the MSc-MAE program is expected to have read and understood all the policies, rules, procedures, and guidelines described in this program specific handbook, school's MSc handbook and the general APP for graduate programs in NU.

Grading System

Graded courses

Letter Grade	Grade Points	Percentage
A	4.00	95-100%
A-	3.67	90-94.9%
B+	3.33	85-89.9%
B	3.00	80-84.9%
B-	2.67	75-79.9%
C+	2.33	70-74.9%
C	2.00	65-69.9%
C-	1.67	60-64.9%
D+	1.33	55-59.9%
D	1.00	50-54.9%
F	0.00	0-49.9%

Non-graded (PASS/FAIL) courses

In the case of a non-graded course, the following assessment percentages apply

Description	Percentage
Pass	59% or Above
Fail	Below 59%

Program Completion Requirements

Satisfactory completion of the MSc program requires that the student progress through a number of distinct stages, each of which is characterized by a key evaluation point (See Appendix) The necessary stages are:

1) Satisfactory application to the program;
2) Completing all required coursework in the program (72 ECTS);
3) Satisfactory completion of the master thesis (48 ECTS);
4) Satisfactory achievement of minimum GPA for continuation through semesters and graduation (Candidacy).

Continuation / normal progress

To continue in the MSc-MAE graduate program at SEDS, NU, a student must maintain a minimum CGPA of no less than a **B- (2.67 on a 4-point scale)** after each grading period and conform to all program rules and policies to maintain normal progress toward degree. A student who fails to satisfy the continuation requirement for the program is subject to dismissal.

Appealing against grades

If a student believes that she or he has received an unfair or erroneous grade, the student may appeal. The following are cases for appeal:

1) In the case of an examination. The student must first consult with the instructor within 5 working days of her or his receipt of the contested grade (this time may be extended in the event that the instructor can be shown to have been unavailable during the period following the student's receipt of the grade in question). The Instructor must respond within the next 5 working days. In the event that the student is still dissatisfied, she or he may appeal to the Dean of the School (or the Dean's designee) within 5 working days. The Dean (or her or his designee) shall consult with the Instructor before making any decision. The decision of the Dean (or of her or his designee) shall be final;

2) In the case of a Final Course Grade. The student must first consult with the instructor within 5 working days of her or his receipt of the contested grade (this time may be extended in the event that the instructor can be shown to have been unavailable during the period following the student's receipt of the grade in question). The date to be used for appeals of Final Course Grades is the date published in the Academic Calendar. The Instructor must respond within the next 5 working days (that time may be extended in the event the instructor is shown to have been unavailable during the period following the student's receipt of their final grade). In the event that the student still believes that the grade is incorrect, or the Instructor has not replied within 15 days, the student may appeal to the Dean of the School (or the Dean's designee) within 5 days. The Dean (or her or his designee) shall consult with the Instructor before making any decision. The decision of the Dean (or her or his designee) shall be final.

Plagiarism

In any coursework or thesis assessment, unacknowledged copying or plagiarism is not acceptable. Plagiarism can result in extremely serious academic actions including cancellation of any or all results, suspension from the program, or even expulsion. Plagiarism means using the work of others in preparing an assignment and presenting it as your own without explicitly acknowledging – or referencing – where it came from. Plagiarism can also mean not acknowledging the full extent of indebtedness to a

source. Work can be plagiarized from many sources including books, articles, the internet, and other media. Plagiarism can also occur unconsciously or inadvertently. Direct copying is definitely plagiarism. Paraphrasing of another's work without acknowledgment is also plagiarism. Submitting someone else's work or ideas without attribution is not evidence of your own grasp of the material and cannot earn you marks.

Nazarbayev University's policy on plagiarism sets out student responsibilities in regard to copying. Students are responsible for ensuring that:

- They are familiar with the expected conventions of authorship and the appropriate use and acknowledgement of all forms of intellectual material relevant to their discipline.
- The work submitted for assessment is their own.
- They take all reasonable steps to ensure their work cannot be accessed by others who might seek to submit it, in whole or in part, as their own.

Whenever you refer to another person's research or ideas -either by directly quoting or by paraphrasing them-, you must acknowledge your source by proper referencing. Turnitin is a useful web-based originality checking service that can help in assessing the originality of one's submitted work. More information on Turnitin can be found in Appendix I and service's web site (http://turnitin.com/).

Description of Courses

Course-type key

Core courses
Elective courses

***Note: In future, minor changes in courses and/or program, subject to approval by SEDS Teaching and Learning Committee, may not be reflected in this document, however, these would be reflected in the corresponding Course Specification Forms.**

Program Core Courses

MSC 600, Research Methods and Ethics

This course addresses the primary need for graduate students to undertake formal training that will help them in understanding how to conduct their research. The course will develop student's understanding of research plan and engender skills enhancement for reading, interpreting, writing, and presenting key ideas. The course will also instill an understanding of a variety of research methods and ethics and implement appropriate strategies in lecture and workshop settings.

CLOs

By the end of this course, students will be able to:

1. Discuss the research process, research methodology, research methods, and research ethics;
2. Effectively use modern technology to plan and manage research projects;
3. Effectively apply the research methodology and appropriate research methods to formulate and validate engineering research problems;

4. Critically analyze and evaluate research findings;
5. Effectively employ appropriate communication techniques to summarize, document and present the research results to both specialists and non-specialists;
6. Develop the skills to maintain good working relations in a research team environment.

MSC 601, Technical Communication

This graduate level course combines the application of rhetorical analysis to stylistic conventions of writing in engineering, with a focus on clarity, conciseness, and coherence. Students will employ process writing to produce genre specific writing familiar to Engineers, including research reports scientific papers designed for specific audiences. This course also trains students to deliver effective and appealing professional and scientific presentations, with attention to best practices in the use of technical English and oral communication.

CLOs

By the end of the course, students will be able to:

1. Understand technical communication along a continuum, identifying appropriate writing and speaking strategies for intra-disciplinary, inter-disciplinary, business and public audiences;
2. Determine audience needs and expectations as they pertain to writing and presentation in engineering genres;
3. Organize and prepare coherent and effective scientific texts and presentations for academic, professional, and public audiences;
4. Communicate effectively and efficiently the process of developing, implementing, and evaluating research;
5. Refine writing style for clarity, concision, coherence, and emphasis;
6. Practice the ethical use of sources and appropriate citation conventions;
7. Work with peers to provide written and oral feedback of student work.

MSC 602, Advanced Applied Mathematics

This course reviews and deepens the advanced analytical and numerical methods to solve ODEs and PDEs. The whole course will be supported by a mathematical software package capable to perform symbolical calculations.
The module is designed for graduate students to cover their research needs concerning mathematical modeling via analytical, semi-analytical or numerical techniques.

CLOs

By the end of this course, students will be able to:

1. Apply appropriate methods of solution for a given mathematical problem concerning modeling with ODEs and PDEs;
2. Design computer programs to solve semi-analytically or numerically engineering problems that require modeling with ODES and PDEs;
3. Justify analytical or numerical results for advanced mathematical models of engineering field.

MMAE 600, Research Seminar

This course enables students to gain and apply basic research knowledge and skills to select their research projects in Mechanical and Aerospace Engineering by attending a series of expert presentations and by assessing, preparing and presenting his or her own preliminary research ideas. The course develops the following knowledge and skills:

1. Identifying the area of research interest;
2. Surveying of state of the art for the area of interest;
3. Identifying the research topic and associated issues;
4. Understanding of the social, cultural, global, and environmental issues associated with chosen research topic;
5. Writing a research paper based on the literature survey under the supervision of a faculty member;
6. Presentation of a seminar and being assessed by a panel.

CLOs

By the end of this course, students will be able to:

1. Explore potential areas of research and select his/her research area;
2. Clearly identify the research topic and research issues;
3. Identify the social, environmental and economic issues related to the research topic.

MMAE 603, Modern Control Engineering

This course reviews the classical control systems, advanced classical control method, state space representation, optimal controller design, adaptive controller design as well as robust controller design. In addition, it deals with the H-infinity performance analysis for Robust controller and digital controller design with pole placement technique. It covers the areas of modern control technologies in manufacturing industries such as NC, CNC, precision control, etc. Finally, it deals with projects based on the problems drawn from mechatronics and manufacturing systems.

CLOs

By the end of this course, students will be able to:

1. Design and analyze controller, based on the modern control approach using various methods according to the specified criterion;
2. Evaluate and compare the performance of the designed modern control system with H-infinity;
3. Propose several control solutions, formulate the trade - offs, choose the best options;
4. Design and develop control algorithm (NC, CNC) in modern manufacturing;
5. Develop skills in MATLAB / Simulink as tool in the design and evaluation processes.

MMAE 605, Advanced Manufacturing Processes and Strategies

This module aims to provide deep understanding of advanced manufacturing terminology and introduces principles, techniques, and applications of abrasive and non-conventional machining processes as well as additive manufacturing. Course topic also includes philosophies, and practices developed by world-class manufacturers to meet current manufacturing challenges, such as lean production, push and pull, just in time, continuous flow manufacturing, Kanban, plant-floor quality assurance, warehousing, life cycle assessment and ISO-9000 certification. Theory is integrated with hands-on, computational and laboratory modeling of 3D product using specific processes, including the concepts of failure and improved performance. Students are expected to carry out an independent study by project and term paper on the related topics.

CLOs

By the end of the course the student will be expected to be able to:

1. Evaluate the fundamentals and principles of advanced manufacturing processes and technologies and be able to apply relevant theories to solve manufacturing problems;
2. Assess the tools of lean manufacturing to analyze a manufacturing system and plan for its improvements;
3. Design part products and generate CNC coding to employ CNC machines for fabricating parts;
4. Perform basic life cycle analysis.

MCEE 603, Finite Element Methods

This course will provide students detailed theoretical backgrounds, formulations and implementations of the Finite Element Method and its application to solid and fluid mechanics. The specific topics include: (1) linear algebra; (2) one-dimensional element formulations; (3) two-dimensional beam element formulations; (4) two-dimensional plate element formulations; (5) plasticity and time integration in finite element methods; and (6) Application of solid and fluid mechanics.

CLOs

On successful completion of the course students will be able to:

1. Examine formulations for one-dimensional and two-dimensional elements;
2. Evaluate linear problems using finite element methods;
3. Evaluate nonlinear problems using finite element methods;
4. Create solutions for engineering problems using finite element methods.

MMAE 604, Advanced Computational Fluid Dynamics (CFD) and Heat Transfer in Mechanical Engineering

This module presents an advanced approach to Computational Fluid Dynamics (CFD) and Heat Transfer (CHT), focusing in problem-solving with applications in Mechanical Engineering. The course will pay especial attention to the overview of fundamental principles, verification, and validation of CFD models and deep immersion in applications with scientific and engineering interest, including turbulence, multiphase, heat transfer and interfacial (i.e., microfluidics) phenomena.

CLOs

By the end of the course the student will be expected to be able to:

1. Create CFD models of complex flows and assess validity and accuracy of space- and time-discretization used in their numerical solution;
2. Evaluate the validity, limitations and accuracy of turbulence and multiphase flow models implemented in the numerical solution of complex flows;
3. Perform numerical simulations of complex flows using professional CFD software to solve engineering problems;
4. Create a written document, according to internationally accepted standards, summarizing technical and theoretical aspects involved in the full development of his/her own numerical results obtained via CFD.

MMAE 601, Master Thesis I

This course intends to give students the opportunity to develop the research proposal. The course develops the following knowledge and skills:

1. Preparation of a thorough and comprehensive literature review to support the research proposal;
2. Formulation of the research hypothesis;
3. Developing and justifying the methods to conduct the research.

CLOs

By the end of this course, students will be able to:

1. Conduct a comprehensive literature review to support the research proposal;
2. Formulate the research hypothesis;
3. Develop and outline the research methods;
4. Independently apply research methods and techniques to perform experimentation/simulation;
5. Effectively present the progress of the research.

MMAE 602, Master Thesis II

This course intends to give students the opportunity to fully implement the research proposal and bring it to a conclusion. The course develops the following knowledge and skills:

1. Planning and conducting, independently, research at an advanced level;
2. Critically analyzing research results;
3. Effectively presenting their results to a wide audience;
4. Effectively compiling their results in the form of an authoritative thesis.

CLOs

By the end of this course, students will be able to:

1. Independently conduct and complete a research project at an advanced level;
2. Critically analyze and discuss obtained research results in accordance with applicable norms of research ethics;
3. Communicate effectively the research results and findings to a wide audience;
4. Generate an authoritative thesis based on their results and findings.

Program Elective Courses

1) Area: Applied Mechanics:

Advanced Statistics and Probability (MMAE 700);
Numerical Techniques for Engineers (MMAE 701);
Modern Control in Aerospace Engineering (MMAE 702);
Flight Dynamics Principles (MMAE 708);
Fatigue Fracture Mechanics (MMAE 709);
Biomechanics (MMAE 711).

2) Area: Engineering Design, Materials, and Manufacturing:

Advanced Engineering Design and Manufacturing (MMAE 703);
Design and Manufacturing with Environmental Concern (MMAE 704);
Design Optimization (MMAE 705);
Advanced Computer Aided Engineering (MMAE 706);
Space Structures Design (MMAE 713).

3) Area: Energy and Thermofluids:

Advanced Conduction and Radiation applied to Mechanical Engineering (MMAE 715);
Aerospace Propulsion (MMAE 707);
Building Energy Analysis (MMAE 714);
Computational Fluid-Structure Interaction: Methods, Models and Applications (MMAE 713);
Renewable Energy (MSC 700).

Elective Courses Descriptions:

MMAE 700 Advanced Statistics and Probability

The concepts of probability and statistics contribute extensively to the solutions of many types of engineering problems. According to an analysis conducted by LinkedIn, Statistical Analysis was one of the most sought-after skills in 2016. Graduates must have a fundamental knowledge of probability and statistics to be competitive in the world market. Advanced Statistics and Probability will best serve Master students in all engineering disciplines. The first half of this course aims at bringing the students, who arrive with quite varying undergraduate backgrounds in statistics and probability, up to the same advanced level. The 2nd half discusses advanced topics (e.g. Decision trees, Multiple Regression Analysis, Statistical Quality Control).

CLOs

By the end of this course, students will be able to:

1. Select appropriate probability distributions to model engineering problems under uncertainty;
2. Utilize statistical methods to analyze engineering problems;
3. Provide engineering solutions to real-life problems.

MMAE 701 Numerical Techniques for Engineers

This subject deals primarily with numerical methods to solve differential equations of relevance in Mechanical Engineering. Emphasis will be placed on solution of systems of ordinary differential equations and boundary value problems in partial differential equations. The student will need to develop numerical algorithms on a programming platform (e.g., MATLAB, C++, Excel, etc., as indicated by instructor) to solve a variety of engineering applications. Numerical solution will be compared with analytical results whenever these ones are available, and students will explore the principles of validity, accuracy, and computational cost of their numerical solution.

CLOs

By the end of this course, students will be able to:

1. Create numerical models based on fundamental algorithms and develop solutions applied to engineering problems;
2. Assess and judge the validity and accuracy of the solution to numerical models developed for solid mechanics, heat transfer and fluids problems;
3. Develop and assess strategies to improve accuracy and cost of solution of a given model, whenever it is possible;
4. Evaluate the output of computational simulations with a critical view and conclude on its physical implications.

MMAE 702, Modern Control in Aerospace Engineering

In this course students will learn to analyze aircraft dynamics and aircraft flight control systems. Students will review the influence of forces and moments acting on the aircraft in terms of its static and dynamic stability, as well as how to model and analyze its dynamic motion and handling qualities. Additionally, students will study different theories on control of dynamic systems and learn to design stability augmentation systems and trajectory control and optimization solutions.

CLOs

By the end of this course, students will be able to:

1. Critically analyze the influence of forces and moments on the static and dynamic stability of aircraft (including longitudinal and lateral motions);
2. Predict the static and dynamic stability characteristics of aircraft resorting to adequate mathematical formulation;
3. Design computational flight simulation systems based on the established dynamic models;
4. Choose advanced control concepts to design stabilization systems and autopilots based on handling quality requirements;
5. Design flight controllers to guide aerospace vehicles.

MMAE 703, Advanced Engineering Design and Manufacturing

Building on knowledge of materials science, mechanics and machine design, the course explores and exploits the couplings between design, manufacturing, operation/ performance, maintenance, and end-of-life and equips students with core knowledge regarding the physical principles involved, constitutive models and applicable architectures and design methods from the state of the art.

The mechanical performance of mission-critical engineering systems and components is analyzed in consideration of a) realistic material constitutive models (incl. hysteresis, plasticity, and creep) and boundary/ operating conditions, b) manufacturing affordances and limitations, incl. residual stresses/ strains, and c) the complete system lifecycle, including technically important phenomena such as fatigue and ageing.

The module is delivered in a project-based format, involving case studies from machine design, space satellite design, aeronautical structures, wind turbines, ground vehicles etc., in the context of running design and research projects with industrial partners.

The course makes use of a dedicated Concurrent Engineering Design environment (Machine Design Laboratory), training students in state-of-the-art workflows (CAD/ CAE/ PDM).

CLOs

By the end of the course the student will be expected to be able to:

1. Frame the design and manufacturing problem and identify the involved systems from a total lifecycle perspective;
2. Analyze machine systems and produce advanced multi-physics-based constitutive and behavioral models involving all pertinent physical degrees of freedom (pDOFs) and design degrees of freedom (dDOFs) to predict work/ ageing-induced states/ properties and manufacturing-induced states/ properties;
3. Design machine systems and related manufacturing methods, where appropriate, to meet requirements extended over the total lifecycle of the systems.

MMAE 704, Design and Manufacturing with Environmental Concern

Nowadays it is crucial to be able to design, manufacture and operate systems in a way that they use energy and resources sustainable while at the same time minimize potential negative impact on the environment. Sustainability implies that the use of energy and resources is at a rate that does not compromise the natural environment, or the ability of future generations to meet their own needs. This course addresses fundamental aspects of sustainability in the development of engineering designs and manufacturing. Topics to be presented include: (a) sustainable development; (b) environmental impact of engineering designs; (c) legal aspects associated to mechanical engineering design and environmental impact; (d) Life-Cycle-Analysis (LCA); (e) ISO 14000 Environmental section; (f) integration of recycling in the design; (g) biology-inspired design; and (h) life-cycle cost analysis.

CLOs

By the end of this course, students will be able to:

1. Assess & evaluate potential impacts on the environment and fully comprehend the notion of product's life-cycle consideration and management;
2. Be aware of environmental laws that are associated with engineering design and manufacturing and be able to choose and apply procedures from standardization organizations regarding environment protection;
3. Be in position to compile an inventory of energy and material input for a particular design along with all related environment releases. Evaluate impact on the environment and be able to assess the results leading in a better-informed design decision;
4. Perform Life-Cycle Cost Analysis and recommend designs and manufacturing procedures accordingly.

MMAE 705, Design Optimization

This module is offered for graduate students who are interested in the design optimization of engineering systems considering several aspects. The objective of this module is to present tools and methodologies for performing engineering optimization in a multidisciplinary design context. This module will cover all three aspects of the problem: (a) the multidisciplinary requirements of the problem, (b) the appropriate guidelines and methodologies applied in modelling for design optimization and (c) the employed tools and methodologies for optimization. However, focus will be given in the modelling requirements and the modern optimization methods that are used to address such problems.

CLOs

By the end of this course, students will be able to:

1. Quantify & evaluate a product design problem by selecting appropriate objective functions, design parameters and constraints;
2. Develop & use gradient-based numerical optimization algorithms;
3. Develop & use modern heuristic optimization techniques such as genetic algorithms (GA), Simulating Annealing, Particle Swarm Optimization, Ant Colony Optimization;
4. Select the optimization technique most suitable to the problem at hand;
5. Perform a critical evaluation and interpretation of analysis and optimization results.

MMAE 706, Advanced Computer Aided Engineering

This is an advanced module to Master's in Mechanical and Aerospace Engineering program and deals with the use of computational tools to generate 3D digital models of parts and to analyze their mechanical performance when used in engineering machinery or devices. This course aims at bringing the MSc students, who arrive with quite varying backgrounds in Computer Aided Engineering (CAE), up to the same advanced level. This module also covers the use of standard software to prepare mathematical models of interest in engineering applications.

CLOs

By the end of this course, students will be able to:

1. Design in a CAE software 2D and/or 3D models (i.e. parts, assemblies, drawings) of complex mechanical devices according to engineering standards;
2. Determine the stress, deformation, and strain components in various positions (point, edge, face) of complex mechanical parts in a CAE software;
3. Conduct static, thermal, frequency, buckling, drop test, fatigue analyses for given problems;
4. Develop engineering solutions to meet desired needs within realistic economic, environmental, social, ethical, safe manufacturing and sustainability constraints.

MMAE 707, Aerospace Propulsion

This course addresses the primary need for graduate students to undertake formal training that will help them in understanding the basic concepts, principles, techniques, and theories for the analysis of aerodynamics and aerothermodynamics in aerospace propulsion systems. The course will develop students' capabilities for applying the knowledge learnt for the analysis and design of aerospace propulsion systems. The course will also instill an appreciation of the historical development of aerospace propulsion systems, as well as develop their skills in using modern engineering tools to solve propulsion-related engineering problems.

CLOs

After completing this course, students will be able to:

1. Understand the basic concepts, principles, techniques and theories for the analysis of aerodynamics and aerothermodynamics in aerospace propulsion systems;
2. Apply these theories and techniques for the design of aerospace propulsion systems;
3. Appreciate the historical development of aerospace propulsion systems;
4. Use modern engineering tools to solve propulsion-related engineering problems.

MMAE 708, Flight Dynamics Principles

To provide knowledge of dynamics, stability, and control of aircraft and to interpret these in the context of flying. The course would be subdivided into two main sections: governing equations and flight dynamics.

CLOs

By the end of the course the student will be expected to be able to:

1. Relate the equations of motion for a rigid airframe to physical movement;
2. Simulate simplified motion of an aircraft;
3. Investigate (research) novel movements of aircraft, e.g. horizontal slide;
4. Discuss and critically assess flying and handling qualities of a given aircraft;
5. Have knowledge of the stability characteristics of an aircraft.

MMAE 709, Fatigue Fracture Mechanics

To provide an understanding of the theories of Fatigue and Fracture Mechanics and to show how these structural concepts can be applied to the design and testing of aircraft structures. Some appreciation of the relationship to Airworthiness Certification will also be included.

CLOs

By the end of this course, students will be able to:

1. Have knowledge of how to avoid fatigue at the design stage;
2. Discuss and critically analyze factors that lead to fatigue factors;
3. Be able to calculate, using theoretical tools the main aspects of fatigue fracture;
4. Be conversant with the main aspects of fracture mechanics.

MMAE 710, Space Structures Design

This course will immerse students in a Concurrent Engineering Design environment (Machine Design Laboratory), where they will be working on the design of various Space Structures in the context of running research projects in a workshop-project format. Students will become intimately acquainted with bleeding edge space technologies, such as gyroscopic systems, vibration damping systems, satellite structures, composites, honeycombs, truss-cores, and nanomaterials. By the end of the course students will be able to perform design of these kinds of space structures.

CLOs

By the end of the course the student will be expected to be able to:

1. Describe spacecraft and satellite systems and identify their subsystems and functionality;
2. Model and analyze various space structures, such as gyroscopic systems, vibration damping systems, satellite structures, composites, honeycombs, truss-cores, and nanomaterials;
3. Perform benchmarking, design, optimization, testing and technology validation studies on aforementioned structures.

MMAE 711, Biomechanics

The objective of this course is to present the mechanics of living systems from an engineering point of view. The students will learn about the history of biomechanics, constitutive equations, the flow properties of bio-fluids, mechanics of cells and the interaction of red blood cells with blood vessels and wall shear with endothelium.

CLOs

By the end of the course the student will be expected to be able to:

1. Fully understand the basic concepts and principles of biomechanics;
2. Apply the basic concepts and principles to characterize and analyze tissues, cells, organs and bio-fluid flows and their interactions;
3. Develop bio-mechanic models to simulate bio systems and processes;
4. Evaluate results of the models and assess their validity;
5. Apply the knowledge learnt in engineering applications.

MMAE 713, Computational Fluid-Structure Interaction: Methods, Models and Applications

The course aims to introduce the students to an important and complicated topic in engineering: Fluid Structure interaction (FSI) and its analysis by computational simulation. The students will learn to understand the physics, methods, and models available for the study of FSI and how to apply them in engineering applications.

CLOs

After completing this course, students will be able to:

1. Understand the physics and theory of FSI;
2. Be familiar with the numerical methods and models available;
3. Know how to use the knowledge and techniques learnt for engineering applications.

MMAE 714, Building Energy Analysis

The whole world is campaigning for sustainable living. Energy used by the built environment is a major factor. As such, energy efficient and low energy building should be designed and built in accordance with its location and functionality and be operated to its requirements and maintained adequately.

CLOs

By the end of the course the student will be expected to be able to:

1. Appraise all the elements which affect the thermal performance of a building;
2. Design building electricity supply and distribution system;
3. Evaluate these elements using the latest software;
4. Predict and rank their contributions to the building energy consumption;
5. Produce energy efficient and low energy buildings.

MMAE 715, Advanced Conduction and Radiation applied to Mechanical Engineering

This module presents advanced knowledge in Conduction and Radiation. The problems will be oriented towards Mechanical Engineering applications. Starting from fundamental principles of conduction and radiation, the course will explore advanced aspects of these two concepts. A special attention will be given to the deep understanding of the problem-solving process and interpretation. Applications such as semi-infinite and/or multidimensional conduction problems, moving interfaces, advanced radiation view factors, radiation involving non-ideal surfaces and semi-transparent media will be investigated.

CLOs

By the end of the course the student will be expected to be able to:

1. Select the appropriate set of equations in the three classic systems of coordinates, and justify their use to solve problems close to the edge of the current research;
2. Assess in conduction problems the influence of space and time constraints in situations close to industry issues or for research applications;
3. Perform analysis using the principles of radiative heat transfer to problems with complex and realistic geometries and surface properties;
4. Produce projects involving challenges with conduction and radiation, and applications for daily-life, industry, or research;
5. Compose appropriately in written and/or verbal manner the results of their project.

MSC 700, Renewable Energy

The ever-increasing demand of power, heating and cooling associated to global population and economic growth, parallel to anthropogenic global warming and fast depletion of fossil fuels, creates an imperative need to incorporate a much larger share of clean and renewable energy. The Renewable Energy Systems course introduces graduate students to the principles of energy conversion, storage, technologies, and economy associated to the use of renewable energy sources.

The course presents a global overview of renewable energy sources with a focus on solar and wind energy sources, covering various aspects of the modeling, design and analysis of solar power and heating, and on-shore/off-shore wind power systems, including their economic and environmental impact analyses.

CLOs

After completing this course, students will be able to:

1. Recognize the construction and operational principles of different renewable energy plants and analyze their functioning;
2. Assess the interaction of wind and turbine rotor for wind turbine performance evaluation and assess solar energy harnessing for efficient thermal and power conversion;
3. Identify the factors governing the siting of PV power plants and wind farms for a wide range of sites and clients;
4. Design systems comprising of generators, controllers, and energy storage components in solar and wind power plants.

Master Thesis Guidelines

The guidelines presented herein form a manual designed to provide you with a quick reference for planning, preparation, and compilation of your thesis manuscript. In this manual, explanations of form and style, as well as a wide range of suggestions and advice, are offered for serving this goal. It is among the aims of this document to clarify the rules and explain possible options in areas where decisions about form and layout are at your discretion.
Finally, it is important that you read the entire manual **before** you begin preparing your manuscript so that you understand the format and purposes behind the rules.

Aims and Objectives

The Master's thesis constitutes a piece of applied research and in this context, your primary goal is to analyze, solve and present your research findings for an existing problem relevant to your field of study. This process should be based on existing scientific and engineering knowledge and follow the principles of responsible research conduct. Hence, you are not expected to conduct basic research and/or produce new knowledge, although this is not prohibited.

The **topic** of your thesis should be related to the advanced studies of the degree program and should be decided in agreement with your thesis supervisor through the preparation and presentation of your Thesis Agreement to the MSc program coordinator for approval.

The primary focus of your research project is usually expressed in terms of **aims** and **objectives**. Your aims should comprise aspirations and/or intentions defined in broad terms which essentially describe what you are hoping to achieve. These aims set out what you targeting to deliver at the end of the project. Objectives, on the other hand, are specific statements that define measurable outcomes and comprise specific goals and steps that must be followed for achieving your aims. Your objectives must be:

Specific; provide precise descriptions of what you are going to do.
Measurable; be able to provide concrete evidence when reaching a goal.
Achievable; avoid setting infeasible goals.
Realistic; plan your steps and goals based on the available resources (time, lab equipment, skills etc.).
Timely delivered; create a timetable, know when each stage needs to be completed, allow extra time for unexpected delays

Thesis components and contents

Thesis components

Your thesis may have up to three components: a core thesis, essential supporting material, and non-essential supplementary material.

Core Thesis. The core thesis must be a self-contained, narrative description of the argument, methods, and evidence used in your thesis project. Despite the ability to present evidence more directly and with greater sophistication using mixed media, the core thesis must provide an accessible textual description of the whole project.
The core thesis must stand alone and be printable on paper, meeting the formatting requirements described in these guidelines. The electronic version of the thesis must be provided in the most stable and

universal format available—currently Portable Document Format (PDF) for textual materials. These files may also include embedded visual images.

Essential Supporting Material. Essential supporting material is defined as mixed media content that cannot be integrated into the core thesis, i.e., material that cannot be adequately expressed as text. Your thesis committee is responsible for deciding whether this material is essential to the thesis. Essential supporting material does not include the actual project data. Supporting material is essential if it is necessary for the actual argument of the thesis and cannot be integrated into a traditional textual narrative. Essential supporting material must be submitted in the most stable and least risky format consistent with its representation.

Non-essential Supplementary Material. Supplementary material includes any supporting content that is useful for understanding the thesis but is not essential to the argument. This might include, for example, electronic files of the works analyzed in the thesis or additional support for the argument (simulations, samples of experimental situations, etc.). Supplementary material is to be submitted in the most stable and most accessible format.

Core thesis/manuscript contents

This Master's program includes courses presenting and explaining research methodologies and reporting methods, however, you should always keep the following in mind when conducting research and compiling your thesis manuscript:

- Always include a pertinent literature review. The literature review aims in describing the existing and established theory and research in your thesis area and, hence, providing a context for your work. Reference all sources mentioned in the review and give full citation in thesis's Reference List.
- Explain the methods used in researching and developing your work. It is highly important to explain what research methods you used to acquire data and/or information and full present the conducted work.
- Discuss with your thesis supervisor the extent and level of detail required; different levels of research depth will obviously require different levels of detail.
- Clearly present your findings. Describe what have been discovered through your research. Give all results, as long as they are products of your research activities. Include tables, graphs, illustrations etc., so that it is easier for the reader to understand your results.
- Always, include a discussion of your findings. Use a discursive and evaluative writing approach and fully present your interpretations and judgements of the results your research shows. Contextualize your ideas in relation to other theories and with other similar research, particularly in reference to the works mentioned in your literature review.

Stages and Procedures

Actions described in Stages 1 & 2 need to be completed within the first eight weeks of the program's 2nd semester, i.e., by the end of February. During the 2nd semester the student has the opportunity, after discussion with his/her current supervisor, to change the topic and/or the supervising committee. After the end of the 2nd semester no changes are allowed.

STAGE 1: Identify Thesis Supervisors (supervisory committee)

1) Students must select their potential MSc thesis supervisors (Lead- & Co-supervisors) within the first 8 weeks of the Program's second semester and inform the MSc Program Coordinator, who is going to initiate the required approval of your supervisory committee by the departmental MSc Program Committee. Both supervisors must be from the department. In exceptional cases, with the approval of the Department MSc. Committee, HoD and Dean, it will be accepted to have the Co-Supervisor external to the Department in which the student is enrolled. But, with no exception, the Lead Supervisor must be a faculty of the Department of the student. In the case of having an external member as Co-Supervisor, that member will act as internal to the effects of evaluation of the Master Thesis. Furthermore, an external examiner needs to be assigned to each student, who will not be part of the student supervisory committee but will be involved in the approval of the final MSc thesis report and the evaluation of the MSc. Thesis defense. The external examiner must be external to your department and can be an academic from another NU department, university or, alternatively, an expert from the industry holding an appropriate academic degree and specializing in your thesis's scientific field. Department's MSc committee will choose the External Examiner from a list of supervisor-proposed candidates. In all stages, all involved individuals and bodies are responsible for identifying and declaring potential or perceived conflict of interest among involved parties and following the rules and guidelines mentioned in Appendix VI.

Constructive supervision is a significant component aiming in the success of your thesis work and requires the vivid interaction between you and your supervisors. However, you should never forget that it is you, the student, who is carrying out the work and it's your motivation, academic knowledge, and interest central in making the supervision process work.

Your supervisory committee comprises academic professionals that will help you track appropriate research sources and support your research and the compilation of your thesis work. Your supervisor may also refer you to other experts (either internal or external to the university) who may have specialized knowledge in the specific topic of your thesis. Your Lead Supervisor is responsible for ensuring that the Master's thesis meets the goals and requirements set by the School of Engineering and Digital Sciences. Your supervisory committee will be able to predict common pitfalls and protect you from them while at the same time provide you with advice helping you meet your thesis's objectives. However, keep in mind that it is required by you to be the dynamic party in the interaction with your supervisors. Discussion and critical argumentation are key features that should be present in your meetings. Supervision is not a monologue, and neither the supervisors nor the student should restrain themselves from asking the other party for clarification of claims. Mutually challenging dialogues can help you in delivering a successful result.

STAGE 2: Selection of topic

Supervisors are in position to suggest appropriate MSc thesis's topics. These may stem from research work being conducted at the school/department or may arise from material covered during your coursework. Furthermore, thesis's topics may be also related to work carried out in the context of research projects involving industrial partners. The topic of the thesis is decided in discussions between you and your chosen supervisors; however, the final choice is always made by you. In this regard, it is customary for interested department faculty members to announce topics and/or areas of interest in helping you choose your thesis topic.

Furthermore, during your first supervised meetings you should spend some time discussing, in addition to academic matters, all practical matters that may arise during your work:

- Do you need all-round supervision? Have you got prior experience in using equipment of software required in the proposed topic? Will you be able to use them?
- When can you meet with your supervisor? How often? Can you set up regular meeting intervals or do you prefer an on-demand approach? Keep in mind that supervisors are bound to offer at least 12 hours of supervision for a 48-credit master thesis.
- How ambitious are you? Are you thinking of later applying for a funded PhD position?

Finally, a *Supervision Agreement* form, found in Appendix II, must be filed in, signed, and submitted to the MSc Coordinator for review and approval by MSc Committee and Head of Department by the end of the second semester. The Supervision Agreement must state the proposed thesis title, supervisors, start date, and intended submission date.

STAGE 3: Submission of your thesis proposal

When you and your supervisor come to an agreement for an appropriate thesis topic, you are required to submit a thesis proposal/candidature within the first four (4) weeks of the Program's 3rd semester. This proposal will be presented with the aid of a short report and defended orally in front of an academic panel, comprising your two supervisors and a third faculty from the Department of Mechanical and Aerospace Engineering appointed by the MSc MAE Committee and approved by the Head of Department. This panel will decide on the appropriateness of your proposed thesis topic and the scientific concreteness of the methodologies you are aiming to apply. Your research/thesis topic proposal should clearly address the following items:

- Outline of the problem/area of application
    - Explain why you think it is worth investigating
    - Set your ideas into a theoretical/academic context
- Aims and Objectives
    - Describe what you are aiming to achieve
    - Present the steps and approaches you will employ for reaching your goals
- Methodology
    - Explain what methods you intend to use when researching and developing your work
    - Use a descriptive writing approach corresponding to the detail required for the panel's comprehension of your approach.
- Scope and constraints
    - Set clearly your scope and anticipated constraints:
        - Your selected topic may be vast with numerous applications and thus, you might want to limit your work in a particular area of application
        - You may not be able to conduct some research due to constraints on time, cost, or availability of resources
- Discuss requirements on resources
    - Do you need any special lab equipment?
    - Is literature review possible with library's resources?
    - Are any materials and/or consumables required in your research?
- Propose a draft timetable for your thesis

The panel may accept your proposal or provide you with feedback and change suggestions that will help you meet the required academic standards for starting your thesis. If the proposal is deemed unacceptable you will have a second chance to revise and present your modified proposal within four weeks. If

your proposal is not accepted for a second time, you will be recommended for dismissal from the program[1].

Your thesis proposal should be obviously discussed during the preliminary meetings with your supervisory committee. Your Lead Supervisor will usually provide pertinent literature and/or additional resources to accelerate your initial work. Finding suitable and reliable information may prove challenging, but there are many ways including library books, databases, international sources, articles, journals, reviews, and a lot more.

STAGE 4: Carrying out research and preparation of your thesis manuscript

Once your proposal has been officially approved, the actual work may begin. It is crucial that you are always well-prepared in meetings with your supervisor. In this context, it is a good practice to always keep minutes of your meetings and circulate agendas with clearly outlined discussion points and expected results prior to your meetings. This makes it easier for the supervisor to focus on significant issues, leading to a better response for you. If you feel that you may have misunderstood a concept, or you are not certain of the steps required for performing a particular task, ask your supervisor for clarifications or further guidance. The supervisors should always guide you with advices on the topics and tasks you should put emphasis on and at the same time turn you away of meaningless tasks that may waste your time.

Try to establish a communication channel that suits both you and your supervisors. Emailing is an easy, asynchronous way of communication that overcomes time and place barriers. Furthermore, since it is primarily based on writing, it requires a certain amount of prior thinking and planning that helps you avoid getting 'off-track' as it may be the case when speaking. However, emails are cumbersome when lengthy and lack the directness of a real meeting. So, it is important to balance the ways of communication based on your needs and supervisor's availability.

Try to follow the work schedule as close as possible and report unexpected delays or difficulties to your supervisor. This does not mean that whenever you are faced with a difficulty, you will turn to your supervisor for doing the work for you. It essentially means that after putting reasonable effort on accomplishing a specific result which is still elusive, you should turn to your supervisor for additional guidance.

Finally, you must keep in mind that writing a thesis cannot happen in one go. You should, as soon as possible, keep track of your work, make notes and sketches, write intermediate reports so that when your work has approached a certain maturity level, you'll be able to compile, with the aid of this material, a successful thesis's manuscript. **In this regard a progress report is required to be submitted by you to the MSc Coordinator as a proof of progress by the end of the 3rd semester. This progress report should include as a minimum requirement a complete literature review and must be approved by your supervisor.**

STAGE 5: Thesis submission & Defense of your work

Before submitting your manuscript, your supervisor will check it thoroughly and give you feedback on corrections and changes that need to be made. Usually, thesis's revision may take up to 1-2 weeks, and an appropriate amount of time should be also reserved for making corrections.

[1]Failing of MSc thesis or dismissal from program are subject to regular appeal process and rules established in the program handbook and guidelines

When you have prepared the revised document, you submit to your supervisory committee and external examiner for evaluation. Keep also in mind that you should aim at meticulously following your supervisor's comment and corrections so that a series of multiple revisions can be avoided. When your supervisory committee & the external examiner approve the final document, your Lead supervisor will fill the required form and you will get permission to submit your final thesis report for evaluation.

The overall grade for your degree is calculated as the credit-weighted average of all course grades. Additionally, a SUCCESSFUL submission and defense of your thesis is required to be considered for graduation; see §Thesis Grading below for the employed scheme in your thesis evaluation.

Thesis submission process involves the following steps:

- **Thesis report submission (in electronic format).**
- **Thesis oral defense in front of the examination committee.**
- **Thesis revision, if required.**
- **Submission of final version of your report (Thesis manuscript).**
- **Thesis mark appeal, if any. The appeal should be submitted to the MSc MAE committee, which is responsible for the Thesis evaluation process.**

The exact deadlines for each submission process step will be announced every year in due time. Commonly, the submission and examination process begin about 1.5 months before the end of the program's 4th (last) semester and may end few days after the end of the semester.

If your supervisory committee does not approve your thesis for defense or you fail the defense, you may continue to work on your thesis during the immediate summer semester and defend the amended thesis in the summer term before the beginning of the following fall semester. You will not receive a scholarship and you may need to cover the tuition and other fees by yourself during the summer term.

You may also request the Dean's permission to extend your MSc program for the following Fall semester if needed to complete the program requirements. The student's academic supervisor must endorse the request. During this period, you will not receive a scholarship and you may need to cover the tuition and other fees by yourself. If you cannot present and/or defend your thesis during this last semester, you will be recommended for dismissal from the program[2].

In any case, re-examination of the MSc thesis may be permitted only once, with the approval of the Dean of School of Engineering and Digital Sciences.

Thesis Assessment Criteria

The grade assigned depends on the level to which the following criteria have been met:

Manuscript Grading (MSc Thesis Manuscript)
Maximum MSc Thesis Manuscript score: **100**

- ***Presentation of the research problem and thesis's objectives (10%)***
  - Is the research problem clearly specified and contextualized?
  - Are the research questions and hypotheses clearly formulated?
  - Does the thesis capture the relevance, rationale, and objectives of the proposed research?
- ***Literature and technology review (15%)***
  - Does the thesis include a comprehensive review and critical discussion of the relevant literature and/or technological developments?

[2] Failing of MSc thesis or dismissal from program are subject to regular appeal process and rules established in the program handbook and guidelines

- Is there a description on how the conducted research positions itself within the generic context of works which have been published in the area?
- Is the relevant background theory covered? Are the presentation, discussion and explanation provided, adequate? Has the theory been contextualized appropriately within the framework of the research problem being investigated?
- Have the latest theoretical developments in the area been presented and described?
- Does the student demonstrate a systematic understanding of the relevant background material and knowledge?

- ***Methodology, design and implementation (35%)***
  - Are the adopted methodologies and/or design approaches clearly justified and described?
  - Is the implementation well explained?
  - Is there a clear identification of any limitations, assumptions and constraints which affect the application of the employed methodology, design approach and implementation?
- ***Testing, results, analysis, evaluation concluding remarks & future work (30%)***
  - Are the test procedures sound and objective?
  - Do the proposed tests address the research problem being investigated?
  - Are the test conditions, assumptions, constraints, and limitations clearly identified?
  - Are the results clearly presented, analyzed objectively and critically evaluated?
  - Do the concluding remarks summarize the work done? Are there suggestions for any future development and/or enhancements?
- ***Structure and presentation of thesis (10%)***
  - Are the thesis contents well structured, focused, and easy to follow?
  - Are the student's contributions and assumptions clearly communicated to the reader?
  - Is it in compliance with the given guidelines?
  - Is it clearly presented and organized? Is the grammar and usage of English of an appropriate level?

Oral Presentation Grading (MSc Thesis Defense)

Maximum MSc Thesis Defense score (presentation + technical content) **100**

PRESENTATION SCORE: *(Maximum presentation score: 50)*

- ***Speech & Style*** *(10p.)*
  - Clear and easily understood. Correct use of terms.
  - Easy-to-understand sequence. Professional appearance. Use of good English.
- ***Structure of the Presentation*** *(10p.)*
  - Logical sequence, good flow. Supporting body of literature mentioned.
  - Development of topics described clearly. Smooth progression from topic to topic.
  - Key points & challenges sufficiently highlighted.
- ***Layout of Visual Aids*** *(10p.)*
  - Clear power point slides, uncluttered. Concise & precise slides.
  - Use of good English. Good use of charts, tables, diagrams, etc.
- ***Questions & Answers*** *(20p.)*
  - Clearly understood the question.
  - Concise answer responding to the point of the question.

TECHNICAL CONTENT SCORE: *(Maximum technical content score: 50)*

- ***Introduction*** *(10p.)*
  - Problem statement & project objectives. Coverage of all main points of the project.
  - Literature review and conclusions. Relevance to the need of industry, society etc.
- ***Technical Competency*** *(30p.)*
  - Viability of the design concept. Justification of the approach
  - Design methodology. Practical Implications.
  - Quality of the concept presentation. Interpretation of the achieved results.

- Use of relevant tools/equipment/software. Costs and efficiency considerations.

- ***Conclusions, Future Work & Professional ethics*** *(10p.)*
  - Conclusions: advantages and disadvantages.
  - Level of the project objectives achievement.
  - Future work and possible improvements.
  - Consideration in design and solution. Applicability to real-life situations.
  - Compliance with good practices and standards.

Thesis Grading

The MSc. Thesis must be compiled in a report (manuscript) according to the specification provided herein and defended in front of MSc. Examination Thesis committee, which comprises your two supervisors and your external examiner. The MSc. Thesis manuscript and MSc Defense Oral presentation will be evaluated using the assessment criteria and weighting presented in the previous section, Thesis Assessment Criteria and Oral Presentation Assessment Criteria, respectively. The Thesis manuscript evaluation (M) contributes 70% to your final thesis evaluation while the remaining 30% comes for your Oral presentation (O).

Thesis is not graded with a letter scale as in the case of other MSc courses, but a SUCCESSFUL / UNSUCCESSFUL attribution is utilized. For a successful completion of your thesis, you are required to achieve an overall supervisory committee evaluation greater or equal to 75%. The examination committee members' evaluations contribute to your MSc thesis result as follows:

1. External examiner's (EE_M and EE_O) evaluations are weighted with a 30% weight, and
2. Lead and Co-Supervisor's evaluations (S1_M, S1_O & S2_M, S2_O) are weighted with a 35% weight each

Hence, your final thesis evaluation (FE) is calculated as follows:
FE = 0.3 O + 0.7 M,
where O = (0.3 EE_O + 0.35 S1_O + 0.35 S2_O) and M = (0.3 EE_M + 0.35 S1_M + 0.35 S2_M)
If FE is greater or equal to 75%, your thesis manuscript & defense is considered SUCCESSFUL, otherwise it will be considered UNSUCCESSFUL.

In case of a difference larger than 25% between evaluation marks given by External and average of Internal Examiners, the Department MSc Committee will decide the final evaluation of the thesis. The percentage difference will be calculated using the following relation:

$$\text{Percentage Difference} = \frac{|V_i - V_e|}{\frac{(V_i + V_e)}{2}} \times 100,$$

where V_i is the average evaluation of the internal members and V_e the evaluation of the external member.

Manuscript Structure & Formatting

Detailed description of manuscript's structure along with specific guidelines for the document's styling can be found in Appendix III – Manuscript Format Specifications.

Referencing

Whenever writing a piece of academic work, you are required to acknowledge the sources of data and information that you have used. This permits you to:

- prove that your work has a substantial factual basis;
- offer your readers the means to identify and retrieve the references for their own use;
- acknowledge the creators/authors of material/methods you have used/employed in your own research work
- support the research methodology and approaches you have used to reach your conclusions.

You can use any established engineering citation methodology to reference any material used in your work. For more information on ASME[3]'s referring style and alternative approaches see Appendix IV – Referencing style.

Always keep in mind that referencing is divided into two key components:

1. *In-text references* where references might be numbered in the order of appearance, as in [1] or using the author's name and date of publication as in (James et al., 2002);
2. *A reference list* displayed at the end of the piece of work which provides full details of all references cited in-text. The references can be ordered as they appear in text or in alphabetical order according to the selected style. In any case, the identification mark for each item in the list must coincide with the in-text reference used.

[3] THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Appendices

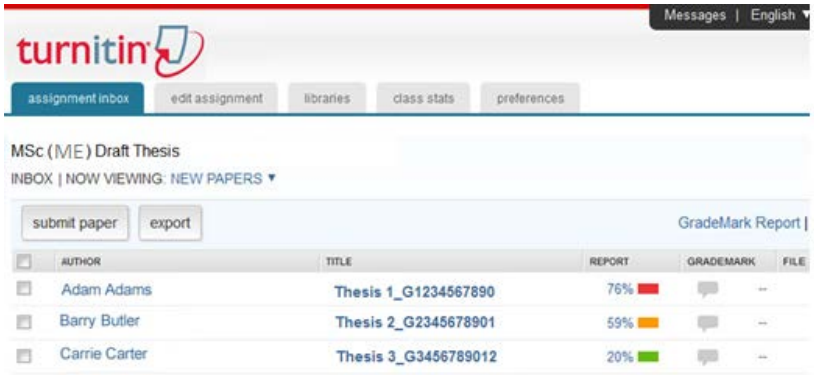
Appendix I - Turnitin

Turnitin is a web-based originality checking service that is used by many universities worldwide to prevent plagiarism. When a student's work is submitted to Turnitin it is matched against millions of internet pages, electronic journals, books, and a database of all previously and concurrently submitted assignments. Turnitin then generates an originality report providing a summary of matching or similar text found in the submitted work. Turnitin can be used to check sources that have been correctly acknowledged and cited.

The higher the percentage indicated on the originality report, the greater the amount of text copied. The similarity percentage index ranges from 0% to 100% and is specified by distinct Colors:

- **Blue** (No matching words)
- **Green** (1 - 24% similarity index)
- **Yellow** (25 – 49% similarity index)
- **Orange** (50 – 74% similarity index)
- **Red** (75 – 100% similarity index)

Acceptable ranges for plagiarism using Turnitin is **20% or below**. The following figure illustrates a sample originality report.



Appendix II – Supervision Agreement Form

MSc Thesis-Supervision Agreement Form
School of Engineering and Digital Sciences, Nazarbayev University

NAZARBAYEV UNIVERSITY

Department of Mechanical & Aerospace Engineering
53 Kabanbay Batyr Ave. Nur-Sultan, Kazakhstan, 010000
Tel. No: +7 (7172) 70 64 23, 70 65 43, 70 65 99
E-mail address: seng@nu.edu.kz
Web-page: seng.nu.edu.kz

Student Name and ID	Name: ID:		
Program	Master of Science in Mechanical & Aerospace Engineering (MSc-MAE)		
Lead Supervisor	Name: Institute / School / Department: Address:		
Co-supervisor	Name: Institute / School / Department: Address:		
External Examiner	Name: Institute / School / Department: Address:		
Proposed thesis title			
Starting date		Intended date of thesis submission	

RIGHTS AND OBLIGATIONS IN THE SUPERVISORY RELATIONSHIP

- The supervisor and the student should, at the outset of the supervisory relationship, discuss and agree on the format of supervision, the expected progress, and the intended date of thesis submission.
- The supervisor and the student should observe the regulations and instructions governing the supervision of the master thesis.
- Regulations and instructions regarding conflict of interest (as described in Appendix VI of MSc MAE handbook) in supervision and assignment of external examiners should be observed by the student, the supervisor, and the MSc MAE committee.

Student

- The student should be well-prepared for meetings with supervisors.
- The student should provide sufficient notice to the supervisors if he/she is not able to attend a scheduled meeting.
- When there are serious problems in supervision, the student should immediately bring this to the attention of the Master's Program Coordinator or Head of Department.
- In case the thesis cannot be completed within the period of the agreement, the student must apply for an extension of the supervision agreement.

Supervisors

- The supervisors should be familiar with and follow the ethical guidelines of supervisors at Nazarbayev University. He/she should also ensure that students are aware of the guidelines.
- The supervisors should ensure that the first meeting with the student takes place shortly after having been assigned, in which the supervisors should discuss with and inform the student about how the supervision is to be organized.
- The supervisors should offer the student at least 12 hours of supervision for a 48-credit master thesis, distributed evenly throughout the supervision period.

- The supervisors should be well prepared for the meetings with the student.
- The supervisors should discuss with the student as well as evaluate the plan, the methodology and execution of the proposed research. He/she should assist the student in planning the research with a view to completing it within the normal period of study.
- The supervisors are expected to read and give detailed comments on the draft of the thesis chapters at least once, but the supervisors will exercise their own judgment in how far it is necessary to give detailed comments on revised chapters and the completed thesis.
- The supervisors may, if appropriate, carry out part of the supervision in small research seminars.
- The supervisors should, through the meetings with the student, monitor the progress of the student's work and evaluate the progress in relation to the planned schedule.
- The supervisors should give sufficient notice to the student if he/she needs to re-schedule a meeting.

Modification or Termination of Supervision Agreement

- Changes can be made to the supervision agreement (i.e. changing the research topic) when both the student and lead supervisor agree.
- Changes to the supervisor and/or co-supervisor and/or research topic can only happen before the end of the program's 2nd semester.
- When the supervisor is to be absent for an extended period of time in the course of the supervisory relationship, the department should, in consultation with the student, determine how the supervision can be organized during this period.
- In case the department considers that the student is not acting according to the supervision agreement, he/she should be notified in writing.
- If the supervisory relationship is not deemed, by the student or the supervisor, to be working satisfactorily, for academic or other reasons, either side may request to be released from the supervisory relationship. A new supervisor should then be arranged.
- The student may be considered as not acting according to the supervision agreement in cases when:
  (a) the student fails to submit the master thesis within the semester which the thesis is due for submission and has not been given approval for an extension and a new submission date.
  (b) the student has not contacted the supervisor for one semester. In such a case, the research can be taken up by other students.
  (c) the allocated hours of supervision have been used up, and the student has no approved plan for submission of thesis.
- The supervision agreement ends when the student:
  (a) submits the master thesis
  (b) is considered as not acting according to the agreement and has been notified of it in writing, and has not received approval for a new plan for submission
  (c) forfeits or gives up the right to his/her place in the master program concerned.

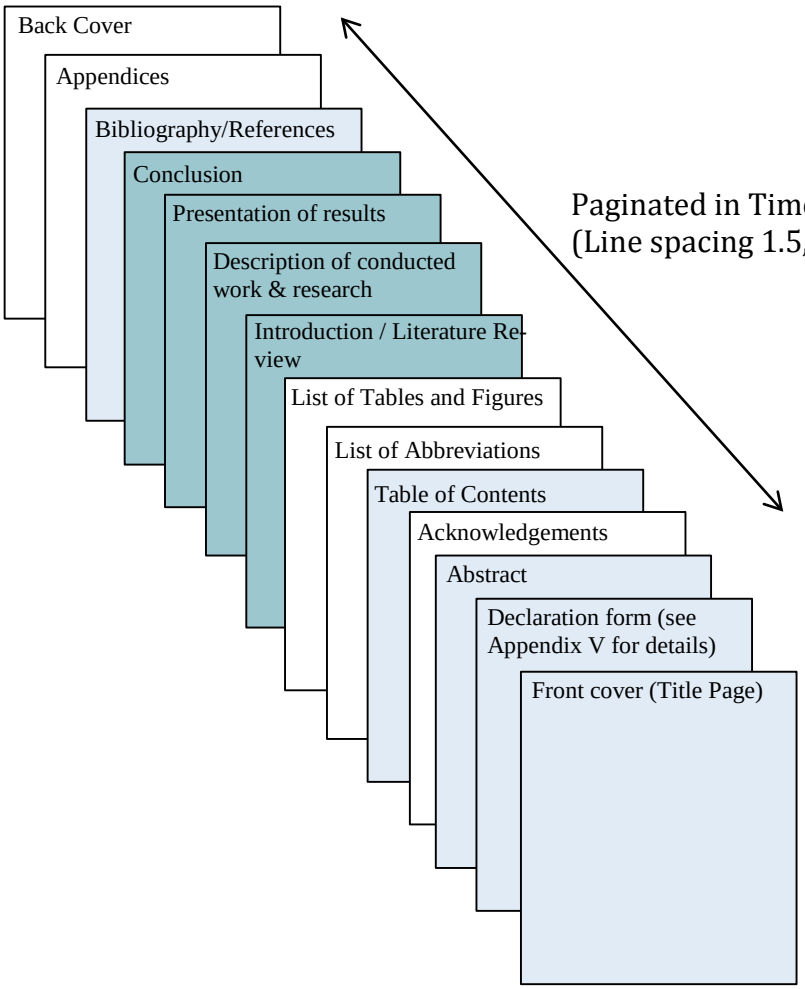
Student	Date	Signature
Lead Supervisor	Date	Signature
Co-supervisor	Date	Signature
Master's Program Coordinator	Date	Signature
Head of Department	Date	Signature
Dean of School	Date	Signature

(Dean's approval is required only for the exceptional case where a supervisor or co-supervisor is external to the department)

Appendix III – Manuscript Format Specifications

1. **Style Requirements**
   - The thesis must be written in English language. Quotations in languages other than English may be included; however, the quotations' translation should be also included.
   - An abstract of the thesis, not exceeding **500** words, should be part of the preliminary material.
   - Supplementary materials, such as questionnaires, large data sets, or copies of photographs, may be placed into appendices. The appendices must be consecutively paginated with the text. The paper quality and margins of the appendices must conform to the standards for the rest of the thesis.
2. **General Thesis Format Requirements**
   - The MSc. Thesis format will be strictly according to the specifications described in this handbook and needs to be limited to **100** pages excluding appendices.
   - The font type will be Times New Roman, in black and size 12 point with the exceptions noted in the detailed guidelines below. The text line-spacing will be one and half. Lengthy quotations, footnotes, and bibliographies may be single-spaced.
   - Your thesis should be divided into chapters. A chapter should be divided into sections and subsections. Sections and subsections of chapters are to be identified by numbers. Chapters use 1st level numbering, i.e., Chapter 1, 2, 3 etc. chapter sections use 2nd level numbering, i.e., C.1, C.2 where C is the number of the corresponding chapter; e.g., the 3rd section in the 2nd chapter should be numbered as 2.3. Subsections use 3rd level numbering and their numbers are preceded by the chapter and section number, e.g., 2.1.4, 2.1.5 etc. Numbering should be used up to subsections.
   - Computer-generated figures, graphs and other diagrams are acceptable. Each diagram should be numerated, include a caption, and should not be divided between two pages.
   - Tables may be used either in the text or in appendices. All tables should include a numerated header (caption) and named rows and columns.
   - All mathematical and/or chemical equations and relations are considered as text and numbered using a chapter numbering scheme; see above. Detailed, lengthy derivations and mathematical proofs should be placed in Appendices.
   - Page headers or decorative borders should not be used.
   - The text should be justified. The beginning of the first line of text of each paragraph should be indented to **1.25 cm**.
   - The page margins for the text will begin at least **2.5cm** from all sides.
   - The second and subsequent pages should be numbered in Arabic figures in the middle of the top of each page.

3. **Detailed Guidelines & Examples**
Order of manuscript elements and chapters



Required elements/chapters

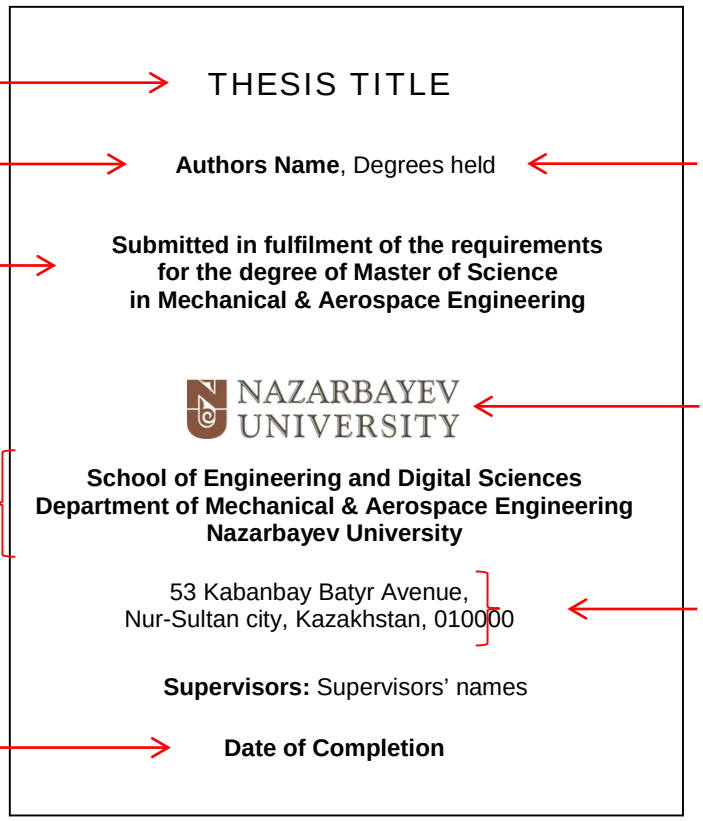
Optional elements

Required chapters (Additional chapters may also be present)

NOTE: All text should by typed using Times New Roman font face. If your word-processing software does not support Times New Roman, substitute with a font face that closely resembles it.

Pagination: All pages must be numbered; page numbers must be displayed on all pages, except the title page. Numbering should be placed in the middle of the top or bottom of each page

Front Cover



Times New Roman, (Bold), Size 16

Times New Roman (Bold), Size 15 Enter your name

Times New Roman (Bold), Size 15

Times New Roman, Size 15 Degrees currently attained (i.e. B. Eng)

Authorized University logo

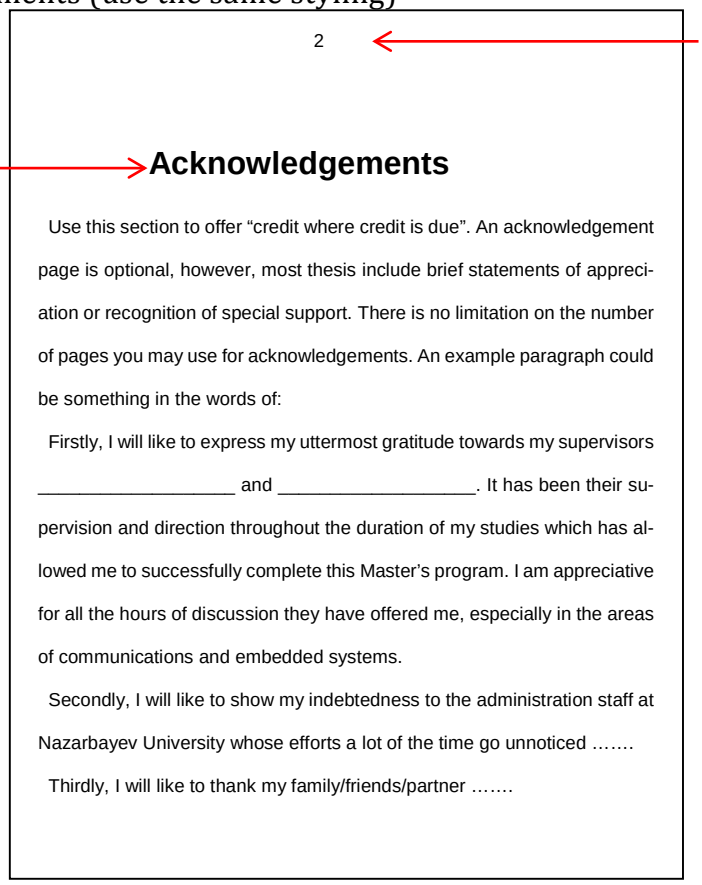
Times New Roman (Bold), Size 15 School, Department, and University Name

Times New Roman, Size 15 Institution Address

Times New Roman (Bold), Size 15 Date of thesis completion (e.g., December 2016)

Insert the declaration form (see Appendix V) as an unnumbered separate page following the cover page.

Abstract & Acknowledgements (use the same styling)

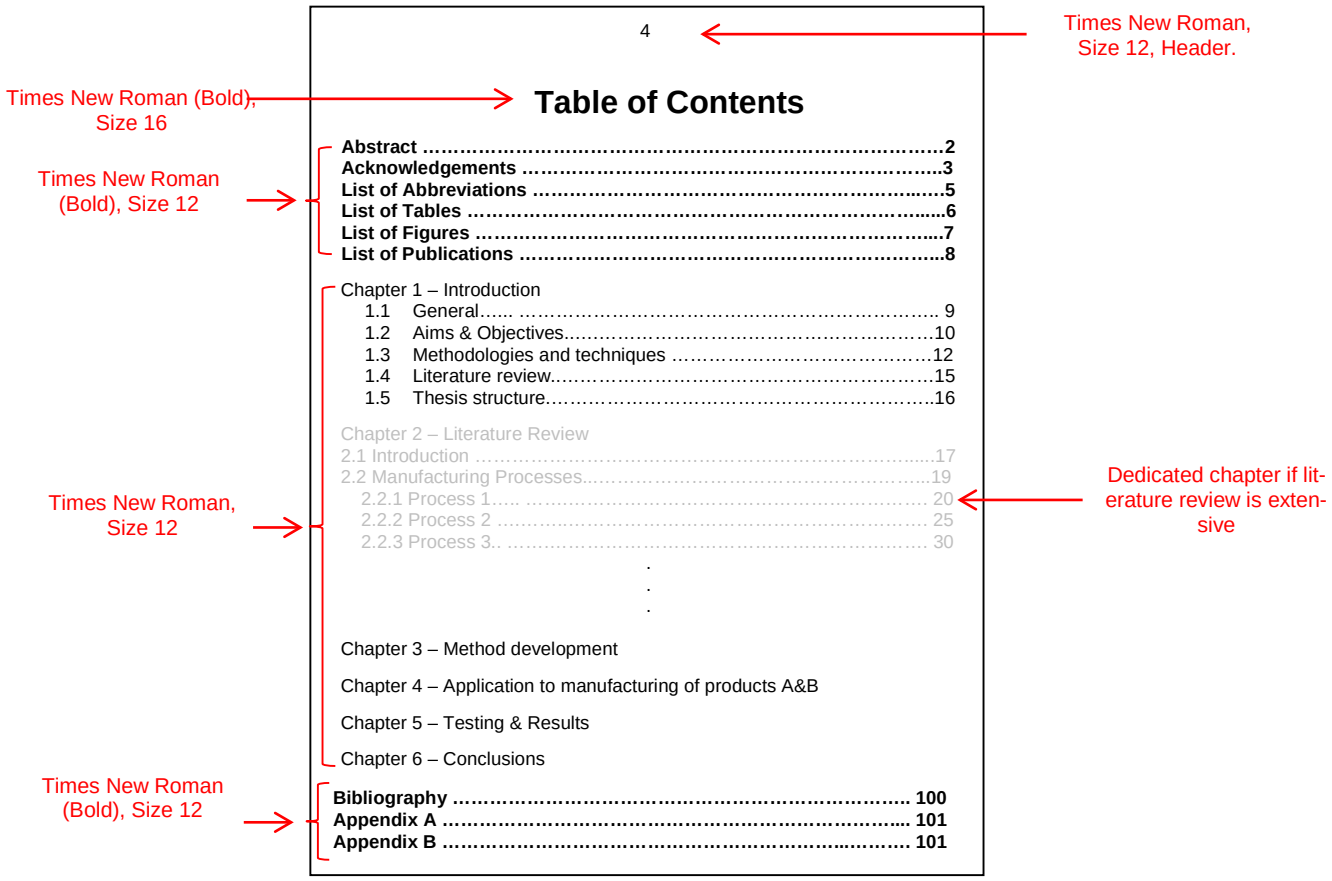


Times New Roman, Size 12, (Alternatively you may print the page numbers at the bottom of the page)

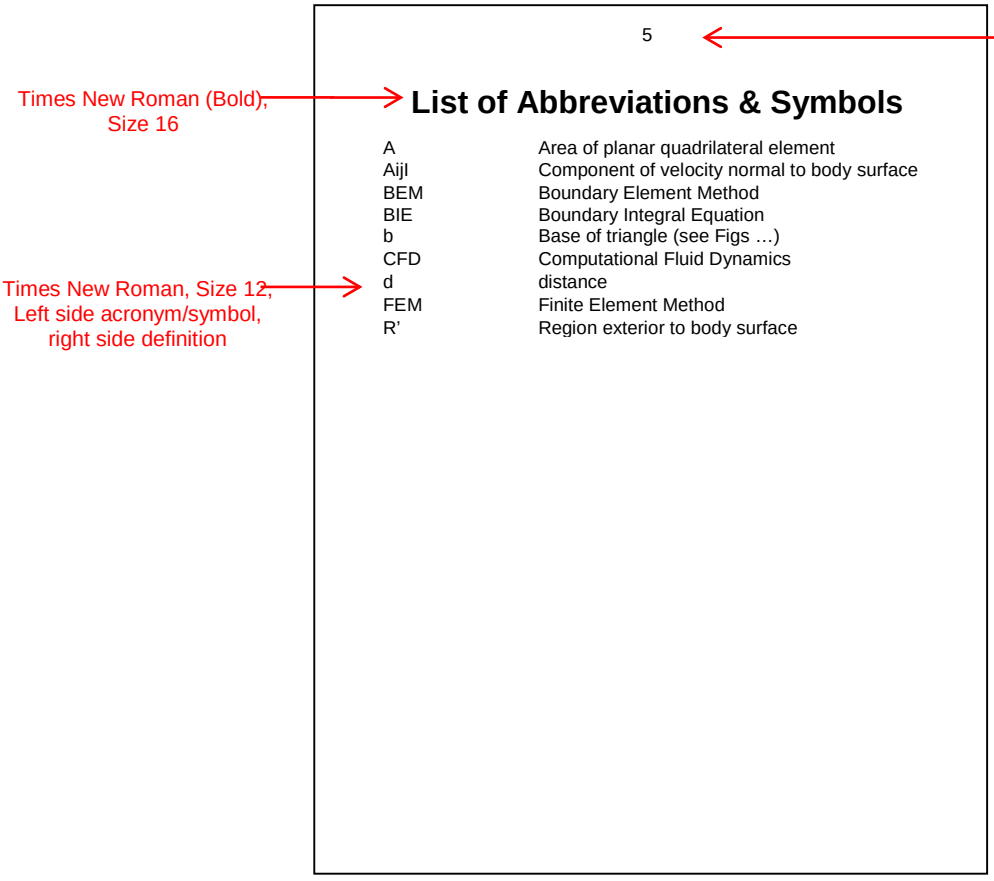
Times New Roman (Bold), Size 16

Times New Roman, Size 12 (If a new page is needed due to many acknowledgments the text will commence at the top of the next page under the header).

Table of Contents



List of Abbreviations



List of Figures (List of Tables should follow a similar format)

Times New Roman, Size 12, Header.

Times New Roman (Bold), Size 16

List of Figures

Chapters

Times New Roman, Size 12, Header.

Times New Roman (Bold), Size 16

Chapter 3 – Computation of Lifting Flow

Times New Roman, Size 12

The body of context is the substance of your thesis. It should introduce, investigate and verify your findings. The conclusion section is often the last part of writing, summarizing and discussing the overall results.

Table 3.1: Tolerances for shaft alignment

Times New Roman (Bold, Italic), Size 12, Note: Table captions come before tables. Make sure that font-sizes in tables are suitable for reading.

TOLERANCES FOR SHAFT ALIGNMENT (±)

RPM	GAP (mils/10")		OFFSET (mils)		SPACER SHAFT (mils/in.)	
	Excellent	Acceptable	Excellent	Acceptable	Excellent	Acceptable
600	10.0	15.0	5.0	9.0	1.8	3.0
900	7.0	10.0	3.0	6.0	1.2	2.0
1200	5.0	8.0	2.5	4.0	0.9	1.5
1800	3.0	5.0	2.0	3.0	0.6	1.0
3600	2.0	3.0	1.0	1.5	0.3	0.5
7200	1.0	2.0	0.5	1.0	0.15	0.25

At RPM: Maximum Soft Foot Reading 2.0 mils. (1 mil = .001")
Note: Use OEM or in-house tolerances if available.

Copyright 2000 by LUDECA, INC., Miami, FL

Related Products:
- Soft Shims
- Undercut Bolts
- Portable Jack Bolt Kits
- Heavy Lifting Devices
- and more ...

8ths
1/8 = .125
1/4 = .250
3/8 = .375
1/2 = .500
5/8 = .625
3/4 = .750
7/8 = .875

Figure 3.4: 3d Model of component B

Times New Roman (Bold, Italic), Size 12, Note: Figure captions are placed below the figure. Make sure all figure elements are clear and readable (Always use vector graphics, if possible).

$$\nabla \cdot \left(-k\nabla T\right) = q_{gen} - \rho c \frac{dT}{dt}$$

$$-k\nabla^2 T + \rho c \frac{\partial T}{\partial t} = q_{gen}$$

$$\nabla^2 T - \frac{1}{\alpha}\frac{\partial T}{\partial t} = -\frac{1}{k} q_{gen} \quad (3.1)$$

Times New Roman, Size 12, Note: Your document editor should support mathematical symbols and formulas

Bibliography/References

Times New Roman, Size 12, Header.

Times New Roman (Bold), Size 16

Bibliography/References

[1] Aftosmis MJ, Melton JE and Berger MJ. Adaptation and surface modeling for Cartesian mesh methods. AIAA Paper, Collection of Technical Papers. Pt. 2 (A95-36501 09-34) 95-1725. In 12th AIAA Computational Fluid Dynamics Conference and Open forum, San Diego, 1995.

[2] Aiso H. Admissibility of difference approximations for scalar conservation laws. *Hiroshima Math. Journal* 1993; **23**: 15–61.

[3] Allmaras S. Analysis of a local matrix preconditioner for the 2-D Navier–Stokes equations. AIAA Paper 93-3330. In AIAA 11th Computational Fluid Dynamics Conference, Orlando, 1993.

[4] Allmaras S. Analysis of semi-implicit preconditioners for multigrid solution of the 2-D Navier–Stokes equations. AIAA Paper 95-1651. In AIAA 12th Computational Fluid Dynamics Conference, San Diego, 1995.

[5] Allmaras S. Algebraic smoothing analysis of multigrid methods for the 2-D compressible Navier–Stokes equations. AIAA Paper 97-1954. In AIAA 13th Computational Fluid Dynamics Conference, Snowmass, 1997.

[6] Alonso JJ and Jameson A. Fully-implicit time-marching aeroelastic solutions. AIAA Paper 94-0056. In AIAA 32nd Aerospace Sciences Meeting, Reno, 1994.

[7] Alonso JJ, Martinelli L and Jameson A. Multigrid unsteady Navier–Stokes calculations with aeroelastic applications. AIAA Paper 95-0048. In AIAA 33rd Aerospace Sciences Meeting, Reno, 1995.

[8] Anderson WK, Thomas JL and Whitfield DL. Multigrid acceleration of the flux split Euler equations. AIAA Paper 86-0274. In AIAA 24th Aerospace Sciences Meeting, Reno, 1986.

[9] Anderson WK and Venkatakrishnan V. Aerodynamic design and optimization on unstructured grids with a continuous adjoint formulation. AIAA Paper 97-0643. In AIAA 35th Aerospace Sciences Meeting, Reno, 1997.

[10] Anderson BK, Thomas JL and Van Leer B. A comparison of flux vector splittings for the Euler equations. AIAA Paper 85-0122. In AIAA 23rd Aerospace Sciences Meeting, Reno, 1985.

Times New Roman, Size 12, Conform to the referencing section of this handbook.

Appendices

Times New Roman, Size 12, Header.

Times New Roman (Bold), Size 16

Appendices

Times New Roman, Size 12.

Appendices are not necessarily part of every thesis. Appendices may be used for supplementary illustrative material, original data, computer programs, and other material not necessarily appropriate for inclusion within the body text of the thesis.

Times New Roman (Bold, underlined), Size 14

Appendix A

Figure A.1 Shape optimization in additive manufacturing

Times New Roman (Bold, Italic), Size 12, Note: use appendix letters in numbering figure captions, i.e. A.1, A.2, B.1.

Appendix B

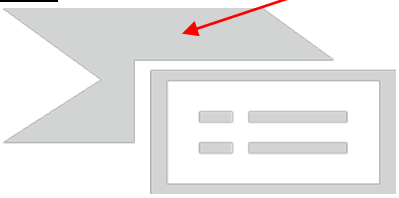


Figure B.1 Code excerpt

Appendix IV –Referencing style

ASME Referencing style

Text Citation. Within the text, references should be cited in numerical order according to their order of appearance. The numbered reference citation should be enclosed in brackets.

Example
It was shown by Prusa [1] that the width of the plume decreases under these conditions.

In the case of two citations, the numbers should be separated by a comma [1, 2]. In the case of more than two reference citations, the numbers should be separated by a dash [5-7].

List of References. References to original sources for cited material should be listed together at the end of the paper; footnotes should not be used for this purpose. References should be arranged in numerical order according to their order of appearance within the text.
(1) Reference to journal articles and papers in serial publications should include:
· last name of each author followed by their initials
· year of publication
· full title of the cited article in quotes, title capitalization
· full name of the publication in which it appears
· volume number (if any) in boldface (Do not include the abbreviation, "Vol.")
· issue number (if any) in parentheses (Do not include the abbreviation, “No.”)
· inclusive page numbers of the cited article (include “pp.”)
(2) Reference to textbooks and monographs should include:
· last name of each author followed by their initials
· year of publication
· full title of the publication in italics
· publisher
· city of publication
· inclusive page numbers of the work being cited (include “pp.”)
· chapter number (if any) at the end of the citation following the abbreviation, “Chap.”
(3) Reference to individual conference papers, papers in compiled conference proceedings, or any other collection of works by numerous authors should include:
· last name of each author followed by their initials
· year of publication
· full title of the cited paper in quotes, title capitalization
· individual paper number (if any)
· full title of the publication in italics
· initials followed by last name of editors (if any), followed by the abbreviation, “eds.”
· publisher
· city of publication
· volume number (if any) in boldface if a single number, include, “Vol.” if part of larger identifier (e.g., “PVP-Vol. 254”)
· inclusive page numbers of the work being cited (include “pp.”)
(4) Reference to theses and technical reports should include:

· last name of each author followed by their initials
· year of publication
· full title in quotes, title capitalization
· report number (if any)
· publisher or institution name, city

Sample References

[1] Ning, X., and Lovell, M. R., 2002, "On the Sliding Friction Characteristics of Unidirectional Continuous FRP Composites," ASME J. Tribol., 124(1), pp. 5-13.
[2] Barnes, M., 2001, "Stresses in Solenoids," J. Appl. Phys., 48(5), pp. 2000–2008.
[3] Jones, J., 2000, Contact Mechanics, Cambridge University Press, Cambridge, UK, Chap. 6.
[4] Lee, Y., Korpela, S. A., and Horne, R. N., 1982, "Structure of Multi-Cellular Natural Convection in a Tall Vertical Annulus," Proc. 7th International Heat Transfer Conference, U. Grigul et al., eds., Hemisphere, Washington, DC, 2, pp. 221–226.
[5] Hashish, M., 2000, "600 MPa Waterjet Technology Development," High Pressure Technology, PVP-Vol. 406, pp. 135-140.
[6] Watson, D. W., 1997, "Thermodynamic Analysis," ASME Paper No. 97-GT-288.
[7] Tung, C. Y., 1982, "Evaporative Heat Transfer in the Contact Line of a Mixture," Ph.D. thesis, Rensselaer Polytechnic Institute, Troy, NY.
[8] Kwon, O. K., and Pletcher, R. H., 1981, "Prediction of the Incompressible Flow Over A Rearward-Facing Step," Technical Report No. HTL-26, CFD-4, Iowa State Univ., Ames, IA.
[9] Smith, R., 2002, "Conformal Lubricated Contact of Cylindrical Surfaces Involved in a Non-Steady Motion," Ph.D. thesis, http://www.cas.phys.unm.edu/rsmith/homepage.html

Other referencing styles

You can use any established referencing style as long as you make sure that all referencing uses a single style. Elsevier journals offer the following referencing services and styles (the following example style refers to the journal of Computer Aided Design (CAD)):

Elsevier References

Citation in text: Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list but may be mentioned in the text. If these references are included in the reference list, they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Web references: As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading, if desired, or can be included in the reference list.

References in a special issue: Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software: Most Elsevier journals have a standard template available in key reference management packages. This covers packages using the Citation Style Language, such as Mendeley (http://www.mendeley.com/features/reference-manager) and also others like EndNote (http://www.endnote.com/support/enstyles.asp) and Reference Manager (http://refman.com/downloads/styles). Using plug-ins to word processing packages which are available from the above sites, authors only need to select the appropriate journal template when preparing their article and the list of references and citations to these will be formatted according to the journal style as described in this Guide. The process of including templates in these packages is constantly ongoing. If the journal you are looking for does not have a template available yet, please see the list of sample references and citations provided in this Guide to help you format these according to the journal style.

If you manage your research with Mendeley Desktop, you can easily install the reference style for this journal by clicking the link below: http://open.mendeley.com/use-citation-style/computer-aided-design when preparing your manuscript. You will then be able to select this style using the Mendeley plugins for Microsoft Word or LibreOffice. For more information about the Citation Style Language, visit http://citationstyles.org.

Reference style guidelines:

Text: Indicate references by number(s) in square brackets in line with the text. The actual authors can be referred to, but the reference number(s) must always be given.

List: Number the references (numbers in square brackets) in the list in the order in which they appear in the text.

Examples:

Reference to a journal publication:

[1] Van der Geer J, Hanraads JAJ, Lupton RA. The art of writing a scientific article. J Sci Commun 2010;163:51–9.

Reference to a book:

[2] Strunk Jr W, White EB. The elements of style. 4th ed. New York: Longman; 2000.

Reference to a chapter in an edited book:

[3] Mettam GR, Adams LB. How to prepare an electronic version of your article. In: Jones BS, Smith RZ, editors. Introduction to the electronic age, New York: E-Publishing Inc; 2009, p. 281–304.

Note shortened form for last page number. e.g., 51–9, and that for more than 6 authors the first 6 should be listed followed by 'et al.' For further details you are referred to 'Uniform Requirements for Manuscripts submitted to Biomedical Journals' (J Am Med Assoc 1997;277:927–34) (see also http://www.nlm.nih.gov/bsd/uniform_requirements.html).

Journal abbreviations source

Journal names should be abbreviated according to the List of Title Word Abbreviations: http://www.issn.org/services/online-services/access-to-the-ltwa/.

Appendix V –Declaration Form

The signed declaration form that follows should be first page after your report's cover sheet

DECLARATION

I hereby, declare that this manuscript, entitled "*title of thesis",* is the result of my own work except for quotations and citations which have been duly acknowledged.
I also declare that, to the best of my knowledge and belief, it has not been previously or concurrently submitted, in whole or in part, for any other degree or diploma at Nazarbayev University or any other national or international institution.

(signature of author)

Name:
Date:

Appendix VI –Conflict of Interest

Definitions:

Conflict of interest - refers to a conflict between official University duties and private interests and personal relationships, where the private interests or personal relationships could improperly influence the way in which a person carries out their official duties.

Perceived conflict of interest - where a reasonable person might perceive that such improper influence as described above could exist.

Personal relationships - relationships with individuals or people that extend outside of the University or University duties, or a relationship where a reasonable person might perceive that there could be some bias, either positive or negative, resulting from that relationship. These include relationships with:

1. immediate family, e.g. spouse or partner, parents, children, step-children, etc.;
2. close relatives, e.g. aunts, uncles, cousins, nephews, nieces etc.;
3. rivals, e.g. competitors or persons with whom one has a history of serious conflict or enmity; and
4. all other relationships that could introduce bias in carrying out official duties.

Private interests - refers to any interests that involve potential gain or loss (financial or non-financial) for an individual or for any other person or organization that individual may wish to benefit (e.g. family, friends, associates) or disadvantage (e.g. competitors, rivals).

Rules and Guidelines:

1. All individuals are responsible for identifying, declaring, and managing conflicts of interest that apply to them.
2. Conflicts of interest may affect or have the appearance to affect sound and professional judgement adversely. Conflicts of interest or perceived conflicts of interest must be declared and managed to ensure integrity and transparency.
3. Staff members, students and other individuals who are charged with carrying out University activities and functions have a responsibility to declare and manage conflicts of interest as they arise. When declared, the conflict of interest should be avoided. Where this is not possible, action must be undertaken to ensure that the conflict (or perceived conflict) is managed in a transparent and appropriate manner.
4. Supervisors, chairs of committees/panels/groups and other responsible parties are accountable for ensuring that declared conflicts of interest, real or perceived, are evaluated and managed appropriately.
5. Declarations of conflict of interest should be made by individuals in writing to the relevant supervisor, chair of a committee/panel/group, other relevant person, or body as soon as the conflict is identified. Where circumstances prevent an immediate written declaration (e.g. conflict arises during a meeting), a verbal declaration should be lodged and, if possible, formally noted (e.g. in minutes of the meeting).

6. Where a supervisor, chair of a committee/panel/group, other relevant person or body becomes aware of a conflict of interest (or perceived conflict of interest) that has not been declared they should discuss the matter with the individual and take appropriate actions.
7. The best way in which to handle a conflict of interest is to avoid it. Where it is not possible to avoid a conflict of interest, the MSc MAE committee, the Head of Department, and the School's Dean and Vice-Dean should be responsible for assessing the risk and taking appropriate actions.