UNT
Department of Mechanical Engineering

Graduate Handbook
for M.S. and Ph.D. students in Mechanical Engineering

Version 4.0

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Physical Address
Discovery Park, University of North Texas Suite F115
3940 North Elm, Denton, Texas 76207

Mailing address
1155 Union Circle #311098; Denton, Texas 76203

Phone: 940-565-2400

mechanical@unt.edu

1. INTRODUCTION

This bulletin provides information about the current practices and policies of the Department of Mechanical Engineering concerning graduate studies. It is the responsibility of each Graduate Student to familiarize himself or herself with these practices and policies and to ensure that all procedures relating to his or her degree have been fulfilled. Additionally, the student is expected to be thoroughly familiar with general requirements as detailed in this Graduate Bulletin.

The Department of Mechanical Engineering offers three graduate degrees:

1. M.S. in Mechanical Engineering
2. M.S. in Engineering Management
3. Ph.D. in Mechanical Engineering

2. ADMISSION

Applicants are encouraged to apply to admission through the procedures outlined at Toulouse Graduate School (tgs.unt.edu) and concurrently submit a vita, GPA, test score for English Language Requirements, GRE score, statement of purpose, and recommendation letters to the Graduate Advisor (GA) of Mechanical Engineering via https://engineering.unt.edu/webforms/submission-graduate-application-documents.

Admission Procedures

Students must apply to the Toulouse Graduate School and meet the minimum requirements for graduate admission to the university. Students must also meet the requirements of the Department's for graduate admission into the program.

1. Review the admission criteria for Toulouse Graduate School
2. Fill out the online application.
3. Have official transcripts, GRE scores and any necessary supplemental materials sent to UNT.
4. International applicants will need to supply proof of English proficiency as well as supply other additional documents. Read more about these requirements by visiting the UNT-International website.
5. After receiving and setting up your UNT EUID, submit your supplemental documents to the department online.

Students must also submit the following materials directly to the Toulouse Graduate School:

- Official transcripts, degrees and academic documentation from all schools attended; should be submitted both in English and applicant's native language If native language is not English
- Minimum 3.0 GPA in undergraduate coursework (for MS applicants or Ph.D. applicants with BS degree) and minimum 3.5 GPA in previous university coursework (for Ph.D. applicants with MS degree)
- Standardized test scores (sent via ETS) including GRE and TOEFL (for international students)
- Acceptable general GRE scores. Successful applicants to Mechanical Engineering typically present scores of 155 or higher on the Quantitative section and 146 or higher on the Verbal section.

Students must also submit the following supplemental materials directly to the ME Department:

- A detailed resume that includes educational experience, relevant work history and research experience
- GPA in previous university coursework.
- GRE Scores
- Three letters of recommendation (The Letters of recommendation must be sent in directly by the person recommending the applicant.)
- A Statement of purpose

- Check the mandatory scores accepted by the university for English Language Requirements.

The department uses holistic criteria for admissions. The GRE, GPA, publications and research experience are all considered in the admission process.

Priority Dates

Fall Applicants: We begin awarding assistantship funding on December 15th each year. To be considered for all funding opportunities, submit all required application materials by December 15th.
Spring Applicants: We begin awarding assistantship funding on May 15th each year. To be considered for all funding opportunities, submit all required application materials by May 15th.
Things to Note:

- The application to the Toulouse Graduate School does not come instantly to the department once completed. There is a process the Graduate School takes before they mail the application to the department physically. Please allow up to, possibly, two weeks for it to get to the department. Please contact the Toulouse Graduate School in regard to a timeline and their official deadlines.
- Once the application is completed, the committee will meet and respond with a decision as soon as possible. Expediting is not guaranteed, but will be considered under request and provided a reason (outside of late application).
- Staff and faculty cannot provide detailed updates in regards to application process but please feel free to reach out with inquiries or concerns for:
  Ph.D. Degree to Dr. Hamid Sadat, the faculty member you are interested in researching with, or MechanicalGraduate@unt.edu.
  M.S. Degrees to Dr. Huseyin Bostanci, the faculty member you are interested in researching with, or MechanicalGraduate@unt.edu.

Transfer credit policies and procedures

For applicants transferring to ME graduate program from graduate programs in other institutes, if admitted, courses can be transferred under following rules:

1. The institute from which credit is to be transferred must be accredited.
2. Upon graduate committee approval, courses will be transferred on the same level and with the corresponding number of hours as earned at the other institution. Courses that do not correspond to courses offered at ME may transfer as elective course.
3. Courses taken at other institutions in which grades are below B are not transferable or applicable toward degree requirements.

3. PLANNING YOUR DEGREE

3.1 M.S. Degree

All students pursuing the master's degree in the Department of Mechanical Engineering must plan their degree program with the assistance of the graduate advisor, major professor and their advisory committee as applicable. The requirement for graduation is at least 30 semester credit hours for Thesis option or 33 credit hours for Non-thesis option. The student needs to maintain at least a B average in all graduate courses.

All M.S. Students must select one of the concentrations (areas of specialization) in their respective degree programs.

- **MS in Mechanical Engineering** has thesis and non-thesis options with concentrations in (1) Materials and Manufacturing, (2) Mechanics, Mechanical Systems and Design, (3) Thermal-Fluids Systems, (4) Energy, Environment and Sustainability, (5) Infrastructure.
- **MS in Engineering Management** has only non-thesis option with concentrations in (1) General Engineering Management, (2) Construction Management, (3) Energy Management.

Thesis Option (30 Credits)

The graduate credit requirement for the thesis option of the MS degree is 30 semester credit hours taken as follows:

1. Twelve hours of coursework from the required core courses in one of the concentrations listed in Appendix C.
2. Twelve hours of coursework chosen from graduate level (5000 or higher) courses offered by the Department of Mechanical Engineering and related departments. Of these, at least 6 hours of coursework chosen from the elective courses in one of the concentrations listed in Appendix C (at least 18 hours of coursework from required core and elective courses must come from the Department of Mechanical Engineering courses). The selection of courses should be done with the approval of the student's major professor and graduate advisor. A maximum of 3 hours of directed study (MEEN 5890) is allowed as part of the coursework. Students taking directed study courses must submit a report.
3. Six hours of master's thesis (MEEN/MSET 5950). Work for the master's thesis is comprised of an independent and original study. As part of these requirements, the student must present and defend a written thesis that must be approved by the major professor and the advisory committee and filed with the graduate dean's office. The thesis must conform to the graduate school requirements, which may be found at www.tgs.unt.edu. It is expected that this material will be of archival quality.
4. An oral presentation of the master's thesis is required. A decision on acceptance of the thesis will be made by the student's advisory committee. For the thesis format, additional preparation guidelines can be found on the website of the graduate school.
5.Students must also register and attend seminar (MEEN 5940) for one semester.

Non-thesis Option (33 Credits)

The graduate credit requirement for the non-thesis option of the MS degree is 33 semester credit hours taken as follows:

1. Twelve hours of coursework from the required core courses in one of the concentrations listed in Appendix C.
2. Twenty-one hours of coursework chosen from graduate level (5000 or higher) courses offered by the Department of Mechanical Engineering and related departments.
    - MS Mechanical Engineering students should take at least 12 hours of coursework from the elective courses in one of the concentrations listed in Appendix C (at least 24 hours of coursework from required core and elective courses must come from the Department of Mechanical Engineering courses).
    - MS Engineering Management students should take at least 15 hours of coursework from the elective courses in one of the concentrations listed in Appendix C (at least 18 hours of coursework from required core and elective courses must come from the Department of Mechanical Engineering courses).

The selection of courses should be done with the approval of the student's major professor and graduate advisor. A maximum of 6 hours of directed study (MEEN 5890) is allowed as part of the coursework. Students taking directed study courses must submit a report.

3. Students must also register and attend seminar (MEEN 5940) for one semester.

3.2 Ph.D.

All students pursuing the doctoral degree with a major in Mechanical engineering must plan their degree program with the assistance of their major professor and their advisory committee. The requirement for graduation is at least 72 semester credit hours beyond the bachelors and 42 semester credit hours beyond masters in ME. For students entering the PhD program with a master degree in other majors, up to 30

hours can be transferred to their PhD program upon graduate committee approval. The student needs to maintain at least a B average in all graduate courses.

Students entering the PhD with a major in Mechanical engineering with a bachelor of science must complete 72 semester hours at the graduate level as follows:

1. Twelve semester credit hours of core courses chosen from core courses listed in Appendix D.
2. A minimum of 24 semester credit hours of electives from courses offered by Mechanical Engineering department listed in Appendix D and related fields (See examples in Appendix E). Courses are selected with approval of the student's dissertation advisor and graduate advisor.
3. Up to 21 hours of research credits
4. Up to 3 hours of seminar
5. A minimum of 12 hours of dissertation (MEEN 6950) credit hours that can be registered for only upon the successful completion of the PhD qualifying examination (both written and oral qualifying exams).

Students entering the PhD with a major in Mechanical engineering with a master of science must complete at least 42 semester credit hours of course work as below.

1. Twelve semester hours of core courses chosen from core courses listed in Appendix D.
2. A minimum of 12 semester credit hours of electives from courses offered by Mechanical Engineering department listed in Appendix D and related fields (See examples in Appendix E). Courses are selected with approval of the student's dissertation advisor and graduate advisor.
3. Up to 6 hours of research credits
4. Up to 3 hours of seminar
5. A minimum of 9 hours of dissertation (MEEN 6950) credit hours that can be registered for only upon the successful completion of the PhD qualifying examination (both written and oral qualifying exams).

Students entering the PhD program with a master degree in other majors might be required to complete more than 42 semester credit hours by taking additional core and elective courses, depending on the number of the transferred credit hours approved by the graduate committee. Additional courses are selected with approval of the student's dissertation advisor and graduate advisor.

4. TYPICAL SEQUENCE

a. Typical Sequence for M.S. Students (Thesis Option)

6 months - 1 year before intended admission date	Apply to Graduate Program (apply directly through www.tgs.unt.edu)
Week before classes begin	Attend Orientation for new graduate students
First Year	First semester: Work with graduate advisor to select courses based on specific program and concentration for first semester Second semester: By the end of eight weeks 1. Choose Major Professor 2. Major Professor selects Master's Thesis Committee 3. File Degree Plan
Second Year	Third semester of degree: 1. Submit conference paper 2. Submit journal paper 3. Begin writing thesis Fourth semester: 1. File for graduation 2. Plan possible defense dates and times with advisor and committee members schedule 3. Complete the thesis and submit to thesis committee for review 7 business days before defense date 4. Present department seminar 5. Publish abstract and defense announcement 1 week ahead of defense date

Details of sequence and timing will depend on your progress and will be arranged between you and your major professor.

b. Typical Sequence for M.S. Students (Non-Thesis Option)

6 months - 1 year before intended admission date	Apply to Graduate Program (apply directly through www.tgs.unt.edu)
Week before classes begin	Attend Orientation for new graduate students
First Year	First semester: Work with graduate advisor to select courses based on specific program and concentration for first semester Second semester: By the end of eight weeks 1. Choose professor(s) to do directed study coursework with. The student can list these faculty as their major advisor. Alternatively, if a degree plan is chosen with no directed course-work selected, the graduate advisor will function as the major advisor 2. Work with graduate advisor to complete degree plan 3. File Degree Plan
Second Year	Third semester of degree: 1. Continue coursework Fourth semester: 1. File for graduation 2. Complete coursework

c. Typical Sequence for Ph.D. Students

6 months - 1 year before intended admission date	Apply to Graduate Program (apply directly through www.tgs.unt.edu)
Week before classes begin	Attend Orientation for new graduate students
First Year	First semester: Take core and elective courses By the end of 10 weeks 1. Choose Major Professor 2. Major Professor selects Doctoral Dissertation Committee 3. Begin active research Second semester 1. End of six weeks, file Degree Plan 2. Plan a poster or conference paper 3. Appear for written qualifier examinations in two subjects
Second Year	Continue active research By the end of the first semester following successful completion of both written qualifier exams, present proposal of Ph.D. research to committee Student completing the written qualifier and oral proposal will be qualified for candidacy Outline journal paper and submit for publication
Third Year	Continue active research Outline journal paper and submit for publication Present department seminar
Fourth Year	Continue active research Complete dissertation Semester of graduation 1. File for graduation 2. Plan possible defense dates and times with advisor and committee members schedule 3. Complete the thesis and submit to committee for review 7 business days before the defense date 4. Present department seminar 5. Publish abstract and defense announcement 1 week ahead of defense date

Details of sequence and timing will depend on your progress and will be arranged between you and your major professor.

5. PHD QUALIFYING EXAM, PROPOSAL DEFENSE, AND PHD CANDIDACY

1. Within one year of being admitted in the doctoral program, the student should do two written qualifying examinations in two topics among **General Energy, Thermodynamics/Heat Transfer, Fluid Mechanics, Solid Mechanics, Structures, Materials Manufacturing, and Vibrations/Controls**. A passing grade corresponds to achieving a 90 or above in the written exam. Students obtaining between 70 and 89 will be offered a supplementary oral exam before the committee corresponding to the area being tested. The committee will weigh the written and oral exam to determine whether the student has successfully qualified.
2. After passing the written qualifying exam, students are required to complete and defend an original research proposal in the form of an oral exam that, if executed, would lead to a PhD dissertation. The proposal oral exam should be evaluated by the major advisor and dissertation committee members. Students must pass the oral qualifying exam within two semesters after passing the written qualifying exam.
3. On passing the written qualifier and oral research proposal examination by the examination committee, the applicant is admitted to candidacy.

6. MS AND PHD DISSERTATION DEFENSE AND FINAL THESIS SUBMISSION

PhD students can take the dissertation course (MEEN 6950) upon the successful completion of the PhD qualifying examination (both written and oral qualifying exams). The student must register for dissertation every semester until they are ready to give an oral dissertation presentation to the dissertation committee and open to the public. The dissertation must be submitted to the committee at least seven days before the oral defense and dissemination of the time and place of the presentation made available to the ME faculty and students. The students will revise the dissertation following the suggestions of the thesis committee and submit the final dissertation to the graduate school of UNT. The thesis must be prepared following the guideline provided by the graduate school (https://tgs.unt.edu/thesis-manual).

7. RESEARCH AND FINAL COMPREHENSIVE EXAMINATION

A comprehensive examination is required by the University for all graduate students at the completion of their graduate studies. This examination is administered by the student's committee and the results are reported to the Dean of the Toulouse Graduate School. Each student should check the University calendar to meet required deadlines.

Ph.D. dissertations and M.S. theses must be of scientific significance and suitable for publication in refereed scientific journals. A final oral examination is required which will be primarily a defense of the thesis or dissertation. For a Ph.D. candidate, it is required that at least two papers will have been accepted by a refereed journal by the time of the oral defense on a topic related to his/her dissertation. A copy of the manuscript published or under consideration should be submitted with the dissertation to his/her dissertation committee. For a MS thesis student, it is expected that at least one refereed paper (a journal article or conference proceeding) will have been accepted by the time of the oral defense on a topic related to his/her thesis.

8. PASS-THROUGH M.S. PROCEDURE

This option is available to Ph.D. students who did not successfully pass the qualifying exam. After consultation with his/her major advisor and committee, the student must
notify the ME Graduate Advisor about their desire to pursue this option, change their major through

Toulouse Graduate School, prepare a M.S. degree plan on a selected concentration and complete the new degree requirements.

Policies and Procedures for Student Termination from Programs

There are circumstances under which a student may be removed from either the M.S. or Ph.D. program.

- Ph.D. Qualifying Exam- If a Ph.D. student does not satisfactorily complete the qualifying exam and use the option of pass-through M.S., the graduate advisor will notify the Toulouse Graduate School.
- M.S. Thesis/Ph.D. Dissertation Defense- If the student's Advisory Committee decides that the student has failed in the defense, the Major Advisor will so notify the student and the Toulouse Graduate School.

9. SELECTION OF A MAJOR PROFESSOR AND ADVISORY COMMITTEE:

Usually by the end of the initial semester in graduate school, and certainly by no later than the end of the first year, the student will be expected to determine his or her specialization and choose a major professor. The selection of a major professor for a M.S. (thesis option) or Ph.D. student should be done only after having interviewed all of the research faculty in the student's major area of interest. When the selection has been made, the direct supervision of the student's program and progress toward the degree sought will be transferred to his major professor.

After consultation with the student, the major professor will propose an advisory committee to the GA for approval; the GA will then submit the committee names to the Graduate Dean for approval. It is imperative that this committee be selected and approved as soon as possible after selecting a major professor because the committee (which includes the major professor as chair) determines the course curriculum for the student.

The minimum requirements for a M.S. advisory committee must be at least three members (including the major professor). The committee should comprise a majority of Mechanical Engineering faculty having an appointment greater than 50% in the ME department. External committee members having industrial or application expertise in the area of research are encouraged. A graduate associate faculty status for the duration of the student’s degree can be filed by providing a vita of the external member to the ME graduate advisor.

The minimum requirements for a Ph.D. advisory committee must be at least five members (including the major professor). The committee should comprise a majority of Mechanical Engineering faculty having an appointment greater than 50% in the ME department. External committee members having industrial or application expertise in the area of research are encouraged. A graduate associate faculty status for the duration of the student’s degree can be filed by providing a vita of the external member and a description of how the external committee member enhances the evaluation of the dissertation to the ME graduate advisor.

10. REQUIREMENT FOR SUCCESSFUL CONTINUATION IN PROGRAM AND ACADEMIC ADVISING

All graduate students should use the typical sequences outlined for each program as guidelines. All full-

time graduate students are required to take a full load, as determined by the Department. Students receiving departmental or grant support must be full-time students.

An average of "B" must be maintained in all formal graduate courses taken by graduate students. Special Problems, Seminar, Thesis, or Dissertation courses are not included in computing the grade point average. Graduate School policy states that a student who does not maintain a "B" average (as defined above) may be suspended. Such a decision is made by the Toulouse Graduate School, after consultation with the Mechanical Engineering Department.

All full-time graduate students should take core and required courses in consultant with the major advisor. The degree plan must be filed in the first semester for M.S. students and in the second semester for Ph.D. students to provide a roadmap. The degree plan should be followed closely during the study. By the end of the second year, PhD students should take written qualifier examinations in two subjects. By the end of the first semester following successful completion of both written qualifier exams, PhD students need to present proposal of Ph.D. research to committee and get their approval.

Seminar Program:

The seminar program is a valuable part of a student's training, as it gives direct exposure to research areas outside the student's immediate interest. All graduate students should attend seminar to be informed about contemporary context to their research. Attendance at Departmental Seminars (defined as those given by UNT faculty and visiting speakers and student seminars) is compulsory unless the student has a conflict with a class or teaching assignment, in which case the Seminar Chair should be informed in advance. Taking seminar in three different semesters are considered part of their PhD degree plan (one seminar for MS) and during semesters when they are enrolled, they should follow additional requirements outlined by the seminar coordinator.

All Ph.D. students should give a departmental wide seminar during his/her third year. The seminar should be on a topic related to student's research is presented to all of the graduate students, his/her committee and to other faculty in the department. This talk will be part of the department's MEEN 5940 seminar program and should be coordinated with the Seminar Chair.

Although the major responsibility resides with the major professor in academic decisions concerning the student's status in graduate school, the GA will monitor the student's progress to ensure minimal standards are being met.

11. FINANCIAL ASSISTANCE

Financial support for graduate students is provided in a number of ways in the Mechanical Engineering Department which include: (a) teaching assistantships, instructional assistants-graders, instructional assistants-technicians, (b) research fellowships made available through research grants to individual faculty members, (c) individual student scholarships or awards available to qualified students from a variety of agencies both public and private, and (d) a number of fellowships and scholarships are often awarded through the College of Engineering, Toulouse Graduate School and the Department of Mechanical Engineering.

As full-time students in the department, TAs, graders, employees not only fulfill their work obligations, but work on their courses and research. All of these combined are considered to be a full-time activity. Therefore, students employed through department financial assistance, are not permitted to have other

simultaneous outside employment unless prior approval has been obtained from the Department.

Awarding of the TAs and graders depends on students' qualification and is recommended in each semester by the graduate committee per UNT policy 06.021. Students' academic and research performance as well as TA performance will be evaluated in each semester and only qualified students will renew their positions. Continuation of funding for TA is subject to passing qualifying exams, good TA performance, and good academic standing.

12. TRAVEL GRANT OPPORTUNITIES

The University of North Texas offers a limited number of competitive awards to selected graduate students to support student research, seminar or presentation opportunities. Funding options include:

- Department Student Travel funding – Apply here: Forms | Mechanical Engineering (unt.edu) *(At bottom of page, click on Travel Request for online submittal).*
- College Student Travel funding – Apply here: https://engineering.unt.edu/students/scholarships
- Toulouse School of Graduate Studies Travel Grant - Apply here: https://tgs.unt.edu/new-current-students/travel-grants

For additional information , contact Graduate Specialist within Department of Mechanical Engineering Main office, or email: mechanicalgraduate@unt.edu

APPENDIX A – Sample Thesis or Dissertation Oral Defense Announcement: to be posted 7 days before defense.

Master's Degree Thesis Defense Announcement

Friday, March 13, 11:00AM at MEE Conference room

Continuum Model for Effective Properties of Orthotropic Truss Lattice Materials

Adithya Challapalli[1] (Thesis advisor: Dr. Jaehyung Ju)

Abstract: Cellular materials, often called lattice materials, are increasingly receiving attention for their ultralight structures with high specific strength, excellent impact absorption, acoustic insulation, heat dissipation media and compact heat exchangers. In alignment with emerging additive manufacturing (AM) technology, realization of the structural applications of the lattice materials appears to be becoming faster. Considering the direction dependent material properties of the products with AM, by directionally dependent printing resolution, effective moduli of lattice structures appear to be directionally dependent. In this paper, we develop a constitutive model of a lattice structure, which is an octet-truss with a base material having an orthotropic material property considering AM. One case study is conducted with an orthotropic property of a base material in 3D Printing. A polyjet based 3D printing material having an orthotropic property with a 9% difference in the principal direction provides difference in the axial and shear moduli in the octet-truss by 2.3 and 4.6%. Experimental validation of the effective properties of octet-truss is done for uniaxial compression test are conducted with a 3D printed octet-truss with a photo-polymer (Procast, 3D Systems). The theoretical values based on the micro-buckling of truss member are used to estimate the failure strength well. Modulus value appears a little overestimate compared with the experiment. Finite element (FE) simulations on uniaxial loading (both compression and tension) of octet-truss lattice materials are conducted. New effective properties and strengths for the octet-truss lattice structure were developed considering the observed behavior of the octet-truss structure under macroscopic compression and tension.

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[1] **A.Challapalli** and J. Ju, 2014, Continuum Model for Effective Properties of Orthotropic Octet-Truss Lattice Materials, In *Proceedings of the ASME International Mechanical Engineering Congress and Exposition*, IMECE2014-38925, Montreal, Canada.

A. Challapalli, SAMPE National Student Additive Manufacturing Contest, Seattle, WA, 06/2014, **2nd Place** ($500) online

APPENDIX B – Ph.D. Qualifier guidelines

Students are to pass exams in two of the topics listed below. For students entering the PhD program Fall 2017 and forward they will have 2 years to successfully pass the qualifying exam and be admitted to Ph.D. candidacy. Students admitted prior to Fall 2017 and transferring from the MTSE-MEE program will be afforded some flexibility as determined on an individual basis by the MEE graduate committee.

Students can review the reading list and meet with the lead faculty to get additional advice on valuable reading material or courses they could do prior to doing the qualifier.

1. Solid Mechanics

Courses relevant to the exam: ENGR 2332; MEEN5410
Textbooks which can be used for the qualifying exam:
Arthur P. Boresi and Richard J. Schmidt, Advanced Mechanics of Materials, 6th Edition (currently used for MEEN 5410 "Advanced Solid Mechanics")

Topics which can be covered for the qualifying exam (Solid Mechanics):
- Elementary Mechanics of Materials (Axial Loading, Bending, Torsion, Column Buckling, Plastic Deformation)
- Stress, Strain, Constitutive Relations, Stress decomposition (volumetric and distortional)
- Failure Criteria including Fracture and Fatigue
- Energy Methods
- Theory of Elasticity

2. Materials and Manufacturing

Courses relevant to the area: MEEN 3100, MEEN 5800.002 (Bioproducts)
Fundamentals of Modern Manufacturing by Groover 6th Edition. ISBN 9781118231463

Topics to be covered:
- Dimensional characteristics, inspection, and product Quality Assurance
- Metal Casting
- Bulk Deformation
- Sheet Metal Forming
- Materials Removal Processes
- Polymer Processing
- Powders Processing
- Joining Processes
- Microelectronics Processing

3. Thermal/Heat Transfer

Courses relevant: MEEN2210 and MEEN 3210
Textbook 1 (Thermodynamics): *Fundamentals of Engineering Thermodynamics*, 7th Edition, ISBN-13: 978-0470495902
by Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner and Margaret B. Bailey.
Topics to be covered:
Energy and the first law of thermodynamics
Evaluating properties
Control volume analysis
The second law of thermodynamics; using entropy

Textbook 2 (Heat Transfer): *Fundamentals of Heat and Mass Transfer*, 6th Edition, ISBN-13: 978-0471457275, by Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine

Topics to be covered:
Steady state conduction (One and two-dimensional)
Transient conduction
Forced convection: internal / external flow
Free (Natural) Convection

4. Fluid Mechanics

Courses relevant: MEEN 3120
Textbook: Fundamentals of Fluid Mechanics by Munson et al., ISBN 978-0-470-26284-9; Fluid Mechanics by F. White, ISBN 0077422414

Topics to be covered:
Governing equations
Control volume analysis
Dimensional analysis
2-D potential flows
Exact solutions of viscous flows of incompressible flows
Boundary layer analysis
Buoyancy-driven flows

5. Vibrations/Controls:

Courses relevant: MEEN3230, MEEN4160 and MEEN 5600
Reference textbook:
William J. Palm III, Modeling, Analysis, and Control of Dynamic Systems, 2nd Ed., John Wiley & Sons, Inc.
D. Inman, "Engineering Vibration," 3rd Ed. Prentice Hall.
Rao, “Mechanical Vibrations”, Fifth edition, Prentice Hall

Topics to be covered:
Modeling of mechanical, electrical, fluid, thermal and mixed energy domain systems (in state-variable or input-output form).
Derivation and analysis of system response in time domain. Solution of system response using the Laplace transform method. The effect of system parameters on system response and stability.
Transfer function. Frequency response analysis of a system. Bode plots.
Mechanical vibration: free vibration, harmonic excitation, general force excitation.
Vibration suppression.
Feedback control system for a linear time-invariant system. PID (proportional - integral - derivative) control. Lead-lag and lag-lead control.
Design of a control system using frequency response. Gain margin, phase margin and bandwidth.

6. Energy:

Textbook: Principles of Sustainable Energy Systems by Frank Kreith and Susan Krumdieck, ISB#13:978-1-4665-5696-6, 2014, CRC Press (Taylor & Francis).

Courses relevant: MEEN 5110 Alternative energy

References:

B. K. Hodge, “Alternative Energy Systems and Applications,”

Topics to be covered:
Basic concepts: Energy production to consumption; Sustainability index
Efficiencies: Thermodynamic limits; Heat transport; Conversions
Fossil fuels, energy, and economics: Fuel types, production, environmental and economic impacts
Solar Energy: System types, performance criteria, and potentials
Wind Energy: Resources, conversion principle, measures of sustainability
Commercial and Residential Buildings: Energy efficiency strategies; Building materials; heat transfer in building design
Energy storage: mechanical and thermal energy storage, batteries, super capacitors, and fuel cells.

Open subject: Technical, environmental and economic challenges of one of the energy forms other than those listed above (e.g., transportation, ocean, geothermal, hydropower, etc.)

7. Structure:

Courses relevant to the exam: ENGR 2332; CNET 3430
Textbooks which can be used for the qualifying exam:
Arthur Keith D. Hjelmstad, Fundamentals of Structural Mechanics, 2nd Edition, Springer, ISBN 978-0-387-23330-7

Topics which can be covered for the qualifying exam (Structural Engineering):
- Kinematics of deformation
- Stress and equilibrium of deformable structures
- Material models
- Matrix method for structural analysis
- Structural mechanics of beams, columns, trusses.
- Static stability of structures

APPENDIX C –Required and Elective Courses for MS Programs

M.S. in Mechanical Engineering (MS ME)

1. **Materials and Manufacturing** Concentration

- *Required core courses*

MEEN 5410 Advanced Solid Mechanics
MEEN 5520 Manufacturing Concepts for Mechanical Engineers
MSET 5020 Design of Experiments
MTSE 5100 Fundamental Concepts of Materials Science

- *Elective courses*

MEEN 5440 Finite Element Analysis
MEEN 5151 Bioproducts Manufacturing
MEEN 5152 Mechanics of Composites and Foams for Lightweight Structures
MEEN 5420 Continuum Mechanics
MEEN 5315 Nanoscale Energy Transport
MEEN 5750 Automotive Manufacturing
MEEN 5760 Robotics and Automation
MEEN 5480 Energy Materials
MSET 5030 Product Design and Development
MSET 5130 Product Reliability and Quality
MSET 5150 Applications of Electron Microscopy and Failure Analysis
MSET 5160 Creep & Fatigue in Engineering Design & System Performance
MTSE 5020 Mechanical Properties of Materials
MTSE 5400 Advanced Polymer Physics and Chemistry
MTSE 5550 Materials and Mechanics for MEMS Devices
MTSE 5710 Computational Materials Science
MTSE 6110 Applied Fracture Mechanics

2. **Mechanics, Mechanical Systems and Design** Concentration

- *Required core courses*

MEEN 5140 Advanced Mathematical Methods for Engineers
MEEN 5410 Advanced Solid Mechanics
MEEN 5600 Feedback Control of Dynamic Systems
MEEN 5640 Mechanical Vibrations

- *Elective courses*

MEEN 5440 Finite Element Analysis
MEEN 5420 Continuum Mechanics
MEEN 5800 Topics in Mechanical and Energy Engineering: Computer Aided Engineering
MEEN 5760 Robotics and Automation
MSET 5020 Design of Experiments
MEEN 5152 Mechanics of Composites and Foams for Lightweight Structures
MEEN 5610 Sensors & Actuators
MEEN 5470 Geothermal Heat Pumps
MSET 5030 Product Design and Development
MSET 5130 Product Reliability and Quality
MSET 5310 Industrial Process Control
MTSE 6110 Applied Fracture Mechanics

4. **Thermal-Fluid Systems** Concentration

- *Required core courses*

MEEN 5140 Advanced Mathematical Methods for Engineers

MEEN 5300 Advanced Thermodynamics
MEEN 5311 Convective Heat Transfer II
MEEN 5340 Advanced Fluid Mechanics

- *Elective courses*
MEEN 5000 Energy: The Fundamentals
MEEN 5110 Renewable Energy
MEEN 5200 Principles of HVAC
MEEN 5220 Computational Fluid Dynamics and Heat Transfer
MEEN 5310 Conduction and Radiation Heat Transfer
MEEN 5315 Nanoscale Energy Transport
MEEN 5330 Combustion Science and Engineering
MEEN 5470 Geothermal Heat Pumps
MEEN 5800 Topics in Mechanical and Energy Engineering: Turbulent Flow
MEEN 5800 Topics in Mechanical and Energy Engineering: Optics and Radiation
MSET 5170 Thermal Management

4. **Energy, Environment and Sustainability** Concentration

- *Required core courses*
MEEN 5140 Advanced Mathematical Methods for Engineers
MEEN 5000 Energy: The Fundamentals
MEEN 5110 Renewable Energy
MEEN 5800 Energy Harvesting

- *Elective courses*
MEEN 5112 Nuclear Energy
MEEN 5150 Thermal Energy Storage Systems and Applications
MEEN 5200 Principles of HVAC
MEEN 5311 Convective Heat Transfer II
MEEN 5315 Nanoscale Energy Transport
MEEN 5480 Energy Materials
MEEN 5240 Energy: A World Perspective
MEEN 5310 Conduction and Radiation Heat Transfer
MEEN 5330 Combustion Science and Engineering
MEEN 5332 Air Pollution Control Engineering
MEEN 5470 Geothermal Heat Pumps
MEEN 5210 Solar Energy
BIOL 6341 Advanced Environmental Impact Assessment
EENG 5350 Renewable Electrical Power Systems

5. **Infrastructure** Concentration

- *Required core courses**
MEEN 5410 Advanced Solid Mechanics
MSET 5220 Building Information Modeling
MSET 5180 Structural Dynamics
MEEN 5440 Finite Element Analysis

- *Elective courses**
MSET 5260 Integrative Construction Management
MSET 5020 Design of Experiments
MSET 5030 Product Design and Development
MSET 5130 Product Reliability and Quality
MEEN 5140 Advanced Mathematical Methods for Engineers
MEEN 5520 Manufacturing Concepts for Mechanical Engineers

MEEN 5420 Continuum Mechanics
MTSE 5100 Fundamental Concepts of Materials Science
MEEN 5152 Mechanics of Composites and Foams for Lightweight Structures
MSET 5250 Sustainable & Lean Construction
**Tentative course selection*

M.S. in Engineering Management (MS EM)

1. **General Engineering Management** Concentration

- *Required courses*
MSET 5020 Design of Experiments
MSET 5030 Product Design and Development
MSET 5130 Product Reliability and Quality
MSET 5050 Engineering Project Management

- *Elective courses*
MSET 5060 Technology Innovation
MSET 5250 Management in Human & Societal Development
MGMT 5300 Entrepreneurship & Venture Management
MGMT 5760 Strategic Management
MGMT 5140 Organization Behavior and Analysis
MGMT 5710 Seminar in Business Ethics and Social
MGMT 5660 International Management

2. **Construction Management** Concentration

- *Required core courses*
MSET 5220 Building Information Modeling
MSET 5200 Advanced Construction Scheduling
MSET 5230 Risk Management in Construction
MSET 5240 Heavy Civil Construction Management

- *Elective courses*
MSET 5020 Design of Experiments
MSET 5050 Engineering Project Management
MSET 5060 Technology Innovation
MSET 5130 Product Reliability and Quality
MSET 5250 Management in Human & Societal Development
MGMT 5300 Entrepreneurship & Venture Management
MGMT 5760 Strategic Management

2. **Energy Management** Concentration

- Required core *courses*
MEEN 5240 Energy: A World Perspective
MEEN 5000 Energy: The Fundamentals
MEEN 5110 Alternative Energy
MEEN 5800 Energy and Environmental Sustainability

- *Elective courses*
MSET 5020 Design of Experiments
MSET 5050 Engineering Project Management
MSET 5060 Technology Innovation
MSET 5130 Product Reliability and Quality
MSET 5250 Management in Human & Societal Development
MGMT 5300 Entrepreneurship & Venture Management
MGMT 5760 Strategic Management

APPENDIX D – Required and Elective Courses for PhD Program

PhD Program Courses

1. **Core Courses**

MEEN 5410 - Advanced Solid Mechanics
MEEN 5520 - Manufacturing Concepts for Mechanical Engineers
MSET 5020 - Design of Experiments
MEEN 5140 - Advanced Mathematical Methods for Engineers
MEEN 5600 - Feedback Control of Dynamic Systems
MEEN 5640 - Applied Engineering Vibration
MEEN 5300 - Advanced Thermodynamics
MEEN 5311 - Convective Heat Transfer II
MEEN 5340 - Advanced Fluid Mechanics
MSET 5180 - Structural Dynamics
MEEN 5440 - Finite Element Analysis

2. **Elective Courses**

MEEN 5000 - Energy: The Fundamentals
MEEN 5110 - Renewable Energy
MEEN 5200 - Principles of HVAC
MEEN 5152 - Mechanics of Composites and Foams for Lightweight Structures
MEEN 5220 - Computational Fluid Dynamics and Heat Transfer
MEEN 5420 - Continuum Mechanics
MEEN 5315 - Nanoscale Energy Transport
MEEN 5240 - Energy: A World Perspective
MEEN 5310 - Conduction and Radiation Heat Transfer
MEEN 5330 - Combustion Science and Engineering
MEEN 5332 - Air Pollution Control Engineering
MEEN 5610 - Sensors & Actuators
MEEN 5480 – Energy Materials
MEEN 5750 –Automotive Manufacturing
MEEN 5760 – Robotics and Automation
MEEN 5800 –Topics in Mechanical and Energy Engineering: Applied Numerical Methods
MEEN 5470 –Geothermal Heat Pumps
MEEN 5620 –Energy Harvesting
MEEN 5151 - Bioproducts Manufacturing
MSET 5130 - Product Reliability and Quality
MSET 5050 - Engineering Project Management
MSET 5150 - Applications of Electron Microscopy and Failure Analysis
MSET 5160 - Creep &Fatigue in Engineering Design & System Performance
MSET 5170 - Thermal Management
MSET 5030 - Product Design and Development
MSET 5060 - Technology Innovation
MSET 5190 - Corrosion Engineering Technology
MSET 5220 - Building Information Modeling
MSET 5230 - Risk Management in Construction
MSET 5200 - Advanced Construction Scheduling
MSET 5210 - Sustainable and Lean Construction
MSET 5240 - Heavy Civil Construction Management
MSET 5270 - Management in Human and Societal Development
MSET 5260 - Integrative Construction Management

APPENDIX E – Example of Elective Courses from Related Fields

BIOL 6341 - Advanced Environmental Impact Assessment
EENG 5940 - Renewable Electrical Power Systems
MTSE 5020 - Mechanical Properties of Materials
MTSE 5100 - Fundamental Concepts of Materials Science
MTSE 5400 - Advanced Polymer Physics and Chemistry
MTSE 5550 - Materials and Mechanics for MEMS Devices
MTSE 5710 - Computational Materials Science
MTSE 6110 - Applied Fracture Mechanics
MTSE 5710 - Computational Materials Science
CSCE 5160 - Parallel Processing and Algorithms
CSCE 5420 - Software Development
CSCE 5810 – Biocomputing
BMEN 5320 - Advanced Biomechanics
BMEN 5324 - Applications of Biomedical MEMS

APPENDIX F- FORMS

All the forms are available on https://mechanical.engineering.unt.edu/forms. Some of the forms are:

Employment Forms
Handshake Application for IA/Technician/Office Hourly Workers
TA/TF/RA Application
TA/IA Evaluation Form
Application Documents Submission
Submit Graduate Application Documents
Degree Plans
Graduate Degree Plans
Other Graduate Forms
Override Form
Order Request Form
Special Topics Form
Graduate Degree Plan Change
Change of Major
Request form for PhD Qualifying Exam
Proposal Defense Form
Defense Flyer Template
Travel
Travel TBA Request
Undergraduate & Graduate College of Engineering Professional Development and Travel Funds
Toulouse Graduate School Travel Grant
College of Engineering Faculty Travel Funds

APPENDIX G- Important Campus Contacts

- College of Engineering Dean's Office
  - PHONE: (940) 565-4300
  - ADDRESS: 3940 N. Elm Suite A 160
    Denton, TX 76207-7102
  - WEBSITE/EMAIL: Contact Us | College of Engineering (unt.edu)
- UNT International Advising
  - PHONE: (940)-565-2195
  - EMAIL: InternationalAdvising@unt.edu
  - ADDRESS: Marquis Hall, Room 105, 1511 West Mulberry Street, Denton, Texas 76201
  - WEBSITE: International Student & Scholar Services | International Affairs (unt.edu)
- Toulouse Graduate School
  - PHONE: (940) 565-2383
  - EMAIL (Admitted): graduateschool@unt.edu
  - EMAIL (Applicants): GoGrad@unt.edu
  - WEBSITE: Toulouse Graduate School
- College of Engineering Information Technology Services (IT)
  - PHONE: (940) 369-7250
  - EMAIL: cengsupport@unt.edu
  - WEBSITE/SERVICE TICKETS: Home | Information Technology Services (unt.edu)
- UNT Emergency Management & Safety Services*
  - PHONE: (940) 369-6153
  - EMAIL: emergency.management@unt.edu
  - WEBSITE: Welcome to Risk Management Services | Risk Management Services (unt.edu)
    *FOR EMERGENCIES CALL 911; LAB SAFETY- RICK PIERSON (940)565-2552