MECHANICAL ENGINEERING
GRADUATE STUDENT HANDBOOK

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

DEPARTMENT OF MECHANICAL ENGINEERING

COLLEGE OF ENGINEERING

GREENSBORO, NORTH CAROLINA 27411

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Notice

This handbook was prepared for use by graduate students in Mechanical Engineering at North Carolina A&T State University. It is designed to supplement existing policy and is intended as a guide. The Department of Mechanical Engineering prepares revisions to its handbooks periodically and information contained herein is proofed for accuracy. However, students are asked to consult their academic advisors and with the appropriate University office for current information and policy. Important changes may occur without notice. The Department attempts to maintain an accurate Graduate Student Handbook at all times; however, errors may inadvertently occur. The Department reserves the right to correct such errors when they are found, without further notice. The presence of errors will not affect the application of rules and requirements to students.

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1.0 Objective

The objective of the graduate program in Mechanical Engineering is to provide advanced level study in distinct areas of specialization. The Master of Science in Mechanical Engineering prepares the graduate student for Doctoral level studies or for advanced mechanical engineering practice in industry, consulting or government service. The Doctoral degree in Mechanical Engineering provides independent research opportunities and skills to students who are interested in research and teaching at the university level.

The Degrees offered are:

- Master of Science in Mechanical Engineering (MSME)
- Doctor of Philosophy (Ph.D.) in Mechanical Engineering

2.0 Master of Science in Mechanical Engineering

The Mechanical Engineering master's program provides advanced level study in distinct areas of specialization such as mechanics and materials, energy and thermal/fluid systems, design & manufacturing and aerospace. The program prepares the graduate student for doctoral level studies or for advanced mechanical engineering practice in industry, consulting or government service.

Additional Admission Requirements

- Unconditional admission requires an engineering undergraduate degree from an ABET accredited mechanical engineering program

Program Outcomes

- Students will develop advanced critical thinking skills by solving complex and challenging problems in mechanical engineering, mathematics and the physical sciences
- Students will communicate effectively by conveying their ideas, both orally and in written form, in accordance with acceptable published standards
- Students will demonstrate their ability to perform research by generating a thesis of an original idea and publishing technical papers under the guidance of an academic advisor
- Graduates will engage in professional activities by attending conferences, presenting papers and serving various roles in professional organizations

2.1 Program Description

The Master of Science in Mechanical Engineering (MSME) emphasizes advanced study in the areas of mechanical systems and materials, energy and thermal-fluid sciences, and aerospace. Three options are available to students. These are (i) thesis option, (ii) project option, and (iii) course option.

2.2 Admission

The Master of Science in Mechanical Engineering Program is open to students with a Bachelor's Degree in Mechanical Engineering or a closely related field from recognized institutions. Applicants may be admitted to the MSME Program unconditionally or conditionally. Acceptable GRE Score is required.

2.2.1 Unconditional Admission:

An applicant may be given unconditional admission to the MSME Program if he/she possesses a Bachelor of Science in Mechanical Engineering degree from an accredited institution with an overall GPA of 3.0 or better on a 4.0 scale. Students admitted on an unconditional basis are expected to have completed "key fundamental courses" as part of their undergraduate program. These courses are:

a. Strength of Materials

b. Materials Science and Engineering
c. Mechanical Engineering Design
d. Thermodynamics
e. Fluid Mechanics
f. Heat Transfer

2.2.2 Conditional Admission:

An applicant may be granted conditional admission if he/she falls under one of the following situations:

a. Applicant has a Bachelor of Science in Mechanical Engineering degree with a GPA of less than 3.0 but has a major GPA of at least 3.0 in the last four semesters of undergraduate study. The overall GPA must not be less than 2.8
b. Applicant has a Bachelor of Science degree in an engineering discipline with a 3.0 GPA or better on a 4.0 scale but is deficient in key fundamental courses as listed in the previous section. These deficiencies must not exceed 12 credit hours.
c. Applicant has a Bachelor of Science degree in a non-engineering discipline but a closely-related undergraduate degree with a substantial and relevant engineering science and mathematics content and a GPA of 3.0 or higher. Background deficiencies should not exceed 12 credit hours.

2.2.3 Change of Admission Status:

The status of conditionally admitted students will be changed to unconditional status when both of the following two conditions are satisfied.

a. All prescribed course deficiencies have been completed with a Grade of "B" or better and
b. A minimum GPA of 3.0 is attained in the first three courses taken at A&T for graduate credits at the end of the semester.

It is the student's responsibility to apply to the department for a change in admission status. Students who fail to have their status upgraded run the risk of not receiving graduate credits for any completed graduate courses. Such students also run the risk of academic probation and dismissal.

2.2.4 International Students:

All international applicants, except those from countries exempted, must provide proof of English language proficiency by obtaining acceptable scores on the Test of English as a Foreign Language (TOEFL). The minimum TOEFL score is 550 (80 in internet based or 213 in computer-based tests).

2.3 MS Program Policies and Requirements

2.3.1 Transfer of Graduate Credits:

Up to twelve (12) credit hours of graduate course work with a grade of "B" or better may be transferred from another graduate program at North Carolina A&T State University or from another university provided that these courses, in the opinion of the graduate committee, can be part of a reasonable and cohesive graduate plan of study.

2.3.2 Transfer of Undergraduate Credits:

Up to twelve (12) credit hours of graduate course work with a grade of "B" or better taken at North Carolina A&T State University as an undergraduate student may be transferred to the MSME program provided it was not counted to fulfill the undergraduate requirements and these courses, in the opinion of the graduate committee, can be part of a reasonable and cohesive graduate plan of study. No graduate credits completed at an undergraduate classification in another institution will be allowed to transfer.

2.3.3 Time Limitation:

The graduate program must be completed within six (6) consecutive calendar years. Part of the program not completed after this time limit are subject to cancellation, revision, or a special examination for outdated work. If the studies are interrupted for military duties, the time limitation shall be extended for the length of time the student has been on active duty provided the candidate resumes graduate work no later than one year after the release from military service.

2.3.4 Advisory Committee:

All graduate students must select an academic advisor during their first semester of enrollment and an advisory committee by the end of the first year. The advisory committee shall consist of at least three members, with the academic advisor serving as the chair. The academic advisor and most of the committee members must be members of the mechanical engineering graduate faculty. The committee assists the student to define the thesis or project topic and reviews the quality of the student's work. The committee also conducts the oral defense of the student's project or thesis work.

2.3.5 Plan of Graduate Study:

All graduate students must submit a Plan of Graduate Study during the first semester of enrollment for approval by the Department and the Graduate School. The plan must be unified and all constituent parts must contribute to an organized program of study and research that satisfies the degree requirements. The plan outlines courses, the program option, and the anticipated graduation date, among others. The plan must be updated as necessary to keep it current. The plan serves as a contract between the student and the University for the fulfillment of the degree requirements.

2.3.6 Degree Requirements:

The coursework requirements include advanced mathematics, core mechanical engineering requirements and a group of coherent specialty courses per the discretion of the student and the major advisor.

Total Credit Hours Required: 30

Core Courses (All Options): 12 Credit Hours
Take 9 credit hours: MEEN 601, 643 and 716
Select 3 credit hours from: MATH 650, 651, 652

Thesis option (18 Credit Hours):
Take 6 credit hours: MEEN 797(6)
Select 9 credit hours from: MEEN 600-899
Select 3 credit hours of technical elective courses approved by the advisor

Technical elective courses: MEEN 600-899; BIOL 600-799; BMEN 600-791; CHEM 600-699, 702-799 excluding 703, 788, 799; CHEN 600-785, 789; CSE 600-785; EES 600-899; ECEN 600-785; INEN 600-785; MATH 600-899; NANO 600-789, excluding 778, 788; PHYS 600-799, excluding 740, 791-792

Pass Oral Defense of Thesis
Present at least a conference paper

Thesis: A student in the Thesis Option must pass the oral examination scheduled by the advisor. The oral examination on the thesis is scheduled after it has been reviewed and approved by each member of the committee. The examination is open to the public. However, the deliberations following the meeting are open only to the committee members. At the deliberation, the committee will determine if the student passes or fails the oral defense, or to repeat the oral defense at another date. The Report of final MS Defense Examination should be submitted to the Graduate College together with the written report within 24 hours of the examination date.

Project Option (18 Credit Hours)
Take 3 credit hours: MEEN 796(3)
Select 9 credit hours from: MEEN 600-899
Select 6 credit hours of elective courses approved by the advisor
Pass Oral Defense of Project

Project: A student in the Project Option must pass the oral examination scheduled by the advisor. The oral examination on the project is scheduled after it has been reviewed and approved by each member of the committee. The exam is open to the public. However, the deliberations following the meeting are open only to committee members. At the deliberation, the committee will determine if the student passes or fails the oral defense, or to repeat the oral defense at another date. The Report of final project Defense Examination should be submitted to the Graduate College together with the written report within 24 hours of the examination date.

Course Option (18 Credit Hours)
Select 9 credit hours from: MEEN 600-899
Select 9 credit hours of elective courses approved by the advisor
Pass Comprehensive Exam

Comprehensive Examination: A student in the Course Option must pass a comprehensive oral examination scheduled by the graduate committee. The topic of the oral examination will be selected by the graduate committee, along with the student, at the beginning of the semester the student is scheduled to graduate. The exam is open to the public. However, the deliberations following the meeting are open only to committee members. At the deliberation, the committee will determine if the student passes or fails the oral defense, or to repeat the oral defense at another date. The Report of Comprehensive Examination should be submitted to the Graduate College within 24 hours of the examination date.

3.0 Doctor of Philosophy in Mechanical Engineering

3.1 Program Description

The Ph.D. degree in Mechanical Engineering provides both advanced instruction and independent research opportunities for students. The Ph.D. degree is the highest academic degree offered and graduates typically are employed in research environments in government laboratories and industries, and as university faculty. The Ph.D. degree program is highly individualistic in nature, and the student is expected to make a significant contribution to the reservoir of human knowledge by investigating a significant topic within the domain of mechanical engineering. The Ph.D. student must study under the guidance of an Academic Advisor and a Dissertation Committee in formulating a plan of study, setting and meeting the degree goals, and selecting a dissertation topic. The academic advisor guides the student during the dissertation phase of the program.

The completion of Ph.D. degree symbolizes the ability to undertake original research and scholarly work of the highest levels without supervision. The degree is, therefore, not granted simply upon completion of a stated amount of course work but rather upon demonstration, by the student, of a comprehensive knowledge and high capability in scholarship. The student must demonstrate both the attainment of scholarship and independent research abilities by writing a dissertation on an original topic and reporting the results.

The student must pass a written qualifying examination to demonstrate his/her preparedness for advanced study, an oral preliminary examination to propose the dissertation topic and research plan, and an oral defense of the dissertation to demonstrate the quality, appropriateness of methodology, findings, and significance of the results of the research.

The Ph.D. student attains candidacy upon completion of all course work requirements and passing the Preliminary Examination. Such a student may only register for Dissertation hours until all the degree requirements are met.

Program Outcomes

- Graduates of the Ph.D. program will apply their critical thinking skills to invent, analyze, and model complex engineering systems and make novel contributions to the discipline.
- Graduates of the Ph.D. program will demonstrate effective communication skills through project and dissertation work and conference presentations.
- Graduates of the Ph.D. program will perform research or undertake advanced projects in an area of mechanical engineering such as mechanical systems and materials, energy and thermal-fluid sciences, and/or aerospace and make novel contributions in their respective areas of research.
- Graduates of the Ph.D. program will be active and effective leaders in their professional societies.

3.2 Admission

The Doctor of Philosophy in Mechanical Engineering Program is open to students with a Master's Degree in Mechanical Engineering or a closely related field from recognized institutions. The program is also open to high-caliber students with a Bachelor's Degree in Mechanical Engineering or a closely related field from recognized institutions. Applicants may be admitted to the Ph.D. Program unconditionally or conditionally. Acceptable GRE Score is required.

3.2.1 Unconditional Admission:

To be considered for unconditional admission to the Doctoral Program in Mechanical Engineering, an applicant must have either:

a. The Master of Science degree in Mechanical Engineering (MSME) or a closely related engineering discipline with a minimum GPA of 3.25. The student must have at least 18 credit hours of mechanical engineering or equivalent courses at the graduate level OR

b. The Bachelor of Science degree in Mechanical Engineering (BSME) with a minimum cumulative GPA of 3.5.

c. Satisfactory GRE scores.

3.2.2 Conditional Admission:

To be considered for conditional admission to the Ph.D. in Mechanical Engineering, an applicant must have either:

a. The Master of Science degree in Physical Science, Mathematics or other related disciplines with a minimum GPA of 3.25 OR

b. The Bachelor of Science degree in Physical Science, Mathematics or other related disciplines with a minimum cumulative GPA of 3.5.

Students entering the doctoral program with ***conditional status*** will be required to take graduate level bridge courses as directed by the graduate committee.

3.2.3 Change of Admission Status:

The status of conditionally admitted students will be changed to unconditional status when both of the following two conditions are satisfied.

a. All proscribed course deficiencies have been completed with a Grade of "B" or better and
b. A minimum GPA of 3.0 is attained in the first three courses taken at A&T for graduate credits at the end of the semester.

It is the student's responsibility to apply to the department for a change in admission status. Students who fail to have their status upgraded run the risk of not receiving graduate credits for any completed graduate courses. Such students also run the risk of academic probation and dismissal.

3.2.4 International Students:

All international applicants, except those from countries exempted, must provide proof of English language proficiency by obtaining acceptable scores on the Test of English as a Foreign Language (TOEFL). The minimum TOEFL score is 550 (80 in internet-based or 213 in computer-based tests).

3.3 Ph.D.. Program Policies and Requirements

3.3.1 Transfer of Credits:

Up to twelve (12) credit hours of graduate course work with a grade of "B" or better may be transferred from another graduate program at North Carolina A&T State University or from another university provided that these courses, in the opinion of the graduate committee, can be part of a reasonable and cohesive graduate plan of study.

No graduate credits completed at an undergraduate classification will be allowed to transfer.

3.3.2 Time Limitation:

Doctoral students are allowed a maximum of six calendar years from admission to the doctoral program to attain candidacy (by passing the Preliminary Examination) for the degree, and a maximum of ten calendar years to complete all degree requirements. The Ph.D. dissertation must be completed in no more than five years after the student has been admitted to candidacy.

3.3.3 Advisory Committee:

All graduate students must select an academic advisor during their first semester of enrollment and an advisory committee by the end of the first year. The advisory committee consists of at least five members, with the Academic Advisor serving as the chair. The academic advisor and most of the committee members must be mechanical engineering graduate faculty members. For members outside of the University, a bio-sketch should be provided to the Department Chair. The committee assists the student in formulating a plan of study and in defining the dissertation topic. The committee also conducts the student's Preliminary Examination and the Final Oral Defense of the dissertation.

3.3.4 Plan of Graduate Study:

All graduate students must submit a Plan of Graduate Study during their first semester of enrollment for approval by the Department Chair and the Graduate School. The plan must be unified, and all constituent parts must contribute to an organized program of study and research to satisfy the doctoral degree requirements. These plans should be updated as necessary to keep it current. The plan serves as a contract between the student and the University for the fulfillment of the degree requirements.

3.3.5 Degree Requirements:

The coursework requirements include advanced mathematics, core mechanical engineering requirements and a group of coherent specialty courses per the discretion of the student and the major advisor. The course work requirements depend on the type of entry into the Ph.D. program.

The Ph.D. program consists of the following:

(i) Core mechanical engineering credit hours: 9
9 credit hours from MEEN 601, 643, and 716.

(ii) Advanced mathematics: 3
3 credit hours selected from: MATH 650, 651, 652

(iii) Technical elective courses: 6
6 credit hours of technical elective courses selected from list and approved by the advisor

Technical elective courses: MEEN 600-899; BIOL 600-799; BMEN 600-791; CHEM 600-699, 702-799 excluding 703, 788, 799; CHEN 600-785, 789; CSE 600-785; EES 600-899; ECEN 600-785; INEN 600-785; MATH 600-899; NANO 600-789, excluding 778, 788; PHYS 600-799, excluding 740, 791-792

(iv) 24 credit hours selected from: MEEN 600-899 (specifically 60%: 15credit hours from 800-899)

(v) 2 credit hours Seminar: MEEN 992 taken twice

(vi) 18 credit hours Dissertation: MEEN 997 taken multiple times as needed

(vii) Pass Qualifying Examination (Refer to Section 3.3.6 in the MEEN handbook)

(viii) Pass Preliminary Examination (Refer to Section 3.3.7 in the MEEN handbook)

(ix) Pass Final Dissertation Oral Defense (Refer to Section 3.3.8 in the MEEN handbook)

(x) Publish at least one Journal paper (Refer to SASC outcomes)

(xi) Total post BS credit hours: 62

All Ph.D. students at graduation must demonstrate that they have meet the MEEN coursework requirements which include advanced mathematics, core mechanical engineering requirements and a group of coherent specialty courses.

Dissertation Research:

A student may not register for dissertation credits before passing the Qualifying Examination. No more than 18 dissertation credits are counted toward the total credit hours requirement for the degree.

3.3.6 Doctoral Qualifying Exam:

The Qualifying Examination provides an early assessment of a student's potential for satisfactory completion of the doctoral degree. The examination tests a student's understanding of the principles of mechanical engineering and his/her ability to apply these principles to solve advanced mechanical engineering problems.

Schedule: A student admitted into the Ph.D. program must pass the Qualifying Examination to be classified as a doctoral student. The Qualifying Examination is given once each semester, and it is held on two consecutive days, about one week after semester break.

Students entering the doctoral program with an M.S. Degree must take the Qualifying Examination by the end of the second semester of enrollment. Failure to pass the Qualifying Examination by the end of the third semester will result in the termination from the program.

Students entering the doctoral program with a B.S. degree must take the Qualifying Examination by the end of the third semester of enrollment. Failure to pass the Qualifying Examination by the end of the fourth semester will result in the termination from the program.

Students who plan to take the Qualifying Examination must notify the Graduate Program Director in writing or via email by August 31st (for Fall Examinees) and January 31st (for Spring Examinees) of the Examination Area they wish to take. This must have the approval of the major advisor. The area chosen by each student must be related to his/her intended area of study.

The Examination consists of four (4) parts of 2-hour duration each. Students will be required to take 2 parts on each day of the examination.

Examination Areas: Each student must take the examination in one of the subject areas below. However, the student has the option to substitute one course from another subject area.

Areas of Examination		
Mechanics and Design	***Materials and Manufacturing***	***Thermo-Fluids***
Statics and Strength of Materials	Statics and Strength of Materials	Fluid Mechanics and Machinery
Dynamics of Particle and Rigid Bodies	Materials Science	Thermodynamics
System Dynamics and Vibrations	Materials Engineering	Heat Transfer
Mechanical Design	Manufacturing Processes	Refrigeration and Air Conditioning

These areas and degree of difficulty are typical undergraduate materials present in most mechanical engineering curricula. The examination is closed books/notes except for an FE Reference Handbook provided at the examination. Students are not allowed to bring their own copy of FE Reference Handbook. Other reference materials will be provided if deemed necessary by the faculty composing the exam. Programmable calculators are not allowed in the examination.

Notification of Results: Each student will be notified of his/her result (pass/fail) by the Department Chair within four weeks after the exam. The Report of Doctoral Preliminary Examination should be submitted to the Graduate College together with the written proposal within 24 hours of the examination date.

Pass: A student who receives a satisfactory grade is considered qualified to continue in the Ph.D. program.

Fail: A student who fails the qualifying examination the first time can retake it the following semester. In the retake of the Qualifying Exam, the student must sit for the entire exam and receive satisfactory scores to continue in the Ph.D. program. A student who fails in the second attempt will be dismissed from the Ph.D. program. Students who fail to take the exam at the scheduled time are considered as failing the exam.

3.3.7 Doctoral Preliminary Examination:

The Preliminary Examination is an oral presentation and defense of the Dissertation Proposal by a student before the advisory committee. The objective is to determine if the student is prepared to undertake the proposed research.

Schedule:

The **student must pass the Preliminary Examination at least six months** before the Dissertation Defense. The Dissertation Advisory Committee must receive a complete written Dissertation P**roposal one week prior** to the date of the Preliminary Examination. The format of the written proposal must be in accordance with the Graduate College Guidelines for Dissertation. The oral examination lasts for approximately two hours.

Results: The Advisory Committee determines whether the student has passed the Preliminary Examination. The Advisory Committee may recommend one re-examination if the student fails at the first attempt and there is sufficient cause for re-examination. Failure to pass the Preliminary Examination terminates the student's work at this department. The Report of Doctoral Preliminary Examination should be submitted to the Graduate College together with the written proposal within 24 hours of the examination date.

Candidacy: A doctoral student is admitted to candidacy upon passing the Preliminary Examination without conditions.

3.3.8 Dissertation and Oral Defense:

The dissertation generally follows the guidelines of the School of Graduate Studies. It is the responsibility of the student to contact the Graduate College for the current dissertation format and submission guidelines**. (http://www.ncat.edu/tgc/continuing/thesis/index.html)**

The Academic Advisor will schedule the examination and inform the Dean of Graduate Studies two weeks before the examination to send a representative to the oral defense.

The oral examination on the dissertation is scheduled after it has been reviewed and approved by each member of the committee. The examination is held at a public meeting. However, the committee deliberations following the meeting are open only to the committee members. At the deliberation, the committee will determine if the student passes or fails the oral defense, or to repeat the oral defense at another date. The Report of Doctoral Final Examination should be submitted to the Graduate College together with the written proposal within 24 hours of the examination date.

4.0 Student Learning Outcomes and Assessment

4.1 Master of Science Program Student Learning Outcomes (SLOs)

(1) Students completing the Master of Science degree program in Mechanical Engineering will exhibit effective communication skills (written, oral, and graphic) appropriate for professionals in this field of study at the master's level.

(2) Students completing the Master of Science degree program in Mechanical Engineering will effectively use quantitative and qualitative problem-solving skills appropriate for professionals in this field of study at the master's level.

(3) Students completing Master of Science degree program in Mechanical Engineering will demonstrate a level of discipline-specific expertise (knowledge, skills, and professionalism) appropriate for professionals in mechanical engineering at the master's level.

(4) Students completing the Master of Science degree program in Mechanical Engineering will demonstrate ability to engage in the review and conduct of interdisciplinary research and creative professional activities appropriate for professionals in mechanical engineering at the master's level.

4.2 Doctor of Philosophy Program Student Learning Outcomes (SLOs)

(1) Students completing the Doctor of Philosophy degree program in Mechanical Engineering will exhibit effective written and oral communication skills appropriate for professionals in engineering at the doctoral level.

(2) Students completing the Doctor of Philosophy degree program in Mechanical Engineering will effectively utilize quantitative and qualitative problem-solving skills appropriate for professionals in engineering at the doctoral level.

(3) Students completing the Doctor of Philosophy degree program in Mechanical Engineering will demonstrate the highest level of knowledge, skills, and professionalism appropriate for professionals in engineering at the doctoral level.

(4) Students completing the Doctor of Philosophy degree program in Mechanical Engineering will demonstrate an ability to contribute productively to knowledge, interdisciplinary research and creative professional activities appropriate for professionals in engineering at the doctoral level.

4.3 Assessment Rubrics

Rubric for Graduate Student Performance in Communication (Presentation) – Theses, Projects, Comprehensive Examination and Dissertations

Performance Indicator	Poor 1	Good 2	Very Good 3	Excellent 4
Organization and Focus on topic (content)	There is very little or no relevance to the research problem and argument; main idea is not clear	There is some relevance to the research problem and argument; main idea is somewhat clear.	There is sufficient relevance to the research problem and argument; main idea is clear.	There is full and complete relevance to the research problem and argument; main ideas stand out.
Subject Knowledge and Accuracy of facts (content)	Student does not have a grasp of the literature, theories and information.	Student is uncomfortable with the literature, theories and information.	Student is at ease with the literature, theories and information, but fails to elaborate.	Student demonstrates full knowledge of the literature, theories and information.
Mechanics, Grammar and Spelling	Presentation and/or composition have numerous spelling errors and/or grammatical errors.	Presentation and/or composition have some misspellings or grammatical errors.	Presentation and/or composition have few misspellings or grammatical errors.	Presentation and/or composition have virtually no misspellings or grammatical errors.

OVERALL				

Rubric for Graduate Student Research/Creative Engagement - Theses, Projects, Comprehensive Examination and Dissertations

Outcome Indicator	Poor 1	Good 2	Very Good 3	Excellent 4
Identifies Research Issues	Poor ability to identify the necessary research gaps and assumptions in the state-of-the-art	Not quite able to identify the necessary research gaps and assumptions in the state-of-the-art	Reasonably able to identify the necessary research gaps and assumptions in the state-of-the-art	Fully able to identify the necessary research gaps and assumptions in the state-of-the-art
Ability to Develop a Research Plan	Poor ability to determine appropriate methodology and plan	Can, to some degree, determine appropriate methodology and plan	Reasonably able to determine appropriate methodology and plan	Quite able to determine appropriate methodology and plan
Ability to Conduct Investigations.	Cannot carry out a research plan without substantial assistance.	Fair attempt to carry out a research plan without substantial assistance	Good attempt to carry out a research plan with minimal assistance.	Fully able to carry out a research plan without assistance
Ability to Analyze Data and Draw Conclusions	Cannot reach accurate conclusions from the analysis	Can, to some degree, reach fair conclusions based on the analysis.	Can reach reasonable conclusions based on the analysis.	Fully able to reach accurate conclusions based on the analysis
OVERALL				

Rubric for Critical Thinking – ALL Graduate Level Graded Courses

Outcome Indicator	Poor 1	Good 2	Very Good 3	Excellent 4
Identifies Assumptions and Context	Poor ability to think critically to identify the necessary assumptions in the theory	Not quite able to think critically to identify the necessary assumptions in the theory.	Reasonably able to think critically to identify the necessary assumptions in the theory.	Fully able to think critically to identify the necessary assumptions in the theory
Ability Identify the Relevant Information Provided in each Question	Poor ability to think critically to identify the relevant information	Can, to some degree, think critically to identify the relevant information	Reasonably able to think critically to identify the relevant information	Quite able to think critically to identify the relevant information
Derive and Justify Solutions.	Cannot derive accurate solutions; Has no command of the subject matter.	Fair attempt to derive accurate solutions; Has adequate command of the subject matter.	Good attempt to derive accurate solutions; Has satisfactory command of the subject matter.	Fully able to derive accurate solutions; Has full command of the subject matter.
Analyze and Draw Conclusions in relation to the subject matter	Cannot reach accurate conclusions from the analysis	Can, to some degree, reach fair conclusions based on the analysis.	Can reach reasonable conclusions based on the analysis.	Fully able to reach accurate conclusions based on the analysis
OVERALL				

5.0 Mechanical Engineering Graduate Courses

It is of interest to note that there are mainly three levels of courses; namely, the 600, 700 and 800 levels. The 600 level categories the introductory level graduate course offerings that are designed mainly for Masters level students, as well as, incoming Ph.D. students who may need introductions to new fields of study. The 800 levels are designed for Ph.D. level training and are considered specialization courses. However, MS students with the consent of their advisors are allowed to take these courses. On the other hand, the 700 level courses are primarily for MS students. These 700 level courses serve the Thesis, Project and non-thesis options requirements of all the MS students in the Department.

MEEN 601 Continuum Mechanics **Credits 3 (3-0)**

This course covers the applications of the laws of mechanics and thermodynamics to the continuum. Topics include a rigorous development of the general equations applied to a continuum and the application and reduction of the general equations for specific cases of both solids and fluids.

MEEN-602. Advanced Strength of Materials **Credit 3 (3-0)**

This course covers stress-strain relations as applied to statically indeterminate structures, bending in curved bars, plates, shells, and beams on elastic foundations. Topics include: strain energy concepts for formulation of flexibility matrix on finite elements, bending in beams and plates, Cartesian tensor notation, and matrix structural analysis. Prerequisites: MEEN 336, MATH 432 or equivalent.

MEEN 604 Intermediate Dynamics **Credits 3 (3-0)**

This course reviews particle and system dynamics and introduces rigid body dynamics with solution techniques for the non-linear systems of ordinary differential equations as initial value problems. Other topics covered include: angular and linear momentum, energy and Langrangian methods of body problems, generalized variables, small vibrations, and gyroscopic effects and stability. Prerequisite: Graduate Standing

MEEN 606 Intermediate Mechanical Vibrations **Credits 3 (3-0)**

This is a course in modeling, analysis and simulation of free and forced vibrations of damped and undamped, single and multi-degree of freedom systems

MEEN 608 Experimental Stress Analysis **Credits 3 (3-0)**

Principles and methods of experimental stress analysis are covered in this course. Photo-elastic and micro-measurement techniques applied to structural models are also addressed.

MEEN 613 Mechanics of Composite Materials **Credits 3 (3-0)**

This course covers micro and macro mechanics failure theories and design of multilayered-multidirectional fiber reinforced composites. Topics include 2-D and 3-D theory of anisotropy, elasticity, micromechanics, failure theories, classical laminate theory and stress analysis of multidirectional laminates under mechanical and hygro-thermal loading.

MEEN 614 Mechanical Modeling and Simulation **Credits 3 (3-0)**

This course covers the state-of-the-art and current trends in modeling and simulation of mechanical systems. Topics include the modeling techniques of the major types of dynamic systems, the solution techniques for the resulting differential equations for linear and nonlinear systems, and the simulation techniques of these systems, and determination of their time and frequency response characteristics.

MEEN 616 Advanced Fluid Dynamics **Credits 3 (3-0)**

This course presents general development of basic equations of fluid motion including Navier-Stokes equations, continuity and energy equation. Exact and approximate solutions of the basic equations are presented.

MEEN 619 Computer-Aided Design and Simulation **Credits 3 (3-0)**
This course covers important methods and techniques for using the computer to aid the design process using a commercial package. Simulation and optimization methods are applied to the design of mechanical systems.

MEEN 630 Fundamentals of Thin Films **Credits 3 (3-0)**
This course introduces the underlying science, technology and practical applications of materials in thin film form. The superior physical, chemical and mechanical properties of thin films with respect to their bulk counterparts are explained in terms of their structure. Topics include: vacuum science and technology, substrate surfaces and film nucleation, preparation of thin and thick films, film structure and its characterization and physical properties.

MEEN 631 Conduction Heat Transfer **Credits 3 (3-0)**
This course presents the development of the general heat conduction equation and its applications to one-, two-, and three-dimensional steady and unsteady boundary value problems. Closed form and numerical solution techniques are addressed.

MEEN 643 Mechanical Instrumentation **Credits 3 (3-0)**
Principles and practices of industrial measurement are presented in this course. Topics include: instrument dynamics and response characteristics; theory of transducers for temperature, pressure, flow, motion, force; and other physical phenomena. Special topics in instrumentation, data acquisition and data reduction are covered. A project is assigned in an instrumentation application.

MEEN 649 Design of Robot Manipulators **Credits 3 (3-0)**
This course covers fundamentals of kinematics, dynamics, computer graphics, sensing devices, measurements and control of robot manipulators. Advances in robotics in industry and society will be discussed.

MEEN 650 Mechanical Properties and Structure of Solids **Credits 3 (3-0)**
This course examines the elastic and plastic behavior of engineering materials in relation to its structure at both the macroscopic and microscopic levels. Major representative classes of materials to be examined are thermoplastic materials, elastomers, glasses, ceramics, metals, and composites.

MEEN-651. Aero Vehicle Structures II **Credit 3 (3-0)**
This course covers deflection of structures, indeterminate structures, fatigue analysis, and minimum weight design. Finite element methods and software are utilized. Prerequisite: MEEN 422.

MEEN 652 Aero Vehicle Stability and Control **Credits 3 (3-0)**
This course covers longitudinal, directional, and lateral static stability and control of aerospace vehicles. It also covers linearized dynamics analysis of the motion of a six degree-of-freedom flight vehicle in response to control inputs and disturbance through the use of the transfer function concept, plus control of static and dynamics behavior by vehicle design (stability derivatives) and/or flight control systems.

MEEN 653 Aero Vehicle Flight Dynamics **Credits 3 (3-0)**
This course covers the basic dynamics of aerospace flight vehicles including orbital mechanics, interplanetary and ballistic trajectories, powered flight maneuvers and spacecraft stabilization.

MEEN 654 Advanced Propulsion **Credits 3 (3-0)**
This covers the analysis and design of individual components and complete air-breathing propulsion systems including turbo fans, turbo jets, ram jets, and chemical rockets.

MEEN 668 Compressible Fluid Flow **Credits 3 (3-0)**
The course covers the equations of motion of compressible fluid flow including normal shocks, flow with friction, heating and cooling, supersonic flow; unsteady wave motion, velocity potential equation; linearized flow; conical flow and slender body theory

MEEN 669 Thermal System Design and Selection **Credits 3 (3-0)**
This course involves the selection process of components needed for fluid and thermal systems to meet system performance requirements. Computer-aided thermal design, simulation and optimization techniques, and investment economics are discussed. Prerequisite: Graduate Standing or consent of instructor

MEEN 675 Solar Energy **Credits 3 (3-0)**
This course deals with the characterization of solar radiation at the earth's surface. Solar collectors of both flat and concentrating types, and storage and distribution systems are discussed and analyzed. System sizing, design and economic analysis for space heating, water heating and industrial process are covered.

MEEN 680 Applied Statistics in Mechanical Design **Credits 3 (3-0)**
This course deals with the statistical nature of design and performance of mechanical components and systems. This includes statistical methods for evaluation of accuracy, precision, safety margin, factor of safety, life-prediction and reliability.

MEEN 685 Special Topics **Credits 3 (3-0)**
This course is designed to allow the introduction of potential new courses on a trial basis or special content courses on a once only basis at the Master's level. The topic of the course and title are determined prior to registration.

MEEN 716 Finite Element Methods **Credits 3 (3-0)**
This course covers fundamental concepts of the finite element method for linear stress and deformation analysis of mechanical components. Topics include the development of truss, beam, frame, plane stress, plane strain, axisymmetric isoparametric, solid, thermal, and fluid elements. ANSYS and NASTRAN software will be used for solving practical stress analysis problems.

MEEN 785 Special Topics **Credit 3 (3-0)**
This course is designed to allow the introduction of potential new courses on a trial basis or special content courses on a once only basis at the Master's level. The topic of the course and title are determined prior to registration. Prerequisite: Consent of instructor.

MEEN 792 Master's Seminar **Credit 1(1-0)**
This course provides a forum for discussions and reports of subjects in mechanical engineering and allied fields. Prerequisite: Master's level standing.

MEEN 793 Master's Supervised Teaching **Credit 3 (3-0)**
Students will gain teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment. Prerequisite: Instructor's approval needed.

MEEN 794 Master's Supervised Research **Credit 3 (3-0)**
This course is supervised research under the mentorship of a faculty member. It is not intended to serve as the project nor thesis topic of the master's student. Prerequisite: Instructor's approval needed.

MEEN 796 Master's Project **Credit 3 (3-0)**

The student will conduct advanced research of interest to the student and the instructor. A written proposal, which outlines the nature of the project must be submitted for approval. This course is only available to project option students. Prerequisite: Master's level standing.

MEEN 797 Master's Thesis **Credit 3 (3-0)**
Master of Science thesis research will be conducted under the supervision of the thesis committee chairperson leading to the completion of the Master's thesis. This course is only available to thesis option students. Prerequisite: Consent of advisor.

MEEN 799 Continuation of Thesis **Credits 3 (3-0)**
This is a continuation of the Master of Science thesis research. This course is only available to thesis option students who have completed 6 credit hours of thesis work. Prerequisite: MEEN 797

MEEN 804 Advanced Dynamics **Credits 3 (3-0)**
This course covers Lagrange's equations of motion as applied to rigid body dynamics. Topics include: generalized coordinates, generalized conservative and dissipative forces, degrees of freedom, holonomic constraints as related to rigid body motion, calculus of variations, and Hamilton's equations of motion.

MEEN 806 Advanced Theory of Vibrations **Credits 3 (3-0)**
This course deals covers the building of general mathematical frameworks for the analysis of rigid bodies undergoing vibration. The development of equations of motion applicable to both discrete and continuous systems, their solution, and analysis of the results will be treated. Vibration analysis of systems with multi-degree of freedom and random vibrations are covered in this course. Additional topics include instrumentation, and computer techniques. Prerequisite: MEEN 606

MEEN 808 Energy Methods in Applied Mechanics **Credits 3 (3-0)**
The course covers the use of energy methods in solving applied mechanics problems. Applications in beams and frames, deformable bodies, plates and shells, and buckling are addressed. Variational methods are also discussed.

MEEN 810 Advanced Theory of Elasticity **Credits 3 (3-0)**
This is a course in strains, stresses, energy principles and equations of elasticity and their solution. Topics include general formulation of the 2-D boundary value problems and the formulation of certain three-dimensional problems with symmetry. Prerequisite: MEEN 602

MEEN 813 Composite Structures **Credits 3 (3-0)**
This course focuses on the application of composite materials to the design and analysis of structures. The topics covered are two- and three-dimensional hydrothermal anisotropic elastic constitutive equations; classical laminate theory; static stress, vibration, and buckling analysis of laminated beams and plates; environmental effects; and fatigue and fracture of laminated composites. Prerequisite; MEEN 613

MEEN 814 Theory of Plasticity **Credits 3 (3-0)**
This course covers stress and strain tensors, transformations and equilibrium, and elastic behavior. Topics include: theories of strength, plastic stress/strain, classical problems of plasticity, including thick-walled pressure vessels and rotating cylinders in elastic-plastic conditions, and slip line theory with applications. Prerequisite: MEEN 602

MEEN 815 Smart Structures **Credits 3 (3-0)**
This course covers sensors and actuators, piezoelectric materials, shape memory alloys, magneto-rheological fluids, fiber optical strain gages, control of structures, biomimetics, and structural health monitoring.

MEEN 816 Wave Propagation in Solids **Credits 3 (3-0)**
The focus is on the theory of stress wave propagation in solid media. Topics include wave propagation in strings, bars, unbounded elastic media as well as different wave-guides. The students will be exposed to current research topics in stress wave propagation.

MEEN 820 Advanced Thermodynamics **Credits 3 (3-0)**
This is an advanced course covering special topics in classical thermodynamics, statistical thermodynamics and thermodynamics of non-equilibrium processes.

MEEN 826 Applied Computational Fluid Dynamics **Credits 3 (3-0)**
The course provides further computational fluid dynamics methods as a design tool for industry and research problems. Emphasis is given to the development and application of both numerical algorithms and physical models to situations found in aerospace applications, two phase flow, heat transfer, turbomachinery and environmental flows.

MEEN 827 Multiphase Flow **Credits 3 (3-0)**
This course covers the physics governing multiphase flow. Particle-fluid interaction, particle-particle interaction, and particle-wall interaction are discussed. It includes the description of the macroscopic properties of multiphase systems as a function of its microstructure. Electro-mechanics of particles are also studied.

MEEN 832 Convection Heat Transfer **Credits 3 (3-0)**
This course covers the analysis of heat convection in laminar and turbulent boundary layer, internal and external flows. Topics include: dimensional analysis, free convection, condensation, and boiling. Prerequisite: MEEN 631

MEEN 833 Radiation Heat Transfer **Credits 3 (3-0)**
This course covers radiation characteristics of surfaces, radiation properties taking account of wave length and direction, and analysis of radiation exchange between idealized and real surfaces. The course also addresses radiation heat transfer in absorbing, emitting, and scattering media. Prerequisite: MEEN 631

MEEN 835 Physicochemical Hydrodynamics **Credits 3 (3-0)**
This course deals with advanced principles of physicochemical hydrodynamics with special emphasis on topics relevant to microfluidics. The topics covered include viscous flow coupled with molecular diffusion and Brownian motion, electro-kinetic phenomena and its applications in electrophoretic separation and colloidal suspension, surface tension and its effects on microstructure wetting and electro-hydrodynamic flows.

MEEN 836 Non-Newtonian Fluid Mechanics **Credits 3 (3-0)**
This course presents the principles of non-Newtonian flow. It covers the fundamentals of rheology, classification of fluids, measurement of properties, constitutive equations and use of numerical methods to evaluate non-Newtonian flows.

MEEN 838 Renewable and Sustainable Energy **Credits 3 (3-0)**
The course covers the current and potential future energy systems, with emphasis on energy conversion and end-use in a sustainable manner. Different renewable and conventional energy technologies will be presented and their attributes (or conversion efficiency) described as effects on the environment. The potential future energy system considered include wind, wave and/or solar. The reference energy systems include petroleum, coal, nuclear and/or biomass.

MEEN 841 Mechanical System Identification **Credits 3 (3-0)**
This course covers the theoretical and practical aspects of system identification and adaptive control design for mechanical systems. General design philosophy and useful tools will be presented. Commonly

used adaptive schemes, including model reference adaptive system and self-turning regulator, will be discussed. Stability, convergence, transient performance, and robustness will be systematically and rigorously addressed.

MEEN 845 Feedback Control of Mechanical Systems **Credits 3 (3-0)**
This course covers theory and application of linear systems and feedback control. Topics include: spaces and linear operators, eigenvalues and eigenvectors, state equations, transfer functions, controllability, observability, realizations, decomposition, stability of mechanical systems including robotics and machine tool vibrations. This course will also cover control design concepts for linear multivariable systems, pole placement and observer design.

MEEN 846 Stochastic Modeling of Mechanical Systems **Credits 3 (3-0)**
This course deals with engineering approach to the analysis of time series data and the development of discrete linear transfer functions. Applications include the analysis of experimental data for system modeling, identification, forecasting, and control.

MEEN 847 Computational Engineering Dynamics **Credits 3 (3-0)**
This course introduces computer-oriented methods for the analysis and design of engineering dynamic systems. Topics include: analytical and experimental techniques for model development, design refinement of components in flexible dynamics systems (machine tools, robots, moving vehicles, etc.), and optimization techniques for transient response analysis on both constrained and unconstrained systems. Prerequisite: Instructor's approval needed

MEEN 848 Digital Control of Machines and Processes **Credits 3 (3-0)**
This course covers control algorithms and design of discrete controllers. Interfaces and command generation for machines and process control are treated. Applications in numerically controlled machines and industrial robots are covered.

MEEN 849 Control of Robot Manipulators **Credits 3 (3-0)**
This course covers basic and adaptive robot control systems sensory requirements and capabilities, and robotic system diagnosis and applications.

MEEN 850 Phase Equilibria **Credits 3 (3-0)**
This course presents interpretation and mathematical analysis of unary, binary and ternary, inorganic, phase equilibria systems with examples for solving practical materials science problems. Topics include: isoplethal and isothermal sections, crystallization paths, and thermodynamic fundamentals.

MEEN 852 Surface and Subsurface Studies **Credits 3 (3-0)**
This course covers thermodynamics of surfaces and subsurfaces, surface energy, surface reconstruction and electronics. Topics include Terrace-Ledge-Kink Model, kinetic theory and vacuum concepts, UHV hardware, pumping and system designs. In-situ experiments structural, chemical analysis and microcopy, diffraction techniques and scanned probe microscopy are included.

MEEN 854 Advances in Nanomaterials **Credits 3 (3-0)**
This course deals with the structural, mechanical and physical properties of nanostructured materials as well as their relevant functions. The course presents a variety of fabrication techniques for nanostructures, related transport phenomena and kinetics at the nanoscale.

MEEN 858 Mechanical Metallurgy **Credits 3 (3-0)**
This course covers continuum mechanics and the microscopic basis of plastic behavior. Emphasis is on the development and use of dislocation theory.

MEEN 860 Fracture Mechanics **Credits 3 (3-0)**

This course introduces the student to the concept of stress and strain singularities and their effect on fracture strength and fatigue life of isotropic and anisotropic materials. Topics covered include: computation of the stress-strain field around a crack-tip, stress-intensity-factor, strain energy release rate, J-integral, fracture toughness, residual strength, and fatigue crack propagation life. The course concepts are applied to the design of damage tolerant structures.

MEEN 885 Special Topics **Credit 3 (3-0)**
This course is designed to allow the introduction of potential new courses on a trial basis or special content courses on a once only basis at the doctorate level. The topic of the course and title are determined prior to registration. Prerequisite: Consent of instructor.

MEEN 992 Doctoral Seminar **Credit 1 (1-0)**
In this course, doctoral students attend colloquia or seminars. They consist of presentations by doctoral students on dissertation topics and works-in-progress and by guests on important classical, contemporary, or research problems in mechanical engineering. Prerequisite: Doctoral level standing.

MEEN 993 Doctoral Supervised Teaching **Credit 3 (3-0)**
This course is designed to introduce the doctoral student to classroom or laboratory teaching under the supervision of a faculty mentor. Doctoral students who serve as teaching assistants or as instructors are required to take this course during the first semester they teach. Others planning to undertake a teaching career are also strongly encouraged to take it. Topics covered include: course planning, classroom teaching, lecture preparation, student evaluation, and grading. The supervisor(s) will observe and provide feedback to the student and evaluate the student's performance. Prerequisite: Doctoral level standing.

MEEN 994 Doctoral Supervised Research **Credit 3 (3-0)**
This is supervised research under the mentorship of a member of the graduate faculty. It is not intended to serve as the dissertation topic of the doctoral student. Prerequisite: Consent of instructor.

MEEN 997 Doctoral Dissertation **Credits 3 (3-0)**
This supervised research serves as the dissertation of the doctoral student. 18 credits of dissertation is required for graduation.

MEEN 999 Continuation of Dissertation **Credits 1 (1-0)**
This is a continuation of the doctoral dissertation research. This course is only available to students who have completed 18 credit hours of dissertation work. Prerequisite: MEEN 997

MATHEMATICS ELECTIVES

MATH 650 Ordinary Differential Equations **Credits 3 (3-0)**
This is an intermediate course in ordinary differential equations with emphasis on applications. Topics include linear systems and various phase plane techniques for non-linear ordinary differential equations. Prerequisite: MATH 431.

MATH 651 Partial Differential Equations **Credits 3 (3-0)**
This course includes introduction to complex variables and residue calculus, transform calculus, higher order partial differential equations governing various physical phenomena, nonhomogeneous boundary value problems, orthogonal expressions, Green's functions and variational principles. Prerequisites: MATH 432 or consent of instructor.

MATH 652 Methods of Applied Mathematics **Credits 3 (3-0)**
This course covers matrix theory, systems of linear equations, vector spaces, eigenvalue problem and its applications to systems of linear ODEs and mechanical vibrations, the simplest problems of calculus of

variations, Euler equations, boundary conditions, extensions of Euler equations, Hamilton's Principles, constraints and Lagrange multipliers, introduction to integral equations, and solutions in iterative and other methods. Prerequisites: MATH 341 or consent of instructor.

6.0 Mechanical Engineering Graduate Faculty

- Atkinson, Michael, Assistant Professor, B.S., M.S., North Carolina A&T State University; Ph.D., Aerospace Engineering, University of Dayton, Ohio.
- Akangah, Paul, Lecturer/Assistant Professor, North Carolina A&T State University, Greensboro
- Coger, Robin, Professor and Dean, B.S., Mechanical Engineering, Cornell University; M.S., Ph.D., Mechanical Engineering, University of California, Berkeley.
- Dunn, DeRome O., Associate Professor, B.S., M.S., North Carolina A&T State University; Ph.D., Virginia Polytechnic Institute and State University.
- Mookesh, Dhanasar, Lecturer/Assistant Professor, B.S., Livingstone College; M.S. and Ph.D., North Carolina A&T State University.
- Ferguson, Frederick, Professor and Department Chairperson, M.S., Kharkov State University; Ph.D., University of Maryland.
- Kizito, John, Professor, B.S., Makerere University; M.S., Ph.D., Case Western Reserve University, Cleveland Ohio.
- Kumar, Dhananjay, Professor and ORNL Joint Faculty, Graduate Program Director, B.S., Bhagalpur University; M.S., Magadh University, Ph.D., Indian Institute of Technology, Mumbai.
- Owusu-Ofori, Samuel P., Boeing Professor and Chairperson, B.S., University of Science and Technology-Kumasi, Ghana; M.S., Bradley University; Ph.D., University of Wisconsin-Madison.
- Sankar, Jagannathan, University Distinguished Professor and Director, NSF Engineering Research Center, B.E., University of Madras; M.E., Concordia University, Ph.D., Lehigh University.
- Shivakumar, Kunigal N., Research Professor and Director of Center of Aviation Safety, B.E., Bangalore University; M.E., Ph.D., Indian Institute of Science.
- Sundaresan, Mannur, Professor, B.E., M.E., Bangalore University, Bangalore, India, Ph.D., Virginia Polytechnic Institute & State University.
- Wang, Shih-Liang, Professor and Undergraduate Program Director, B.S., National Tsing Hua University; M.S., Ph.D., Ohio State University; Professional Engineer**.**
- Waters, Cynthia, Associate Professor, B.S., M.S., Virginia Tech, Ph.D., North Carolina A&T State University.
- Yi, Sun, Associate Professor, B.S., Seoul National University; M.S., Ph.D., University of Michigan-Ann Arbor.

Name	Title	Terminal degree, University, Year of Graduation	Area of specialization
Michael Atkinson	Assistant Professor	Ph.D., Aerospace Engineering University of Dayton, 2012	Computational Fluid Dynamics, Hypersonics & Flow control
Paul Akangah	Lecturer/ Assistant Professor	University, Year: Ph.D., North Carolina A&T State University, 2011	Mechanics of advanced composite materials and structure
Robin Coger	Professor	Ph.D., Mechanical Engineering, University of California - Berkeley, 1993	Thermosciences, Tissue Engineering, Cryopreservation
Adrian Cuc	Part time Lecture	Ph.D., University of South Carolina, 2010	Structural Health Monitoring

Mookesh Dhanasar	Lecturer/ Assistant Professor	Ph.D., North Carolina A&T, Mechanical Engineering 2009	Hypersonics, Computational Fluid Dynamics, Energy
DeRome O. Dunn	Associate Professor	Ph.D. Engineering Mechanics, Virginia Tech, 1991	Engineering Mechanics: Fatigue and Fracture Mechanics
Frederick Ferguson	Professor & Chair	Ph.D., Aerospace Engineering, University of Maryland, 1993	CFD, Aerospace Propulsion Systems, Waveriders, Numerical Methods, Expert Systems & Objected Oriented Programing.
Saeil Jeon	Part time Lecture	Ph.D., Mechanical Engineering, Texas A&M Univ. College Station, 2011	Heat & Mass Transfer, Fluid Dynamics
John Kizito	Professor	Ph.D., Mechanical Engineering, Case Western Reserve University, 1996	Fluid Dynamics, Thermal Management, Astronautics, Microgravity, CFD, Physiochemical hydrodynamics
Dhananjay Kumar	Professor	Ph.D., Chemistry, Indian Institute of Technology, 1994	Condensed Matters, Nanomaterials
Jagannathan Sankar	Distinguished University Professor	Ph.D., Metallurgy and Materials Engineering, Lehigh University, 1983	Advanced and Multifunctional Materials, Structure-Property Relationships, Innovation in Process Technologies.
Kunigal Shivakumar	Professor	Ph.D., Aeronautical Engineering, Indian Institute of Science, 1979	Engineering Solid Mechanics and Polymer Composite Materials & Structures
Mannur Sundaresan	Professor	Ph.D., Virginia Tech, 1988	Engineering Science and Mechanics
Cynthia Waters	Associate Professor	Ph.D., North Carolina A&T, Mechanical Engineering, 2004	Materials including; Powder Metallurgy, Metal Additive Manufacturing Characterization
Sun Yi	Associate Professor	Ph.D., University of Michigan Ann Arbor, 2009	System Dynamics and Control

7.0 Appendix

Graded courses:

This section provides a list of all grades that may be awarded for graded courses, that is, courses that are taken both for credit and for a letter grade. Letter grades A, A-, B+, B, B-, C+, C and F correspond to a specified grade point value. The student's Grade Point Average (GPA) is calculated by adding quality points for all courses where the quality points for a course equal the grade point value times semester credit hours. Some grades do not have associated quality points and are not included in GPA calculation.

A (Excellent); 4.0 points

A-; 3.7 points

B+; 3.3 points

B (Average); 3.0 points

B-; 2.7 points

C+; 2.3 points

C (Below average); 2.0 points

F (Failure); 0 points

AU (Audit); not included in GPA

I (Incomplete until the I is removed. If not removed by the deadline the I grade becomes an F); not included in GPA

CR (Transfer Credit); not included in GPA

CE (Credit by Examination); not included in GPA

W (Withdrawal Voluntary); not included in GPA

WM (Withdrawal, Medical); not included in GPA

WA (Withdrawal, Administrative); not included in GPA

Non-Graded courses:

Certain courses are non-graded or taken for credit only. These include Continuation/Residency, Dissertation, Project, Seminar, Supervised Research, Supervised Teaching, and Thesis. The following grades may be awarded for courses that are non-graded or are taken for credit only.

S (Satisfactory)

U (Unsatisfactory)

Additionally, the following examinations, if required in the program, are recorded as either being Satisfactory (or completed) or Unsatisfactory (not completed): Comprehensive Examination, Qualifying Exam, and Preliminary Exam. The S or U grade for a non-graded or credit-only course or for a required examination will have no effect on the student's grade point average. However, courses with a required course with an S/U grade must be completed with a grade of S. A student with a grade of U in a required course will not have fulfilled his/her Plan of Study and will not be permitted to graduate. Similarly, required examinations must be passed before a student is permitted to graduate.

Finally, a student will be required to show evidence of at least a publication based on the Thesis or Dissertation work.

Plan of Graduate Study: All MS and Ph.D. students must submit a Plan of Graduate Study during the first semester of enrollment for approval by the Department and the Graduate College. The plan must be unified, and all constituent parts must contribute to an organized program of study and research that satisfies the degree requirements. The plan outlines courses, the program option, and the anticipated graduation date, among other items. The plan must be updated as necessary to keep it current. The plan serves as a contract between the student and the University for the fulfillment of degree requirements.

Indirect Requirements: (1) The final oral defense of MS or Ph.D. should be open to the public (2) Students completing graduate degree programs in Mechanical Engineering will publish technical papers in journals or peer reviewed conference proceedings to demonstrate the highest level of expertise in the discipline. The program requires evidence of paper publication to satisfy the degree requirements.

Degree Clearance Form: Upon the student applying for graduation, the Graduate College sends a notification to the Graduate Program Director who in turn submits to the Graduate College a degree clearance form including the following declarations:

(1) For Non-Course Requirements for Degree: indicate if the student has (a) Passed Required Exams (such as: Qualifying, Comprehensive)
(2) Indicate if an Approved Plan of Study has been submitted
(3) Indicate if Formal Exams are required
(4) Indicate if the Report of Committee Composition has been submitted (Ph.D. Only)
(5) For Thesis/Dissertation Candidates: indicate the following:
    a. Student is on track to meet the deadline to submit draft.
    b. Student is on track to meet/has met the final defense deadline.
    c. Corrections scheduled in time to meet final submission deadlines.
(6) Final Recommendation for Degree: the MEEN department Chair provides the following recommendation to the Graduate College:
    a. I recommend the Graduate College to award final degree clearance for this student pending final grades on his/her courses in progress and based upon my review of his/her academic record and plan of study.
    b. I do not recommend final degree clearance (with reason) for this student based on my review of his/her academic record and plan of study.

Late Work

Assignments, homework and projects must be turned in a timely manner on the assigned due date. Late submissions will be graded with progressive late penalty equal to Letter grade per week.

Class Attendance

Attendance will be taken at the beginning and end of the lectures. Late students and students who leave early will be marked absence. A priori written reasonable excuses for absences/lateness will be accepted.

Classroom Citizenship

See Student Handbook. Rule 28: Disorderly or disruptive conduct - defined as the intentional creation of a disturbance on University property or at University sponsored events including but

not limited to fighting, committing a nuisance, endangering one's own physical well-being, disrupting, disturbing, or interfering with the academic atmosphere of a living or learning environment or social activity. Technical Support If you experience any problems with your A&T account you may call Aggie Tech Support (formerly Help Desk) at 336.334.7195.

Student Travel Procedures and Student Travel Activity Waiver
Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address: Student Travel Procedures and Student Travel Activity Waiver. Additional information is available from the office of Student Affairs, please check the website.

Student Handbook:
North Carolina A&T State University has rules and regulations that govern student conduct and discipline meant to ensure the orderly and efficient conduct of the educational enterprise. It is the responsibility of each student to be knowledgeable about these rules and regulations. Please consult the undergraduate and graduate bulletins: student handbook for detailed information about specific policies such as academic dishonesty, cell phones, change of grade, disability services, disruptive behavior, general class attendance, grade appeal, incomplete grades, make up work, student grievance procedures, withdrawal, etc.
See:
http://www.ncat.edu/divisions/academic-affairs/bulletin/2014-2015/student-life/student-conduct.html

COE Academic Integrity Policy
Academic integrity is critical to maintaining high standards within the academic community. All students enrolled in the College of Engineering are expected to demonstrate academic integrity when submitting course-related work (e.g., assignments, quizzes, individual projects, and exams). Academic integrity violations, when submitting course-related work, will result in the loss of credit for the specific assignment, quiz, individual project or exam, or a grade of "F" for the course. Repeated academic integrity violations may lead to dismissal from the University. To review the North Carolina A & T State University's Academic Dishonesty Policy, please see the following URL: http://www.ncat.edu/student-affairs/student-services/dean/assets/downloads/student-handbook.pdf (pp. 40-41).

F.D. Bluford Library: An Overview
F.D. Bluford Library is the main library for North Carolina Agricultural and Technical State University located on the south side of main campus, in close proximity to the College of Engineering and Division of Research and Economic Development (DORED). Its mission is to support and advance academic scholarship and research through services, collections, technologies, expertise and spaces. The library is committed to ensuring access to global information resources that inspire exploration, discovery, and personal growth.

The Library strives to assemble a collection that supports its technology-focused institutional mission and the particular research needs of its clientele. As such, science, technology, engineering and mathematics subject areas are collected at the Research Level. Per the American Library Association Guidelines for the formulation of collection development policies,

the collection includes the major source materials required for dissertations and independent research, including materials containing research reporting, new findings, scientific experimental results, and other information useful to researchers. It also includes all important reference works and a wide selection of specialized monographs, as well as a very extensive collection of journals and major indexing and abstracting services in the field.
Library features include:

- Federal Depository Library collection, including patents and NASA technical reports
- University Archives
- Institutional Repository
- Black Studies Collection
- 200+ PC and Mac workstations
- Collaboration rooms for group study and practicing presentations
- Printed and online course reserves
- Electronic research guides
- a scanner and a copier
- Mondopad for off-site collaboration and Skype
- F.D. Zone for refreshments
- 24x7 virtual reference service
- 3D Virtual Tour
- Expanded access to university newspapers, yearbooks, theses, and dissertations is also available through the Institutional Repository. Some of the specialized software available includes MATLAB, AutoCad, Adobe CS5, SPSS, and the most current EndNote citation management software. Wireless internet is available throughout the building.

North Carolina Agricultural and Technical State University
THE GRADUATE COLLEGE

Request for Transfer of Credit

Full Name _____ _____ _____
Last *First* *MI*

Student ID Number _____ Student Email Address _____

Degree Program Select Program/Major _____ Current Term Select Current Term _____

Guidelines for Transfer of Credit from an Outside Institution

- An **official transcript** must be sent to The Graduate College from the transferring institution's Registrar's office.
- Graduate level credit hours may be credited to a graduate program at NCA&T provided the total number of credit hours transferred does not exceed 40% of the total master's degree requirements at NCA&T. Refer to "Transfer of Credits" policy in the Catalog on The Graduate College website (www.ncat.edu/tgc).
- Only graduate level courses with earned grades of "B" or above can be transferred.
- Graduate courses taken as an undergraduate student can be transferred only if they were not used to meet undergraduate degree requirements, or masters for doctoral requirements. **The bachelor's program coordinator must certify to this in writing on an attached page.**

STUDENTS COMPLETE SECTION I - SUBMIT TO ACADEMIC DEPARTMENT FOR APPROVAL

SECTION I: Requested Course(s) for Transfer					
Institution/Course	Credits	NCAT Course Equivalent	Institution/Course	Credits	NCAT Course Equivalent

Student's Signature _____ Date _____

DEPARTMENT COMPLETE SECTION II: Approved Course(s) for Transfer					
Institution/Course	Credits	NCAT Course Equivalent	Institution/Course	Credits	NCAT Course Equivalent

Department Chairperson's Printed Name _____

Department Chairperson's Signature _____ Date _____

Graduate College Only: [ ] Approved [ ] Denied [ ] Request Approved Pending final Grades [ ]

Graduate College Dean's Signature _____ Date _____

Processed by _____ Date Processed _____

The Graduate College • 1601 E. Market Street • Greensboro, NC 27411• (336) 285-2366 • Fax (336) 334-7282 • Email: grad@ncat.edu

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North Carolina Agricultural and Technical State University

THE GRADUATE COLLEGE

PLAN OF GRADUATE STUDY

Expected Graduation: Select Term

REVISED _____Date

Last:	First:	Banner ID:
Student Email:	Student Phone:	
College: Select College	Major: Select Program/Major	

Credit Hours

Required Credit Hours	Certificate	Master's	PhD
Coursework			
Master's Project			
Thesis			
Dissertation			
Total Credit Hours	0	0	0

Academic Advisor / Committee Members

Name	Department	Email
Academic Advisor/Committee Chair:		
Committee Member:		
Committee Member:		
Committee Member:		
Additional Member:		
External Member:		
Graduate College Representative:		

Comprehensive Examinations, Licensure or other Non-course/Testing requirements

Title of Thesis or Dissertation

Graduate Courses Completed at Other Institutions (Transfer Credit has been submitted and approved)

Institution/Course Number	A&T Course Equivalent (Prefix/Course Number)	Date	Credits	Grade

Note: Degree-seeking students must submit an approved Plan of Graduate Study to the Graduate College by the end of the second semester of admission to the degree program. **Changes or substitutions for required courses will require submission of a revised Plan of Graduate Study.**

Name **Banner ID:**

***CORE & ELECTIVE COURSES, Excluding final semester** (Refer to the Graduate Catalog. DO NOT include background/pre-requisite courses in this section)

Prefix, Course Number, and Title	Substituted Course (if applicable)	Credit Hours	Completion Term
Final Semester Courses (See Academic Calendar for Deadline for	the Application for Graduation)		

Total Credit Hours (NCAT)	0	
Transfer Credit Hours	0	
GRAND TOTAL CREDIT HOURS	0	

Pre-requisite and/or Background Courses	

_____ _____
(Student) Signature Date

_____ _____
Academic Advisor Name (Print) Advisor Signature Date

_____ _____ _____
Approved by Dept. Chair or Graduate Coordinator (Print) Dept. Chair or Graduate Coordinator Signature Date

Graduate Students must enroll and complete an application for graduation in the semester they plan to graduate.

Rev August 25, 2017

REPORT OF THESIS / DISSERTATION COMMITTEE COMPOSITION

Student Information

Last Name | First Name | Middle Initial | Student ID #

Expected Graduation | Tel # | Email Address | Department

Thesis or Dissertation? Briefly describe Thesis/Dissertation topic:

Proposed Thesis / Dissertation Committee

POLICY NOTE:
A **Master's Thesis committee** must be composed of *at least 3* members of the Graduate Faculty (including the committee chair).

A **Doctoral Dissertation commttee** must be composed of *at least 4* members of the Graduate Faculty (including the committee chair). For Doctoral Dissertation committees *only*, an additional committee member, the Graduate Faculty Representative, will be assigned by the Graduate College.

Committee Member Names	Department
1. _____ *Major Professor / Committee Chair*	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

Confirmation of Committee Members by Committee Chair _____ (Signature) Date

GRADUATE COLLEGE USE ONLY BELOW THIS POINT

Ph.D. Students Only: Graduate Faculty Representative
(this entry to be completed by the Graduate College)

_____ _____

Approval of Committee Members and Graduate Faculty Representative by Dean of the Graduate College _____ (Signature) Date

Thesis/Dissertation Proposal Submitted at the Preliminary Examination

Program: ☐ M.S. ☐ Ph.D.

Thesis/Dissertation Title:_____

Student _____
(Type or print) Signature and Date

Academic Advisor _____
(Type or print) Signature and Date

Graduate Program Director _____
(Type or print) Signature and Date

Components of Thesis/Dissertation Proposal

Title

The title should be brief, scientifically and technically valid, understandable to a scientifically or technically literate reader, and suitable for use in the public press.

Abstract (less than 400 Words)

The abstract should include a statement of objectives, methods to be employed, and the significance of the proposed activity to the advancement of knowledge. It should be informative to other persons working in the same or related fields.

Problem Statement

This section should be a clear statement of the work to be undertaken stating the purpose, scope, and limitations of the proposed study. It should state the relevance and important of the problem and the significance, originality, and generality of the research results.

Background

This section should summarize relevant issues and previous work. Relation of the proposed research to the present state of knowledge in the field and to work in progress elsewhere should be described.

Methodology

This section should describe the methods and experimental procedures to be used in addressing the problems stated in the Problem Statement Section.

Expected Results

This section should describe the major expected results and the anticipated contribution of the research.

Bibliography

Citations must be complete (including full name of the authors, title and location in the literature).

Benefits of the Proposal

A well-conceived Proposal should:

- ensure that the student has the approval of the topic at an early date
- provide a safeguard against duplication of research effort
- serve to minimize disasters of misunderstanding later
- help the student to develop critical questions
- help the student to isolate pending problems and suggest actions
- help the student to serve as a "map" for the research
- ensure that the proposal is not overly (or less) ambitious considering time given to the student

The research should provide a useful educational experience for the student emphasizing creativity, independent action and learning, research methodology, and scholarly approach.

Notice of Public Defense

All student dissertation/Thesis defenses shall be publicly announced two weeks prior to a student's public defense. An administrative staff member from ME sends announcement information. The following information should be included in the announcement:

- Student and Advisor names
- Program
- Dissertation or thesis
    - Abstract
    - Title of dissertation or thesis
    - Date of defense
    - Time of defense
    - Place of defense

The public announcement will be sent to graduate students and faculty, and be posted on the bulletin board or electronic scroll

MECHANICAL ENGINEERING DEPARTMENT

PhD Dissertation & MS Thesis Oral Defense Evaluation

Student Name:…….. Date: …….

Semester:…… PhD/MS:……

Presentation Title:……

Rubric for Graduate Student Performance in Communication (Presentation) – Theses, Projects, Comprehensive Examination and Dissertations

Performance Indicator	Poor 1	Good 2	Very Good 3	Excellent 4
Organization and Focus on topic (content)	There is very little or no relevance to the research problem and argument; main idea is not clear	There is some relevance to the research problem and argument; main idea is somewhat clear.	There is sufficient relevance to the research problem and argument; main idea is clear.	There is full and complete relevance to the research problem and argument; main ideas stand out.
Subject Knowledge and Accuracy of facts (content)	Student does not have a grasp of the literature, theories and information.	Student is uncomfortable with the literature, theories and information.	Student is at ease with the literature, theories and information, but fails to elaborate.	Student demonstrates full knowledge of the literature, theories and information.
Mechanics, Grammar and Spelling	Presentation and/or composition have numerous spelling errors and/or grammatical errors.	Presentation and/or composition have some misspellings or grammatical errors.	Presentation and/or composition have few misspellings or grammatical errors.	Presentation and/or composition have virtually no misspellings or grammatical errors.
OVERALL				

Rubric for Graduate Student Research/Creative Engagement - Theses, Projects, Comprehensive Examination and Dissertations

Outcome Indicator	Poor 1	Good 2	Very Good 3	Excellent 4
Identifies Research Issues	Poor ability to identify the necessary research gaps and assumptions in the state-of-the-art	Not quite able to identify the necessary research gaps and assumptions in the state-of-the-art	Reasonably able to identify the necessary research gaps and assumptions in the state-of-the-art	Fully able to identify the necessary research gaps and assumptions in the state-of-the-art
Ability to Develop a Research Plan	Poor ability to determine appropriate methodology and plan	Can, to some degree, determine appropriate methodology and plan	Reasonably able to determine appropriate methodology and plan	Quite able to determine appropriate methodology and plan
Ability to Conduct Investigations.	Cannot carry out a research plan without substantial assistance.	Fair attempt to carry out a research plan without substantial assistance	Good attempt to carry out a research plan with minimal assistance.	Fully able to carry out a research plan without assistance
Ability to Analyze Data and Draw Conclusions	Cannot reach accurate conclusions from the analysis	Can, to some degree, reach fair conclusions based on the analysis.	Can reach reasonable conclusions based on the analysis.	Fully able to reach accurate conclusions based on the analysis
OVERALL				

MECHANICAL ENGINEERING DEPARTMENT

PhD Dissertation & MS Thesis Oral Defense Evaluation

Signature Section

PhD/MS Committee Member	PhD/MS Committee Member
……	……..
PhD/MS Committee Member	Graduate College Committee Member
……	……..
PhD/MS Advisor	ME Assessment Director
……..	……..
ME Graduate Program Director	ME Chair's Signature

*Note: This form must be completed at the time/day of oral presentation along with the MS Thesis/PhD Dissertation defense form.

*Certify that you have read and graded the written Thesis/Dissertation

*Graded copy filed in the student's file

ALL Graduate Level Graded Courses

MEEN #:…….. Date: …….

Semester:……

Critical Thinking Title:……

Rubric for Critical Thinking – ALL Graduate Level Graded Courses

Outcome Indicator	Poor 1	Good 2	Very Good 3	Excellent 4
Identifies Assumptions and Context	Poor ability to think critically to identify the necessary assumptions in the theory	Not quite able to think critically to identify the necessary assumptions in the theory.	Reasonably able to think critically to identify the necessary assumptions in the theory.	Fully able to think critically to identify the necessary assumptions in the theory
Ability Identify the Relevant Information Provided in a Given Question	Poor ability to think critically to identify the relevant information	Can, to some degree, think critically to identify the relevant information	Reasonably able to think critically to identify the relevant information	Quite able to think critically to identify the relevant information
Derive and Justify Solutions.	Cannot derive accurate solutions; Has no command of the subject matter.	Fair attempt to derive accurate solutions; Has adequate command of the subject matter.	Good attempt to derive accurate solutions; Has satisfactory command of the subject matter.	Fully able to derive accurate solutions; Has full command of the subject matter.
Analyze and Draw Conclusions in relation to the subject matter	Cannot reach accurate conclusions from the analysis	Can, to some degree, reach fair conclusions based on the analysis.	Can reach reasonable conclusions based on the analysis.	Fully able to reach accurate conclusions based on the analysis
OVERALL				

Signature Section

……	……..
Instructor	Assessment Director
……..	……..
Graduate Program Director	ME Chair's Signature

*Note: This form must be completed at end of each semester.

University Student Learning Goal 2: Critical Thinking Skills

Students completing this degree program will effectively use quantitative and qualitative analytical problem-solving skills appropriate for professionals in this field of study.

Graduating students will demonstrate in one or more of the following skills:

- Competency in computational methods such as finite element methods or computational fluid dynamics (CFD)
- Use advanced calculus to formulate solution to physical problems
- Use statistical tools such as multivariate analysis, design of experiment to mathematically model and analyze complex mechanical systems to demonstrate quantitative and qualitative analysis skills.

Mechanical Engineering Graduate Students Checklist MS or PhD Student:

*Name*_____ *Banner ID……..*

	Item	*Initial and Date*
☐	*Qualifying Exam (PhD only)*	
☐	*Comprehensive Exam (MS course option only)*	
☐	*Project Exam Committee (MS project option only)*	
☐	*Committee Composition Form*	
☐	*Preliminary (Proposal) Exam Pass Form (PhD only)*	
☐	*Committee Graded Forms for Oral and Written for either Proposal/Project/Comprehensive*	
☐	*Application for Graduation (submitted at the beginning of the semester you plan to graduate)*	
☐	*Authored Publication(s) (MS Thesis) Poster/Presentation/Abstract/Conference*	
☐	*Authored Publication(s) Refereed Journal (PhD)*	
☐	*Notice of Public Defense*	
☐	*Thesis or Dissertation Defense Form*	
☐	*Committee Graded Forms for Oral and Written for either Thesis or Dissertation*	
☐	*Advanced mathematics (MATH 650, 651, 652)*	
☐	*Core Mechanical Engineering Course(s) MEEN 601, 643, and 716*	
☐	*Credits Program Requirements Course option /Project /Thesis /Dissertations*	
☐	*Thesis or Dissertation Finalized (email from GC)*	
☐	*Copy of Abstract (on bonded paper)*	
☐	*Copy of Title Page (on bonded paper with signatures)*	
☐	*Student Exit Survey (see Student Service Specialist)*	
☐	*Student Information Sheet (see Student Service Specialist)*	
☐	*Alumni Information Bio Sheet (see Student Service Specialist)*	