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DEPARTMENT OF AEROSPACE ENGINEERING

GRADUATE STUDENT HANDBOOK

REVISED FALL 2011

I. ABSTRACT

This handbook contains information regarding the administrative structure of the University and the Department and is a supplement to the Graduate College Handbook. The contents of this handbook include research interests of the departmental faculty, various policies and procedures of the department, and the graduate degree requirements.

II. INTRODUCTION

As you enter graduate study in the Department of Aerospace Engineering, you will undoubtedly have a number of questions about procedures and regulations. Answers to many of your questions can be found in a number of different publications: the Graduate Catalog which is available online at <http://www.registrar.iastate.edu/catalog/2009-11/graduate/graduatecollege.html>; the Graduate College Handbook, published by the Graduate College and available online at <http://www.grad-college.iastate.edu/publications/gchandbook/homepage.html>, and information on electronic thesis/dissertation preparation and submission which is available online at <http://www.grad-college.iastate.edu/thesis/homepage.html>. You will undoubtedly need to refer to these publications at various times during the course of your graduate program. However, there are a number of questions for which the answers are not found in current publications that are particular either to the College of Engineering or the Department of Aerospace Engineering.

III. DEPARTMENT DESCRIPTION

The department offers work leading to the degrees of Master of Engineering (with creative component), Master of Engineering (course work only option), Master of Science, and Doctor of Philosophy in each of two degree programs: aerospace engineering and engineering mechanics. Areas of specialization include: aircraft icing, composites and

structural dynamics, computational and theoretical fluid dynamics, computational nano-scale mechanics and boundary elements, elastic wave propagation and scattering, experimental aerodynamics and flow visualization, gas turbine aerodynamics and heat transfer, guidance, controls and navigation, mechanics of smart materials and structures, micro-/nano-mechanics and manufacturing, nondestructive evaluation, rotorcraft aerodynamics, spacecraft systems, trajectory optimization, ultrasonics and thermography, and wind engineering and energy.

Each Master's degree requires a minimum of 30 semester hours of graduate credits¹ in research and/or course work. The Master of Science degree program is research oriented and requires a thesis. The Master of Engineering programs include more course work in exchange for less research experience.

The Doctor of Philosophy degree is strongly research oriented and requires at least 72 semester hours of graduate research and course work plus a dissertation.² Doctoral students must also pass a written qualifier examination, written and oral prelims, and a final oral examination.

As mentioned earlier, there are a wide variety of areas of specialization in which you may pursue your degree. We encourage you to talk to faculty members and your fellow graduate students regarding your choice of a major professor and members for your

¹ As stated in Chapter 4 of the Graduate College Handbook (online and last updated June 2010), "The number of credits in a major for a master's degree will vary according to the degrees listed below. General credit requirements for all master's degrees include:

- a minimum of 30 graduate credits is required for all master's programs at ISU,
- at least 22 graduate credits must be earned at ISU (specific master's programs may require more; see descriptions in Appendix E),
- for the specialization that is considered essential for an advanced degree, approximately two-thirds of the work should be devoted to the major field, but this is not necessarily restricted to one program,
- any transfer of graduate credits from another institution must be recommended in the program of study by the POS committee, and
- graduate credit earned as a graduate student will be approved for transfer only if a B grade or better was earned.
- Two master's degrees require 22 non-overlapping graduate credits."

² As stated in Chapter 4 of the Graduate College Handbook (online and last updated June 2010), "A minimum of 72 graduate credits must be earned for a Ph.D.

- At least 36 graduate credits, including all dissertation research, must be at ISU.
- At least 24 of these credits must be earned during two consecutive semesters or during a continuous period including two semesters and a summer session while in residence at the university. (This requirement does not apply to doctoral students who are employed half time or more at ISU or government laboratories in Ames.)
- There is no specific university requirement regarding the number of credits to be taken inside or outside the major/program.
- Two Ph.D. degrees require 36 non-overlapping graduate credits."

program of study committee. Following are the graduate faculty members of the Department of Aerospace Engineering and their research interests.

GRADUATE FACULTY

Ashraf Bastawros bastaw@iastate.edu

Professor (Ph.D., Brown University, 1997). Experimental micro-mechanics; micromechanics of fracture and plasticity of crystalline solids; reliability of thin films and coatings; thermomechanical properties of cellular materials; biomaterial systems.

Dale E. Chimenti chimenti@iastate.edu

Professor (Ph.D., Cornell University, 1974). Elastic wave propagation; waves in anisotropic materials; air-coupled ultrasonics; ultrasonic nondestructive evaluation of composites.

Vinay Dayal vdalay@iastate.edu

Associate Professor and Associate Chair for Education (Ph.D., Texas A&M University, 1987). Composite materials; ultrasonic nondestructive evaluation of structures; experimental stress analysis; smart structures.

Paul Durbin durbin@iastate.edu

Professor and holder of the Martin C. Jischke Professor of Aerospace Engineering (Ph.D., University of Cambridge, 1979). Fluid mechanics (physics of turbulence, turbulence modeling), heat transfer, turbines.

David K. Holger holger@iastate.edu

Associate Provost, Dean of Graduate Studies, and Professor (Ph.D., University of Minnesota, 1974). University administration; acoustics; noise control.

Stephen D. Holland sdh4@iastate.edu

Assistant Professor (Ph.D., Cornell, 2002). Thermography, Ultrasonics, Nondestructive Evaluation.

Wei Hong whong@iastate.edu

Assistant Professor (Ph.D., Harvard University, 2006). Continuum mechanics, computational methods, modeling and simulation of microstructure of materials, mechanics of soft-active materials and electro-active polymers.

Hui Hu huhui@iastate.edu

Associate Professor (Ph.D., Beijing University of Aeronautics and Astronautics, 1996 and The University of Tokyo, 2001). Fundamentals of fluid

flow and heat transfer phenomena; active and passive control of vortex flows; bio-inspired aerodynamic designs, flapping flight and micro-air-vehicles; micro-flows and micro-scale heat transfer; wind engineering and wind energy; icing physics, aircraft and wind turbine de-icing/anti-icing; advanced optical diagnostic techniques for fluid flow and heat transfer sensing; digital signal and image processing techniques.

Valery Levitas vlevitas@iastate.edu

Professor and holder of the Schaefer 2050 Challenge Professorship (Ph.D., Institute of Superhard Materials, Kiev, 1981). Phase transformation, large inelastic deformation of materials, high-pressure research, nanomechanics, micromechanics of multiphase and composite materials, strain-induced chemical reactions in energetic materials, mechanochemistry, and computational mechanics.

Ping Lu plu@iastate.edu

Professor (Ph.D., University of Michigan, 1988). Aerospace guidance; on-board algorithms for trajectory/mission planning; nonlinear control theory and applications; flight control; optimal control.

Ambar K. Mitra akmitra@iastate.edu

Associate Professor (Ph.D., Indian Institute of Science, 1979). Boundary element method; inverse problems; computational mechanics; numerical modeling of manufacturing processes.

R. Ganesh Rajaopalan rajagopa@iastate.edu

Professor (Ph.D., West Virginia University, 1984). Computational fluid dynamics; numerical simulation of flow through rotors; aerodynamics of helicopters, propellers, tilt-rotors, and gas turbine engines; rotor body interference and wind energy conversion systems.

Alric P. Rothmayer roth@iastate.edu

Professor (Ph.D., University of Cincinnati, 1985). Computational fluid dynamics; asymptotic methods; unsteady two and three-dimensional viscous flows; stability of laminar flows; aircraft icing; flow control.

Thomas J. Rudolphi rudolphi@iastate.edu

Professor (Ph.D., University of Illinois, 1977). Boundary element methods; computational solid mechanics; analytical fracture mechanics; continuum

mechanics; viscoelastic contact.

Partha P. Sarkar ppsarkar@iastate.edu

Professor and Director of WiST Laboratory (Ph.D., The Johns Hopkins University, 1992). Wind engineering; wind-tunnel and full-scale testing of engineering structures; aerodynamics of bridges and buildings; structural dynamics; system identification applications; multimedia-based course development.

Lester Schmerr Jr. lschmerr@iastate.edu

Professor (Ph.D., Illinois Institute of Technology, 1970). Ultrasonics; nondestructive evaluation; stress waves; artificial intelligence.

Peter Sherman shermanp@iastate.edu

Associate Professor (Ph.D., University of Wisconsin, 1984). Systems theory, statistical signal processing and time series, with recent applications to machine health, brain wave analysis, climate change, quantum computing, and IC wafer scratching.

Leroy D. Sturges sturges@iastate.edu

Associate Professor (Ph.D., University of Minnesota, 1977). Rheology and non-Newtonian fluid mechanics.

Zhi J. Wang zjw@iastate.edu

Professor, Associate Chair for Research, Director of CFD Center, Wilson Chair Professor, and Director of Graduate Education (DOGE) (Ph.D., Glasgow University, 1990). Computational fluid dynamics and computational aeroacoustics, including the development of adaptive high-order methods and the application of these methods for vortex dominated flows, and LES/DNS of turbulent flows; geometry modeling and grid generation; parallel computing.

Bong Wie bongwie@iastate.edu

Professor, holder of Vance Coffman Endowed Chair, and Director of Asteroid Deflection Center (Ph.D., Stanford University, 1981). Space vehicle guidance, control, and dynamics; astrodynamics and space mission design; space technology for robotic and human exploration of near-Earth objects (NEOs); and NEO impact threat mitigation technologies.

Richard Wlezien wlezien@iastate.edu

Professor and Vance & Arlene Coffman Endowed Department Chair in Aerospace Engineering (Ph.D., Illinois Institute of Technology, 1981). Fluid mechanics, turbulent shear flows, laminar and turbulent flow control, aircraft drag reduction, and wind engineering.

Loren W. Zachary zach@iastate.edu

Professor (Ph.D., Iowa State University, 1976). Experimental stress analysis.

COURTESY APPOINTMENTS

Mark Bryden kmbryden@iastate.edu

Courtesy Appointment/Associate Professor ME (Ph.D., University of Wisconsin, 1998). Thermal-fluid sciences, combustion, CFD, power plants, decision sciences.

Abhijit Chandra achandra@iastate.edu

Courtesy Appointment/Professor ME (Ph.D., Cornell University, 1983). Mechanics of manufacturing processes; nano-scale surface modification; boundary element method.

Atul Kelkar akelkar@iastate.edu

Courtesy Appointment/Associate Professor ME (Ph.D., Old Dominion University, 1993). Control theory, robust and nonlinear control, flexible multi-body dynamics and control, control of aerospace systems, acoustic noise control, vibration control, predictive control, integrated design via multi-objective optimization, robotics, and neural networks.

James H. Oliver oliver@iastate.edu

Courtesy Appointment/Professor, ME (Ph.D., Michigan State University, 1986). CAD, virtual engineering.

Gene Takle gstakle@iastate.edu

Courtesy Appointment/Professor, Atmospheric Science (Ph.D., Iowa State University, 1971). Hydrometeorology, regional climate modeling and simulation, shelterbelt.

ADJUNCT OR AFFILIATE FACULTY

Xianglan Bai bxl9801@iastate.edu

Adjunct Assistant Professor/CSET (Ph.D., University of Tokyo, 2000). Thermochemical conversion of biomass, bio-related heat transfer, electric heating includes joule heating and dielectric heating, FEM analysis, Molecular Dynamics (MD) simulation.

Timothy A. Gray zorgon@iastate.edu

Adjunct Assistant Professor/CNDE (Ph.D., Iowa State University, 1981). Nondestructive evaluation.

Fred L. Haan, Jr.

Associate Affiliate Professor/Associate Professor at Rose-Holman (Ph.D., Notre Dame

University, 2000). Experimental aerodynamics, unsteady aerodynamics and aeroelasticity, discrete vortex simulation, wind engineering, tornado/microburst-induced wind loads.

Norio Nakagawa nakagawa@iastate.edu

Adjunct Professor/CNDE (Ph.D., University of Tokyo, 1984). Mathematical physics, constructing theoretical models of eddy-current nondestructive evaluation.

Ronald A. Roberts

rroberts@cnde.iastate.edu

Adjunct Associate Professor/CNDE (Ph.D., Northwestern University, 1984). Wave propagation and experimental ultrasonics.

IV. POLICIES AND PROCEDURES

A. Admission

The normal prerequisite for major graduate work in aerospace engineering or engineering mechanics is the completion of a curriculum substantially equivalent to that required of the corresponding undergraduate studies at Iowa State University. However, because of the diversity of interests within the graduate programs in aerospace engineering and engineering mechanics, it is possible for a student to qualify for graduate study even though their prior undergraduate or graduate education has been in engineering, physics, mathematics, or related fields. In such cases, it may be necessary for a student to take additional work to provide the requisite background.

B. English Requirement

Graduate students whose native language is not English and who do not have a bachelor's or advanced degree from ISU or any US institution must take the English Placement Test at the beginning of their first semester of enrollment. A student who does not pass this examination is assigned to one or more courses in the English 99 and 101 series. This course work must be completed during the first year of study. A graduate student whose native language is not English but did graduate from a US institution may submit the Graduate English Requirement Approval form if the following conditions are met...

- the student must have received a bachelor's, master's, or PhD degree from a US college or university, AND
- the language of instruction at that college or university must have been in English.

New graduate students who are on a **teaching assistantship (TA)** and whose first language is not English, are also required to take the Oral English Certification Test (formerly the SPEAK/TEACH test) administered by the International TA Program. This is a university-wide English speaking proficiency test required of all international TAs. The test consists of two sections...the Oral Proficiency Interview section and the TEACH teaching simulation section. **Reappointment for a teaching assistantship at the same salary is contingent upon the student achieving at least a Level 2 rating by the end of their second semester at Iowa State.**

C. Assistantships

Deserving students from the pool of admitted students are given financial support in the form of **Research Assistantships (RA) or Teaching Assistantships (TA)**. Department sources include all state, contract, and grant funds associated with faculty members of the department. Research Assistantships are offered by the individual faculty member and are based on the suitability of the admitted student for a specific project. A limited number of the admitted students are also offered a Teaching Assistantship based on the departmental needs and availability of funds. In general, RAs are offered for a year (2 academic semesters and a summer) and TAs are given for nine months (2 academic semesters). However, continuation of the assistantships (both RA and TA) from semester to semester is subject to satisfactory performance by the student both in their course work and their research work. Failing to maintain a cumulative Grade Point Average (GPA) of 3.00 will result in automatic termination of all assistantships effective immediately. Teaching Assistantships thus terminated will have a minimum waiting period of one semester and will not be considered for assistantship until their GPA is 3.00 or better.

In general Teaching Assistantships should not extend beyond four consecutive semesters or two years. Students supported on a Teaching Assistantship are expected to take the initiative (work with the faculty member they determine to be their major professor) to move their support as soon as possible to a Research Assistantship after one year of support as TA. If a TA has served two years in a row and an RA is unavailable for the third year, then that TA can receive a continued ¼-time assistantship the following year IF AND ONLY IF his/her Major Professor makes a request in writing on behalf of the student and funds are available. The request to continue as a TA must be submitted to the Department Chair before the end of the second year.

Each M.S. and Ph.D. student serving as a TA will be evaluated by his/her faculty supervisor at the end of each semester on his/her job performance as a TA for the course assigned. The job performance is rated as {excellent}, {good}, and {poor}. If {poor} is given, then an explanation must be provided by the assigned faculty supervisor. The TA-job-performance rating will be placed in the student's file in the department. **Two consecutive semesters of {poor} rating WILL cause the student's TA to be terminated.**

Under certain circumstances, it may be necessary to terminate a graduate assistantship appointment early for loss of funds or cause (i.e., academic standing, discipline). The Graduate College guidelines regarding **termination of an assistantship** are found in Chapter 9 of the Graduate College Handbook which is online at <http://www.grad-college.iastate.edu/publications/gchandbook/chapter09.html#Termination>.

D. Major Professor, Program of Study Committee

As a new graduate student in the department, you are required to select a Major Professor and Program of Study (POS) committee. It is recommended that you have your major professor selected **by the end of your first semester of graduate study** in the department. The Recommendation for Committee Appointment form is to be submitted to the Graduate College by the end of your second semester in your graduate program. This requirement to select a Major Professor and POS committee within two semesters also applies to students who are continuing on for their Ph.D. degree after completion of an M.S degree in the department. **If the Recommendation for Committee Appointment form is not submitted by the deadline, your assistantship appointment for the next semester will be deferred until it is submitted.** You are strongly encouraged to discuss your plans and interests with a number of faculty members before selecting a Major Professor. The role of the major professor is to guide you in the selection of the appropriate courses you should take to achieve your educational objectives and, also, to direct the research work or creative component for your graduate program. For information about faculty members who are actively seeking additional graduate students, please contact the Director of Graduate Education (DOGE) of the department.

The POS committee will include your Major Professor and other faculty members who will reflect your spectrum of interests for your graduate program in both course work and research. Effective Fall Semester 2006 the Graduate Council approved a change in the definition of the "outside" committee member to be someone "outside the student's field of emphasis."

The **Master's (MS or ME with creative component) POS Committee** consists of at least three members of the graduate faculty. It must include two members, including the major professor, from inside the major/program. One member of the committee

must be from outside the student's field of emphasis to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's master's research as a co-major professor if a member of the graduate faculty serves as the other co-major professor and jointly accepts responsibility for the direction of a program of study. A POS committee is not required for the course work only **MEng** degree. For this degree, the Director of Graduate Education (DOGE) will review and approve your program of study. If situations arise where input is needed from other faculty members then the graduate committee will serve the function of the POS committee.

The **Ph.D. POS Committee** consists of at least five members of the graduate faculty. It must include at least three members, including the major professor, from within the student's major/program. At least one member of the PhD POS committee must be outside the student's field of emphasis to ensure diversity of perspectives. A term member of the graduate faculty may participate in the direction of a student's dissertation research as a co-major professor if a member of the graduate faculty serves as a co-major professor and jointly accepts responsibility for direction of the dissertation.

E. Program of Study

A Program of Study must also be submitted by all graduate students (new students to study at ISU as well as those who are continuing on for their Ph.D. after completion of a Master's degree in the department) **by the end of their second semester** of graduate study in the department. **If the Program of Study form is not submitted by the deadline, your assistantship appointment for the next semester will be deferred until it is submitted.** The program of study form lists the courses and research credits you intend to take throughout your graduate program. Your POS committee will assist you in filling out a Program of Study, which is then submitted to the Graduate College for approval.

Any changes to your POS, after it is approved, are made on the Modifications to Program of Study form which is available online. This form must be signed by your major professor and committee members, the DOGE, and then sent to the Graduate College for approval.

A minimum of 30 credits is required for the Master of Science or the Master of Engineering degrees; a minimum of 72 credits is required for the Ph.D. degree. The above credit totals include research and/or creative component credits, and are subject to further restrictions of the Graduate College and those of the specific departmental majors described elsewhere in this handbook. Departmental policy is that Aerospace Engineering courses **may** be considered to be outside the student's major area for EM graduate students, at the discretion of the POS committee if they

are not cross- or co-listed with EM courses. Under similar constraints, EM courses **may** be considered to be outside the major area for Aerospace students.

The department requires students on assistantship to be registered for **a minimum of 9 credits per semester** (any combination of coursework and research credits). Until a Major Professor has been selected, course registrations must be approved by the Director of Graduate Education (DOGE). All changes to course registrations for each semester must be approved by the Major Professor or the DOGE, if a Major Professor has not yet been selected. Violation of this rule may cause the teaching assistantship (TA) or research assistantship (RA) to be terminated during that semester.

F. Examinations and Evaluations

Final oral examinations are required for all graduate degrees in the department with the exception of the course work only MEng degree. In addition, a written qualifier examination, a written preliminary examination, and an oral preliminary examination are required for the Ph.D. The POS committee is also required to complete an evaluation/recommendation form for all M.S. students wishing to continue to study for the Ph.D. in the department. Further information regarding the Ph.D. qualifier examination is located elsewhere in this handbook.

To ensure steady progress towards their degree, each M.S. and Ph.D. student will be evaluated by his/her Major Professor at the end of each semester including summer (if supported on an assistantship) on the progress that he/she made towards his/her degree during that semester. The progress towards thesis is rated as {excellent}, {good}, and {poor}. If {poor} is given, then an explanation must be provided by the Major Professor. The progress-toward-thesis rating will be placed in the student's file in the department. **If a student is funded by a TA, then two consecutive semesters of {poor} rating will cause the student's TA to be terminated. If a student is funded by an RA, then two consecutive semesters of {poor} rating may cause the student's RA to be terminated.**

G. Time Limits

According to the Graduate College Handbook, "The master's degree student is expected to complete the degree program within five years. A student beginning a Ph.D. degree program at ISU with a master's degree is expected to complete the program within five years, while a student beginning a Ph.D. degree program without the master's degree is expected to complete the program within seven years. If warranted, the student's major professor and the program's DOGE may request by letter that the Dean of the Graduate College extend these time limits."

H. Facilities and Supplies

Stationary and Office Supplies

These items **will not be provided by the department** unless they are required for a student's teaching assistant assignment.

Photocopying

Photocopying on departmental copy machines is limited to **departmental business only**. **Copies for your personal use are not to be made on these machines**. The department **does not provide transparencies** for research meetings and/or oral exam presentations. Please see your major professor if transparencies are required for this type of research activity.

Office Space, Furniture, and Telephone Usage

Office space, furniture and telephone are provided for the **use of Aer E/EM graduate students only**. Since it is necessary for multiple students to be assigned to an office, please be considerate of your office mates and their belongings. Keep phone calls at a reasonable length so the phone is available to everyone. If you are listening to music while studying, please keep it at a low decibel so as not to interfere with others as they work or study. Keep visitors to a minimum; if you are meeting others to go to dinner or such, you can use any of the outer areas to meet them (i.e., the atrium area). Keep food to a minimum; there are other places in the building to eat meals and food kept in desk drawers or on shelves can draw unwanted pests. To prevent an odor from food items, please take waste items home for disposal...do not leave them in the waste baskets. **DO NOT SMOKE IN YOUR OFFICE**. This is a state regulation -- ALL university buildings are non-smoking. Each graduate student office should have a blue recycling container. **Only white paper** is to be disposed of in this container. Place all other waste in your office trash can. It is also requested that students take their turn at emptying the blue recycling bin in their office as the custodial staff does not empty this. If you do not know where the recycling is to be emptied, please see office staff in 1200 Howe.

Mail

Graduate students are not to have personal mail sent to the departmental mailing address. This causes a problem when the student leaves Iowa State as the post office will not forward mail to their new address when it has a current address at Iowa State University.

V. GRADUATE DEGREE REQUIREMENTS

A. *Ph.D. Qualifier Exam – Aerospace Engineering & Engineering Mechanics*

To qualify as a Ph.D. student in Aerospace Engineering **OR** Engineering Mechanics, a student must successfully pass a qualifier examination. This exam will be given twice during each academic year. According to the current schedule students who already have a Master's degree are required to take the examination according to the following table:

Semester of entry into PhD program	1 st Attempt	2 nd Attempt
Summer (June)/ Fall (August)	the first Saturday of Spring Semester	the Saturday just prior to the start of Fall Semester
Spring (January)	the Saturday just prior to the start of Fall Semester	the first Saturday of Spring Semester

Students who are admitted to the PhD program directly without a Master's degree can take the qualifier one semester later than the above schedule. Each graduate student must take three parts of the qualifier exam: the math exam, the exam for the student's declared area of specialization, and one minor exam chosen by the student from the **specific list of exams below....restricted to your declared major**. Each student must give a list of the three exams he/she is planning to take at least four weeks before the exam. (Note: Study guides for topics covered in the exams are available in the Departmental Office.)

- Math (one exam)
- **Engineering Mechanics** (any **two** of the following exams): Strength of Materials, Rigid Body Dynamics, or Fluid Mechanics
- **Aerospace Engineering** (any **two** of the following exams): Aircraft Structures, Incompressible/Compressible Aerodynamics, Orbital Mechanics and Controls, or Stability and Flight Mechanics

A student's score will be presented to the full faculty and the pass-fail decision will be made by a faculty vote. The passing score is approximately 70% on each of the three exams.

Students in both majors are given two opportunities to pass the qualifier examination. If a student does not pass the exam in the first attempt, the exam **must be taken the next time it is given**. A student will not be allowed to change the subject areas for the student's second attempt.

B. Major in Aerospace Engineering

Master of Engineering (with creative component) – A minimum of 27 credits of acceptable course work, at least 18 credits of which must be graduate course work in Aerospace Engineering along with a minimum of 3 credits of Aer E 599 (creative component) must be taken. The POS for this degree must include at least one course from each of the four following Aer E core areas.

Master of Engineering (course work only option) – A minimum of 30 credits of acceptable course work, at least 18 credits of which must be graduate course work in Aerospace Engineering must be taken. The POS for this degree must include at least one course from each of the four following Aer E core areas.

Master of Science – A minimum of 21 credits of acceptable course work, at least 15 credits of which must be graduate course work in Aerospace Engineering. In addition, a minimum of 9 credits in AerE 699 (thesis research) must be taken and an acceptable thesis is required. The POS for this degree must include at least one course from 3 of the 4 following Aer E core areas.

Aerospace Engineering Core Areas

Aircraft Structures

1. Aer E 521 - Airframe Analysis
2. EM 525 - Finite Element Analysis
3. Aer E 569 - Mechanics of Composite and Combined Materials
4. EM 514 - Advanced Mechanics of Materials

Astrodynamics and Flight Dynamics

1. Aer E 551 - Orbital Mechanics
2. Aer E 577 - Linear Systems
3. Aer E 578 - Nonlinear Systems
4. EM 548 - Advanced Engineering Dynamics

Incompressible/Compressible Aerodynamics

1. Aer E 541 - Incompressible Flow Aerodynamics
2. Aer E 532 - Compressible Fluid Flow
3. Aer E 543 - Viscous Flow Aerodynamics

Guidance, Navigation, and Control

1. Aer E 556 - Guidance and Navigation of Aerospace Vehicles
2. Aer E 531 - Automatic Control of Flight Vehicles
3. Aer E 573 - Random Signals and Kalman Filtering
4. Aer E 574 - Optimal Control

Doctor of Philosophy – The Graduate College requires a minimum of 72 credits for a Ph.D. degree. The department's requirements include a minimum of 36 credits of acceptable course work, at least 24 credits of which must be graduate course work in Aerospace Engineering. You must also have a minimum of 9 credits of acceptable course work from outside the major. Courses related to the history, philosophy, sociology or political aspects of science and technology are strongly encouraged. Some course work at the 600 level is expected in all Ph.D. Programs of Study. The minimum of 36 credits of course work may include appropriate 590, 690 and experimental course credits. The POS for this degree must include one course from 3 of the 4 Aer E core areas listed above. The remainder of the POS is to be determined by the student and the POS committee.

Each graduate student is required to present an open seminar as the first portion of the final thesis defense.

C. Major in Engineering Mechanics

Master of Engineering (with creative component) – A minimum of 24 credits of acceptable course work, at least 18 credits of which must be graduate work in Engineering Mechanics, or a closely related specialty. In addition, a minimum of 3 credits of acceptable mathematics and 3 credits in E M 599 (creative component) must be taken. The POS for this degree must include at least one course from each of the following E M core areas.

Master of Engineering (course work only option) – A minimum of 30 credits of acceptable course work, at least 18 credits of which must be graduate work in Engineering Mechanics, or a closely related specialty. In addition, a minimum of 3 credits of acceptable mathematics must be taken. The POS for this degree must include at least one course from each of the following E M core areas.

Master of Science – A minimum of 18 credits of acceptable course work, at least 12 credits of which must be graduate work in Engineering Mechanics, or a closely related specialty. In addition, a minimum of 3 credits of acceptable mathematics and 9 credits in E M 699 (thesis research) must be taken. The POS for this degree must include at least one course from 3 of the 4 following E M core areas:

Engineering Mechanics Core Areas

Solid Mechanics/Mechanics of Materials

1. E M 514 – Advanced Mechanics of Materials
2. E M 510 – Continuum Mechanics
3. E M 516 – Mechanics of Deformable Solids
4. E M 564 – Fracture and Fatigue

Fluid Mechanics/Aerodynamics

1. Aer E 541 – Incompressible Flow Aerodynamics
2. Aer E 532 – Compressible Fluid Flow

Dynamics/Vibrations/ Wave Mechanics

1. E M 548 – Advanced Engineering Dynamics
2. E M 518 – Waves in Elastic Solids with Applications to Ultrasonic NDE
3. E M 543 – Introduction to Random Vibrations and Nonlinear Dynamics

Computational Mechanics

1. E M 525 – Finite Elements Analysis
2. Aer E 546 – Computational Fluid Dynamics
3. Math 561 and Math 562 – Numerical Analysis I and II

Doctor of Philosophy – The Graduate College requires a minimum of 72 credits for a Ph.D. degree. The department's requirements include a minimum of 36 credits of acceptable course work, at least 24 credits of which must be graduate work in Engineering Mechanics, or a closely related specialty. The Ph.D. candidate must complete 12 credits total of acceptable course work from outside E M, at least 6 of these credits must be acceptable mathematics courses. Courses related to the history, philosophy, sociology or political aspects of science and technology are strongly encouraged. The course work may also include appropriate 590 or experimental course credits. In addition, a minimum of 36 credits in EM 699 (thesis research) must be taken. The POS for this degree must include one course from 3 of the 4 EM core areas listed above. The remainder of the POS is to be determined by the student and the POS committee.

Each graduate student is required to present an open seminar as the first portion of the final thesis defense.

D. Preliminary Exam

For the Ph.D. degree in both Aerospace Engineering and in Engineering Mechanics, you must take a Preliminary Examination which is administered by your POS committee. This is an oral examination over your PhD research and related technical topics. A set of written materials which document your PhD research must be

provided to your POS committee members at least one week prior to the oral examination. While the exact nature of the written materials given to your POS committee members is decided in consultation with your major professor, the written materials must consist of some combination of: i) an early draft dissertation or written overview of your research; ii) copies of technical publications; iii) a literature review; iv) a plan for completion of your PhD dissertation, as well as any other supporting materials. During the oral examination, the POS committee members may also ask you questions about technical topics and coursework related to your field of study. The individual POS committee members are given broad latitude in their selection of questions to be asked during the examination. The purpose of the preliminary examination is to assess your progress towards completion of your dissertation, evaluate your research and establish your depth of understanding of your field of study. The examination must be passed **no later than six months prior to your final exam** (dissertation defense). If you fail all or part of the preliminary oral examination, then you may retake the exam. Six months must elapse between the first attempt and the next.

E. Co-Majors and Minors

There are no minors required for either Master's degrees or the Ph.D. As previously indicated courses outside the major are encouraged for the Master's degree and required for the Ph.D. However, outside courses need not be necessarily all from one area. If you wish to declare a minor, one member of your Program of Study committee must be from that minor department – he/she would be listed as a minor representative.

The minor requirements, in terms of specific courses, are determined by your POS committee and/or your minor representative. It is unusual to declare a minor at the Master's level. If you do, you would probably take 7-10 credits designated as minor credits. For a Ph.D. declared minor, usually 10-20 credits are designated as minor credits. Some departments may have requirements that must be satisfied for declared minors outside their department. You should consult with your minor representative for specific course requirements.

A co-major is more common than a minor. According to the Graduate College Handbook...“A co-major is a program of study for a single degree in which the requirements for two separate majors are met. A joint major is similar to a co-major but is only available in specific participating programs. In both programs, the single degree is granted when the student fulfills the requirements of both majors. The program of study (POS) committee will include co-chairs, each of whom represents one of the co-majors. Both co-chairs must be members of the graduate faculty. The same person, if a faculty member in both majors, will be allowed to serve as major professor for both majors. A preliminary oral examination and research work for the

Ph.D. degree should be related to both majors. Students declaring co-majors or joint majors must satisfy requirements established by each major as monitored by the representatives on the program of study (POS) committee and the DOGEs of the two majors. A co-major or joint major cannot be added after the preliminary oral examination has been taken.”

VI. ADDITIONAL INFORMATION

A. *Letter of Intent*

All graduate assistants must sign a letter of intent for the department offering the assistantship. The letter of intent establishes the amount of the monthly stipend, length of appointment, and the number of hours of service per week during the appointment. **It should be understood that the letter of intent is an agreement between the department and the student. The student is an employee of the university and is expected to fulfill his/her responsibilities from the first day of the letter of intent through the end of the semester or the end date of the letter of intent.**

B. *Leave*

Per the Graduate College Handbook...”Arrangements for a leave of absence are made between the graduate assistant and that assistant’s supervisor. When a graduate student employee needs to be absent either for personal reasons or illness, the supervisor should be understanding and accommodating to that need. At the same time, the graduate assistants should attempt to plan personal leave so that it does not interfere with or cause neglect of the duties associated with his or her appointment. Supervisors of graduate assistants are responsible for ensuring that their assistants do not exceed reasonable limits for leave.”

Therefore, the department has determined that the vacation/leave of absence for graduate students should be allocated to all regular “university holidays” (days when the university offices are closed for business) and an additional two weeks of vacation. Please note that Spring Break is not a university holiday and time between Fall and Spring Semesters is not a university holiday. (Ex: TAs are expected to be available when classes resume at the beginning of the semester.) You should confirm your vacation plans with your immediate supervisor/major professor and then notify the graduate secretary of your travel dates by completing the Travel Notification Form (Personal) for Aer E Graduate Students. If your travel plans should exceed the two weeks, your salary may be adjusted accordingly.

C. Prescription Drug Benefit Program

Per the Graduate College Handbook...“Graduate Students receive single coverage free of charge in a program that reduces the cost of prescription medication available at the Thielen Student Health Center Pharmacy. Spouse and children can receive the prescription benefit if they are enrolled in the ISU Student and Scholar Health Insurance Plan and the payroll deduction option is chosen for payment of premium. For further information, browse the Web site at <http://www.hrs.iastate.edu/sship/homepage.html> or contact the Thielen Student Health Center Pharmacy at 515-294-7983.”

D. Health Insurance

Per the Graduate College Handbook...“Graduate assistants receive single student coverage free of charge under the ISU Student and Scholar Health Insurance Plan. Coverage for hospital, accident expenses, surgical care, and maternity care are included. Graduate assistants may enroll their spouse and children for an additional premium. An enrollment form must be completed before the Semester Enrollment Deadline or within the first 30 days of the date of appointment, whichever is later.

The health insurance plan is from Aetna Student Health. A copy of plan information is available on-line at <http://www.hrs.iastate.edu/sship/homepage.html>. For further information, contact Aetna Student Health at 1-800-466-2381 or the ISU Student Health Insurance Representative in 0570 Beardshear, 515-294-4820. Graduate assistants do not participate in the ISU staff medical plans.”

E. Graduate Students on Assistantship

“Students hired to teach or to perform research that is part of their educational program should be hired as graduate assistants, **not** as hourly employees, unless those duties do not involve ISU facilities or faculty supervision” (Graduate College Handbook). This applies to summer support as well. Graduate assistants must register and pay tuition and fees for each term in which they hold an appointment. Students on full or provisional admission with graduate assistantships of ¼-time or more (for three months or more during the academic term) are assessed C-base (same as resident) tuition and fees. Non-resident students on full or provisional admission with graduate assistantships of ¼-time or more (for three months or more during the term) retain their non-residency classification, but are assessed C-base tuition and fees as long as the graduate assistantship is continued. Students on appointment (1/4-time or more) for more than five class days but less than three months of the term are assessed fees by the credit hour according to residency and are not eligible for scholarship credit. Students on appointment for less than five class days are not required to register. The Graduate College’s minimum registration requirement for a graduate assistant is at least the equivalent of 2 credits.

F. Graduate Tuition Scholarship Awards

Graduate students on full or provisional admission and who are appointed to graduate assistantships of $\frac{1}{4}$ -time or more, except those also holding traineeships or fellowships that provide funds for payment of tuition and/or fees, are assessed tuition at the C-base (same as resident) rate and fees. In addition these students are eligible for a Graduate Tuition Scholarship award covering a portion of the C-base tuition. (Note: Students on restricted admission or on academic probation who may be on assistantship are not eligible for the scholarship tuition funds...any exceptions must be approved by the Dean of the Graduate College.) The scholarship awards are:

- For Master's students
 - $\frac{1}{2}$ -time or greater appointment – 50% of resident tuition costs
 - $\frac{1}{4}$ - to $\frac{1}{2}$ -time appointment – 25% of resident tuition costs

- For Ph.D. students
 - $\frac{1}{2}$ -time or greater appointment – 100% of resident tuition costs
 - $\frac{1}{4}$ - to $\frac{1}{2}$ -time appointment – 50% of resident tuition costs

For fall and spring semesters, a student must be on appointment for at least three months of the semester to qualify for a scholarship award. For summer session, a student must be on appointment for at least six weeks of the term to qualify for a Graduate Tuition Scholarship award. For all terms, appointment papers must have been processed by the Graduate College before the end of the first full month of classes (i.e., usually around the fifth week of the fall or spring semesters). Graduate tuition scholarships not used by the due date of the second fee payment installment will be forfeited.

G. Tenure of Appointment

Per the Graduate College Handbook..."Assistantship appointments are made fiscal year by fiscal year. Because of this, each appointment is made for one year or less. Appointments may be terminated for two reasons only: 1) for cause, or 2) loss of funding. Termination for cause is discussed in [Chapter 9](#). The satisfactory completion of one appointment, plus satisfactory academic performance, will ordinarily make a student eligible for reappointment. However, departments have the discretion not to reappoint. Failure to reappoint is not termination and is not subject to formal appeal. Departments do have an obligation to provide reasonable notice if reappointment is not to be made. Also, programs may make commitments to support students for periods longer than one year. Such commitments are not formally treated as appointments. Students should obtain the terms of such commitments in writing. Assistantship support for more than seven or eight years is strongly discouraged, and

departments may set limits on the number of years a student is eligible for assistantship support.”

During the period of appointment, the university provides services and equipment essential to the performance of the assistant's duties, taking into account practical limitations of the resources of the university.



VII. GRADUATION SCHEDULE

The following is a summary of the examinations and preparations you need to follow for graduation. The items marked with an * must be submitted to the Graduate College and, except for those that are multi-page forms (indicated with a +), are available for completion at the following website:

<http://www.grad-college.iastate.edu/forms/forms.html>

<i>ITEM</i>	<i>COMPLETION DATE</i>
Major Professor	It is recommended that your major professor be selected by the end of 1st semester of graduate program.
Program of Study Committee *	Submitted by the end of 2nd semester of graduate program (recommendation of the Graduate College as well as the department).
Program of Study (POS) *	Submitted by the end of 2nd semester of graduate program (recommended by Graduate College as well as the department).
Qualifier Exam (PhD only)	See schedule on page 12.
Preliminary Exam (PhD only; written exam)	Scheduled and passed prior to preliminary oral exam.
Request for Preliminary Exam (PhD only; oral exam) * +	Submitted at least two weeks prior to proposed date for prelim exam; must be passed at least six months prior to final oral exam.
Application for Graduation (Diploma Slip) *	Submitted by the end of the first week of classes the planned semester of graduation.
Request for Final Oral Exam * +	Submitted at least three weeks prior to the proposed date of oral exam.
Final Oral Examination	See "Finishing up your Master's or Ph.D. degree" flier for specific dates. ³
Final submission of thesis or dissertation	See "Finishing up your Master's or Ph.D. degree" flier for specific dates. ³
Graduate Student Approval Slip	Required of every degree candidate. Must obtain signatures and return to Grad College. See "Finishing up your Master's or Ph.D. degree" flier for specific dates.

³ Available at Graduate College office, 1137 Pearson Hall or online at <http://www.grad-college.iastate.edu/deadline/deadlines.html>

