

DEPARTMENT OF ENVIRONMENTAL ENGINEERING AND EARTH SCIENCES

GRADUATE STUDENT HANDBOOK FOR THE ACADEMIC YEAR 2023-2024

VERSION 1



MS Degrees: Biosystems Engineering (BE)
Environmental Engineering & Science (EES)
Hydrogeology (HYDR)

PhD Degrees: Biosystems Engineering (BE)
Environmental Engineering & Earth Sciences (EEES)

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1.0 INTRODUCTION

We, the faculty and staff in the Department of Environmental Engineering and Earth Sciences (hereafter designated as the *EEES Department* or, more simply, the *Department*), are glad that you have chosen to pursue your graduate studies here, and we look forward to getting to know you better during your time at Clemson. **It is extremely important that you read this Handbook because it is your responsibility as a graduate student to keep track of your progress in the degree program.**

The first four sections of this Handbook inform graduate students in the Department about academic affairs and regulations pertaining to the granting of advanced degrees. Students should become familiar with this information, as well as with the general Graduate School requirements available from: <https://www.clemson.edu/graduate/>

Also become familiar with the Graduate School policies and procedures, available at:

<https://www.clemson.edu/graduate/students/policies-procedures/index.html>.

The final chapters discuss graduate assistantships and miscellaneous departmental, university, and laboratory policies.

While we have attempted to make sure that all material in this Handbook is consistent with policies set forth by the Graduate School, there may be instances in which there are differences. In that event, the Graduate School policies take precedence, *unless the graduate degree program requirements in question are more stringent than the minimum requirements specified by the Graduate School.*

2.0 REGISTRATION

2.1 Graduate Program Coordinators in the Department

- For the 2023-2024 academic year, Professor Mark Schlautman serves as the Graduate Program Coordinator for the MS degree in Environmental Engineering and Science (EES) and PhD degree in Environmental Engineering and Earth Sciences (EEES).
- For the 2023-2024 academic year, Professor Ron Falta serves as the Graduate Program Coordinator for the MS degree in Hydrogeology (HYDR).
- For the 2023-2024 academic year, Professor Christophe Darnault serves as the Graduate Program Coordinator for the MS and PhD degrees in Biosystems Engineering (BE).

The Graduate Program Coordinators should be contacted whenever questions or problems occur relative to regulations and procedures pertinent to their graduate degree programs.

Barbara Smith serves as the Graduate Student Services Coordinator for all graduate students in the Department.

2.2 Registration for New Graduate Students

Prior to registration for their first semester of study, beginning graduate students must communicate with their advisor and/or their respective Graduate Program Coordinator who will help them plan their initial program of study. As needed, the Graduate Program Coordinator will help identify suitable major advisors. Registration may be accomplished through iROAR, the on-line registration portal (www.registrar.clemson.edu/portal/) provided by the Office of Registration Services, prior to arriving on campus.

2.3 Registration Procedures for All Graduate Students

The Office of Registration Services provides an on-line registration portal (www.registrar.clemson.edu/portal/) with links to registration procedures, schedule of classes, etc., that may be referred to for steps to be taken in the registration process. If a student's questions are not answered by consulting the on-line resources, including this Handbook, please contact the appropriate Graduate Program Coordinator or the Graduate Student Services Coordinator. The *minimum* credit requirements for graduate students in the Department are provided in Table 2.1. Exceptions to these requirements may exist for students who are supported by funding from outside of Clemson University. Students are responsible for checking for additional requirements for full-time

status, visa status, insurance, fellowships, or other considerations.

Note: There are different requirements for students supported by an assistantship.

Table 2.1. Minimum Credit Requirements for Graduate Students in the Department

Student Status*	Fall	Spring	Long Summer	SS-I[‡]	SS-II[‡]
Supported-full or partial					
Full time, class and/or research	9	9	6	3	3
Full time, thesis writing only	9	9	6	3	3
Part-time, class and/or research	not allowed: supported students must be full-time				
Part-time, thesis writing	not allowed: supported students must be full-time				
Off-campus	not allowed: supported students must be full-time				
Student Status*	Fall	Spring	Long Summer	SS-I	SS-II
Not Supported					
Full-time, class and/or research	9	9	6	3	3
Full-time, thesis writing only	9	9	6	3	3
Part-time, classes only	credits of classes taken				
Part-time, class & research or just research	3	3	2	1	1
Part-time, thesis writing, on-campus	3	3	2	1	1
Off-campus, thesis writing	1	1	2	1	1

***INTERNATIONAL STUDENTS SHOULD CHECK WITH THE OFFICE OF GLOBAL ENGAGEMENT'S INTERNATIONAL SERVICES TO CLARIFY THE NUMBER OF CREDITS REQUIRED FOR THEIR SPECIFIC VISA.**

[‡]SS-I and -II = first and second summer terms, respectively.

2.4 Section Assignments

Table 2.2 lists section numbers that should be used when signing up for courses such as research (8910 and 9910) and special topics:

Table 2.2. Section Numbers for Graduate Directing Faculty in the Department

COURSE		SECTION	USERID	NAME
BE	8910/9910	001	CDRAPCH	Drapcho, Caye
BE	8910/9910	002	WALKER4	Walker, Terry
BE	8910/9910	003	TOWINO	Owino Tom
BE	8910/9910	004	DVANEGA	Vanegas, Diana
BE	8910/9910	005	CDARNAU	Darnault, Christophe
BE	8910/9910	006	HUANC	Huan, Chen
EES	8910/9910	001	NMARTI3	Martinez, Nicole
EES	8910/9910	002	DEVOL	DeVol, Timothy A.
EES	8910/9910	003	TKARANF	Karanfil, Tanju
EES	8910/9910	004	CDARNAU	Darnault, Christophe
EES	8910/9910	005	KTF	Finneran, Kevin
EES	8910/9910	006	LC	Lee, Cindy M.
EES	8910/9910	007	BFLINCH	Flinchum, Brady
EES	8910/9910	008	AMETCAL	Metcalf, Andrew
EES	8910/9910	009	FALTAR	Falta, Jr. Ronald W.
EES	8910/9910	010	DFREEDM	Freedman, David L.
EES	8910/9910	011	LADNER	Ladner, David
EES	8910/9910	012	LSHULLE	Shuller-Nickles, Lindsay
EES	8910/9910	013	LMURDOC	Murdoch, Lawrence C.
EES	8910/9910	014	BPOWELL	Powell, Brian
EES	8910/9910	015	ECARRAW	Carraway, Elizabeth R.
EES	8910/9910	016	MSCHLAU	Schlautman, Mark A.
EES	8910/9910	018	TOWINO	Owino, Tom
EES	8910/9910	019	CDRAPCH	Drapcho, Caye
EES	8910/9910	020	WALKER4	Walker, Terry
EES	8910/9910	021	ECATES	Cates, Ezra
EES	8910/9910	022	MADALE	Dales, Michael
EES	8910/9910	023	SOPAT	Popat, Sudeep
EES	8910/9910	028	JBREGY	Bregy, Josh
EES	8910/9910	029	HUANC	Huan, Chen
GEOL	8910	001	APULLEN	Pullen, Alexander
GEOL	8910	002	FALTAR	Falta, Ron
GEOL	8910	003	KLAZAR	Lazar, Kelly
GEOL	8910	004	LMURDOC	Murdoch, Lawrence
GEOL	8910	005	CDARNAU	Christopher Darnault
GEOL	8910	006	LC	Lee, Cindy M.
GEOL	8910	007	BFLINCH	Flinchum, Brady

2.5 Maximum Enrollment Limits

The University sets limits on the maximum number of credits (graduate and undergraduate credits combined) that graduate students may earn in a given term, as specified in the Graduate School Policies and Procedures Handbook. All requests for permission to exceed these limits must be approved by the graduate student's advisor and the Dean of the Graduate School.

3.0 POLICIES AND PROCEDURES FOR MASTER OF SCIENCE (MS) DEGREES

3.1 Introduction

These policies were adopted by the faculty of the Department on 10 March 1997, and govern all students matriculating in the master's program after August 2015. These policies supersede the policies dated 10 March 1997, 17 January 1986 and 2 March 1985. [Amended: 14 November 1986; 15 August 1989; 20 August 1990; 30 August 1990; 1 February 1991; 13 December 1991; 18 August 2003; 26 August 2011; 26 August 2011; 12 August 2015; 12 August 2016; 18 August 2018; and 16 September 2019; 28 August 2023] Academic policies and procedures are posted on the Graduate School website: <https://www.clemson.edu/graduate/students/policies-procedures/index.html>

3.2 Major Advisor

Every MS student must have a major advisor who is responsible for chairing advisory committee meetings. The major advisor/committee chair must be a Graduate Directing Faculty (see the Graduate School Policies and Procedures Manual for appropriate definitions) and hold a regular or administrative faculty appointment in the EEES Department. In consultation with their major advisor, MS students will select the other members of their advisory committee. If desired, an advisory committee co-chair may be selected. Faculty holding Graduate Advising or Graduate Directing Faculty status are eligible to serve as co-chair of the committee.

MS thesis students supported by a teaching assistantship should select a major advisor during the first semester following matriculation if one is not already selected. The advisor will guide the day-to-day research activities and the preparation of the thesis. The advisor also helps plan the student's curriculum. The selection of the advisor is one of the most important decisions facing the graduate student.

During each semester, all MS students receiving financial assistance and pursuing the thesis option should meet with their advisor to discuss their research project on a regular basis. Students funded under a teaching assistantship will be contacted by the Department Chair or an instructor regarding their TA assignment near the beginning of the semester.

All matriculating students not receiving financial assistance are considered non-thesis students. Non-thesis students should select a major advisor during the first semester following matriculation and meet with their advisor at least once per semester. In special cases, a student not receiving financial assistance may request permission to pursue thesis research. For these

special situations, the student must make a written request to the appropriate Graduate Coordinator who will either approve or deny the request based on student qualifications, department resources available, etc.

3.3 Advisory Committee

The MS advisory committee must consist of a minimum of three members, all of whom must be Graduate Advising or Graduate Directing Faculty. The majority of the MS advisory committee, including the chair, must be full-time Clemson University regular or administrative faculty. In addition, a majority of the MS advisory committee must have a primary appointment in the EEES Department. If a student declares a minor, this area must be represented on the advisory committee.

If appropriate, an external advisory committee member (i.e., non-Clemson Faculty) may be selected as described below in Section 3.3.1, subject to the constraints listed above. An external committee member will be given the status of Graduate Advising Faculty and approved to be a regular member of the MS advisory committee only.

Graduate School policy states that the MS advisory committee must be formed no later than the middle of the second semester after matriculation. However, we strongly encourage MS students to form their advisory committees sooner as indicated in Table 3.2.

3.3.1 External Committee Members

The appointment process for an external member to a MS advisory committee must be initiated by the submission of a formal request from a tenured or tenure-track Department faculty member to the corresponding TPR committee. This request must include a current and complete resume from the potential candidate. Although the candidate's resume does not need to be in the exact CECAS format, it should contain the same key information such as: education, complete employment history, all peer reviewed publications, and grants and contracts. Candidates typically will have an earned PhD in a pertinent field to be approved for serving on a MS advisory committee, although exceptions may be allowed based on sufficient professional experience and associated credentials. The TPR committee will consider the request for approval as a Graduate Advising Faculty and make a positive or negative recommendation about the appointment to the advisory committee. The appointment must then be approved by a majority of the voting Department faculty.

Once an external advisory committee member has been approved by the Department faculty, a student may submit a request to add the external member as outlined in the Graduate School Policies:

<https://www.clemson.edu/graduate/students/external-advisor.html>

Previously, non-Clemson individuals had to seek approval for appointment as an adjunct professor in the EEES Department before they could serve on graduate student advisory committees. The external committee member procedure described above simplifies this process. Nevertheless, the Department maintains an active list of adjunct faculty members (<https://www.clemson.edu/cecas/departments/ees/people/index.html#associatedfaculty>) who continue to be available for serving as external members of graduate student advisory committees.

3.3.2 Role of the Committee

The MS student advisory committee will perform the following functions:

- specify required co-requisite/remedial courses, if deemed necessary (both the thesis and non-thesis options);
- approve course work/GS2 Plan of Study (both the thesis and non-thesis options);
- supervise the research program (thesis option only);
- administer the final oral examination (both the thesis and non-thesis options);
- approve the MS thesis (thesis option only); and
- make a recommendation to the Graduate School for awarding the degree (both the thesis and non-thesis options).

Note: Co-requisite/remedial courses are specified by the advisory committee to resolve deficiencies in a student's educational background and must be completed before receipt of the MS degree.

3.4 Curriculum Requirements for MS Degrees

There are four unique degree tracks/programs at the MS level in the EEES Department: 1) Biosystems Engineering (BE); 2) Environmental Engineering and Science (EES); 3) Environmental Engineering and Science – Environmental Health Physics (EHP); and 4) Hydrogeology (HYDR).

3.4.1 Biosystems Engineering

For the thesis option of the MS degree in **Biosystems Engineering** (BE), the following requirements apply:

- A minimum of 24 hours of graduate course credits, exclusive of thesis research and seminar;
- At least one-half of the total graduate credit hours required by the Advisory Committee, exclusive of thesis research, must be selected from courses numbered 8000 or above;
- 9 graduate credits of coursework with engineering rubric (excluding special topics courses), of which 6 credit hours should be of the BE

- course rubric;
- 6 hours of thesis research;
- STAT 8010;
- 3 credit hours of additional coursework that emphasizes advanced mathematics, i.e., courses with the Mathematics, Engineering or Experimental Statistics (STAT prefix) rubric;
- A minimum of one credit of BE 6510;
- Submission of one manuscript to a peer-reviewed journal;
- A maximum of 3 credit hours of special topics (regardless of rubric); and
- Attendance in EES 8610 during the fall semester and BE 6510 during the spring semester.

Course work for the MS degree in Biosystems Engineering is typically completed in two years. An oral defense is required for the thesis. A non-thesis option is available for Biosystems Engineering students (*see Section 3.8 below*).

Remedial coursework for Biosystems Engineering students is required for those who do not have an ABET-accredited (or equivalent) undergraduate degree. The remedial coursework consists of:

- Basic math courses through differential equations (MATH 2080);
- Freshmen chemistry and biology courses that include laboratories; and
- Three of the listed engineering science courses required for undergraduates majoring in Biosystems Engineering. These include Statics, Dynamics, Fluids, Mechanics of Materials, Thermodynamics, and Circuits; consult the BE undergraduate curriculum to determine equivalent courses.

3.4.2 Overview: EES, EHP & HYDR

For the MS degree tracks in Environmental Engineering and Science (EES), Environmental Health Physics (EHP) and Hydrogeology (HYDR), the following requirements apply:

- A minimum of 24 hours of graduate course credits, exclusive of thesis research and seminar requirements. At least one-half of the non-research, non-seminar courses listed on the GS2 must be numbered 8000 or above; *
- A minimum of 6 hours thesis research (EES 8910 or GEOL 8910); *
- Attendance in EES 8610 or GEOL 8510 during the fall and spring semesters.

*** NOTE: not applicable for the non-thesis option – see Section 3.7.1.**

Prerequisite and co-requisite courses do not count toward the 24 semester hours of graduate credit required for the degree. Prerequisite and co-requisite courses are specified by the faculty to resolve deficiencies in a student's educational background. Prerequisite courses typically must be completed before admission as a graduate student, whereas co-requisite courses must be completed before receipt of the MS degree. **Note:** *any pre-requisite or co-requisite course taken at Clemson will be included in the overall GPA, which must be 3.0 or above to be in good academic standing.*

3.4.3 Required Core Courses for the MS in EES

All MS students pursuing the Environmental Engineering and Science degree are required to take three core courses (unless a similar course was previously taken and accepted by the EES Graduate Program Coordinator or Department Chair), constituting a total of nine credit hours.

- EES 8020, Environmental Engineering Principles;
- EES 8430, Environmental Chemistry; and
- EES 8510, Biological Principles of Environmental Engineering,
or
EES 8150, Radiobiology (*EHP students only*)

3.5 Focus Areas for the MS in EES

Each student pursuing an MS in Environmental Engineering and Science (EES) will choose one of the following five focus areas and meet the requirements listed. Substitutions and changes will be allowed upon written approval of the student's advisor and the EES Graduate Program Coordinator. Filing of the GS2-Committee Selection and Plan of Study Forms is required by the end of the student's second semester.

In addition to the three core classes listed above, the five focus areas below specify 3 to 9 credit hours in required courses (typically 9) and typically another 3 from an approved list of electives. A program of the three core courses, three required courses in a focus area, and an elective in the focus area constitutes 21 of the minimum 24 credit hours of course work for the thesis-based MS degree.

3.5.1 Process Engineering Focus Area

The purpose of the process engineering focus area is to prepare graduates to design engineered systems for removing contaminants from air, water, and soil – an activity that is central to the field of environmental engineering. Because of the continually evolving nature of the problems faced by environmental engineers, courses in this area focus on the approach to problem solving rather than on specific solutions to today's problems. This provides the students with a strong foundation in unit operations and the

ability to assemble them into process trains capable of solving any pollution control problem, regardless of its complexity or nature.

Required Courses:

- EES 8030 Physicochemical Operations I
- EES 8060 Process and Facility Design for Environmental Control Systems (at least 3 credit hours)

Approved Electives: (at least one required)

- EES 8040 Biochemical Operations in Wastewater Treatment Systems
- EES 8330 Combustion and Air Pollution Control Systems
- EES 6370 Biodegradation and Bioremediation

Other courses on appropriate subjects may be substituted upon approval of the student's Advisory Committee.

Suggested Electives:

EES 6300	Air Pollution Engineering
EES 6840	Municipal Solid Waste Management
EES 8050	Environmental Unit Operations Laboratory
EES 8320	Air Pollution Meteorology
EES 8330	Combustion and Air Pollution Control Systems
EES 8450	Environmental Organic Chemistry
EES 8470	Advanced Environmental Chemistry
EES 8560	Pollution of the Aquatic Environment
EES 8800	Environmental Risk Assessment
CHE 6010	Transport Phenomena
CHE 6500	Chemical Reaction Engineering
CHE 8050	Chemical Engineering Kinetics
CHE 8140	Applied Numerical Methods in Process Simulation
MICRO 6100	Soil Microbiology

NOTE: *The above suggested courses are a sampling of recent course offerings. Students are encouraged to consult current course offerings.*

Example programs of study for the first three semesters within the Process Engineering focus area are outlined in Table 3.1, based on five subareas:

Table 3.1. Example Course Sequences for Process Engineering Focus Area
(NOTE: Seminar and research requirements are not shown in table below)

Wastewater Treatment			Biological Treatment		
Fall	Spring	Fall	Fall	Spring	Fall
EES 8020	EES 8030	EES 8060	EES 8020	EES 6370	EES 8060
EES 8430	EES 8040	Elective 2	EES 8430	EES 8030	Elective 1
EES 8510	Elective 1	Elective 3*	EES 8510	EES 8040	Elective 2*
Physicochemical Treatment			Hazardous Waste Treatment		
Fall	Spring	Fall	Fall	Spring	Fall
EES 8020	EES 8030	EES 8060	EES 8020	EES 8030	EES 8060
EES 8430	Elective 1	Elective 3	EES 8430	Elective 1	EES 6370
EES 8510	Elective 2	Elective 4*	EES 8510	Elective 2	Elective 3*
Air Pollution Control					
Fall	Spring	Fall			
EES 8020	EES 8030	Elective 2			
EES 8430	EES 8330	Elective 3			
EES 8510	Elective 1	Elective 4*			

*These electives would be taken by non-thesis students.

3.5.2 Environmental Chemistry Focus Area

The overall goal of the Environmental Chemistry focus area is to introduce the fundamental concepts important to environmental chemistry. In particular, the focus is on understanding sources of chemicals in the environment and the characteristics of the chemical and the environment that control fate and effects. Also of interest are the physical, chemical and biological processes that affect the behavior of inorganic and organic contaminants in natural and engineered systems and how these properties may be exploited to detect, quantitatively model and control the contaminants in environmental systems.

Required Courses (at least one):

- EES 8450 Environmental Organic Chemistry
- EES 8460 Inorganic Environmental Geochemistry

Approved Electives: (at least three required)

- EES 6370 Biodegradation and Bioremediation
- EES 8030 Physicochemical Operations I
- EES 8170 Applied Process Simulation
- EES 8330 Combustion and Air Pollution Control Systems
- EES 8340 Particles in the Atmosphere
- EES 8330 Combustion and Air Pollution Control Systems
- EES 8450 Environmental Organic Chemistry
- EES 8460 Inorganic Environmental Geochemistry

- EES 8470 Advanced Environmental Chemistry
- EES 8560 Pollution of the Aquatic Environment
- EES 8800 Environmental Risk Assessment
- ETOX 6370 Ecotoxicology
- ETOX 8060 Advanced Environmental Toxicology
- PLPA 8090 Analytical Techniques in Plant Science
- GEOL 8090 Subsurface Remediation Modeling

Other courses on appropriate subjects may be substituted upon approval of the student's Advisory Committee.

Other Suggested Courses:

EES	6300	Air Pollution Engineering
EES	6840	Municipal Solid Waste Management
EES	6850	Hazardous Waste Management
EES	6860	Environmental Sustainability
EES	8030	Physicochemical Operations I
EES	8130	Environmental Radiation Protection Lab 3 (1,6)
EES	8170	Applied Process Simulation
EES	8320	Air Pollution Meteorology
CH	8110	Analytical Chemistry
CH	8120	Chemical Spectroscopic Methods
CH	8160	Separation Science
CH	8350	Chemical Kinetics
CHE	6010	Transport Phenomena
CHE	6500	Chemical Reaction Engineering
CHE	8050	Chemical Engineering Kinetics
CHE	8140	Applied Numerical Methods in Process Simulation
ETOX	6300	Toxicology
ETOX	8060	Advanced Environmental Toxicology
ETOX	8520	Ecological Models
ETOX	8540	Aquatic Toxicology
STAT	8010	Statistical Methods I 4 (3,3)
STAT	8040	Sampling
GEOL	6820	Groundwater and Contaminant Transport
GEOL	8080	Groundwater Modeling
GEOL	8100	Analytical Methods for Hydrogeology
GEOL	8750	Hydrogeology Summer Field Camp
MICR	6100	Soil Microbiology

NOTE: *The above suggested courses are a sampling of recent course offerings. Students are encouraged to consult current course offerings.*

3.5.3 Subsurface and Surface Processes Focus Area

The main objective of the Subsurface and Surface Processes Focus Area is to provide students with the knowledge and training needed to deal with transport and fate processes in engineered and natural systems. Natural systems include the atmosphere, surface waters and subsurface waters. Incorporation of the results of transport analyses into management decisions involving monitoring and remediation often requires the quantification and analysis of various real and perceived risks, so an additional objective is to provide the basic tools needed for risk and decision analysis. A fundamental, quantitative understanding of all these processes is emphasized, so that students will be able to adapt readily to ever-changing conditions in the real world.

Required Courses (two out of three):

- EES (GEOL) 8080 Groundwater Modeling
- EES 8800 Environmental Risk Assessment
- EES (GEOL) 8170 Applied Process Simulation

Approved Electives Group A: (at least two required)

- EES (GEOL) 8080 Groundwater Modeling
- EES 8800 Environmental Risk Assessment
- EES (GEOL) 8170 Applied Process Simulation
- EES (GEOL) 8090 Subsurface Remediation Modeling
- EES 6370 Biodegradation and Bioremediation
- GEOL 6590 Biogeochemistry
- EES 8420 Actinide Chemistry
- EES 8450 Environmental Organic Chemistry
- EES 8470 Advanced Environmental Chemistry

Approved Electives Group B: (at least one required)

- GEOL 6130 Stratigraphy
- GEOL 6210 GIS Applications in Geology
- GEOL 6820 Groundwater and Contaminant Transport
- GEOL 8010 Field Geophysical Techniques
- GEOL 8030 Geostatistics
- GEOL 8060 Aquifer Characterization
- GEOL 8140 Environmental Sedimentology
- GEOL 8160 Aquifer Systems
- GEOL 8180 Hydrogeology of Fractured Aquifers
- GEOL 8750 Hydrogeology Summer Field Camp

Other courses on appropriate subjects may be substituted upon approval of the student's Advisory Committee.

3.5.4 Sustainable Systems & Environmental Assessment Focus Area

The Sustainable Systems and Environmental Assessment focus area is designed to challenge students to think about environmental systems in a broader context.

The objective of the curriculum is to provide a basis for the analysis of complex interactions between human and natural systems. The required courses cover fundamental principles of systems analysis and risk assessment while the electives allow students to define a path of study that encompasses the three domains of sustainability: economy, society, and environment.

Students must choose classes to meet each of the five core skills and at least one class in each of the three domains: economy, society, environment, as depicted in the table below, with some suggested choices provided. Students must take one of the two required courses (see below) but are free to choose which classes to take to meet these requirements. Students must discuss the matter with their advisory committee and give suitable reasoning for their choices. Course choices are subject to approval by the advisory committee.

CORE SKILLS	ECONOMIC	SOCIAL	ENVIRONMENTAL
1. Systems analysis & modeling	<ul style="list-style-type: none"> MGT 8660 	<ul style="list-style-type: none"> PRTM 8800 	<ul style="list-style-type: none"> EES 8200 CRP 8340 ETOX 8410 BIOL 6410
2. Data collection and analysis	<ul style="list-style-type: none"> CPSC 8650 		<ul style="list-style-type: none"> GEOL 6090 STAT 8150
3. Decision support and decision-making	<ul style="list-style-type: none"> DSA (MGT) 8590 ECON 6400 	<ul style="list-style-type: none"> PSYC 8720 IE 8030 PADM 8700 	<ul style="list-style-type: none">
4. Communication	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> PADM 8480 PADM 8850 COMM 8050 ENGL 8320 	<ul style="list-style-type: none"> WFB 8550
5. Infrastructure systems	<ul style="list-style-type: none"> APEC 8130 ECON 6280 	<ul style="list-style-type: none"> CRP 8020 CE 8410 	<ul style="list-style-type: none"> CE 8390

Required Courses: (one out of two)

- EES 8200 Environmental Systems Analysis
- EES 8800 Environmental Risk Assessment

Potential Electives:

- APEC 6570 Natural Resource Economic Theory and

APEC	8100	Natural Resources Management and Policy
APEC	8110	Economics of Environmental Quality
BIOL	6410	Ecology
BIOL	6430	Freshwater Ecology
CE	6360	Sustainable Construction
CE	6370	Sustainable Energy Project Design and Analysis
CPSC	8300	Systems Modeling
CRP	8340	Spatial Modeling Using GIS (note pre-requisites)
CRP	8000	Human Settlement
CRP	8030	Site Planning and Infrastructure
CRP	8060	Urban Systems and Growth Management
CRP	8140	Public Transit
CRP	8410	Seminar in Environmental Planning
CRP	8450	Water Policy and Law (POST 8450)
CRP	8700	Seminar in Sustainable Development
ECON	6400	Game Theory
EES	8200	Environmental Systems Analysis
EES	8800	Environmental Risk Assessment
ENR	6130	Restoration Ecology
ENR	6290	Environmental Law and Policy
ENR	6500	Conservation Issues
ENSP	6720	Environmental Planning and Control
ETOX	6300	Toxicology
ETOX	8410	Procedures and Techniques in Ecological Risk
ETOX	8520	Ecological Models
ETOX	8540	Aquatic Toxicology
GEOL	6210	GIS Applications in Geology
HLTH	6980	Improving Population Health
IE	6870	Industrial Safety
IE	8030	Engineering Optimization and Application
MATH	6030	Introduction to Statistical Theory
MATH	6340	Advanced Engineering Mathematics
MATH	6410	Stochastic Models
ME	6200	Energy Sources and Their Utilization
POST	8700	Seminar in Sustainable Development
PRTM	8490	Sustainable Event Management
PRTM	8500	Sustainable Tourism: Myth or Reality?
SOC	6330	Globalization and Social Change
SOC	8360	Environmental Sociology
STAT	8010	Statistical Methods I

STAT 8150 Environmental and Ecological Statistics

Other courses on appropriate subjects may be substituted upon approval of the student's Advisory Committee.

3.5.5 Environmental Health Physics

Environmental Health Physics (EHP) is designed to address broad environmental issues associated with anthropogenic and natural radioactivity. The objective of the curriculum is to provide students with knowledge and training needed to protect human health and the environment from ionizing radiation. Integral to this program is assessing risk associated with ionizing radiation. Research areas include low-level radiation detection, analytical techniques to quantify stable elements utilizing radiation, environmental monitoring, radionuclide transport, radioactive waste management, and risk assessment.

Educational Objectives

The educational objectives of the EHP are for its alumni to demonstrate following a few years after graduation:

- EHP alumni will advance in responsibility in their careers through addressing contemporary problems in environmental health physics
- EHP alumni will make significant professional contributions in independent research, project leadership or professional leadership

NOTE: *the Environmental Health Physics program is accredited by the Accreditation Board for Engineering and Technology (ABET) Applied and Natural Science Accreditation Commission (ANSAC), <http://www.abet.org>, under the General Criteria and the Health Physics Program Criteria. .*

Required Courses:

- EES 6100 Environmental Radiation Protection
- EES 8020 Environmental Engineering Principles
- EES 8110 Ionizing Radiation Detection and Measurement
- EES 8150 Radiobiology
- EES 8430 Environmental Engineering Chemistry
- EES 8800 Environmental Risk Assessment

Approved Elective Courses:

- BIOE 6310 Medical Imaging
- EEES 6010 Environmental Engineering
- EES 6140 Radioecology

- EES 6300 Air Pollution Engineering
- EES 6850 Hazardous Waste Management
- EES 8030 Physicochemical Operations I
- EES 8080 Groundwater Modeling
- EES 8090 Subsurface Remediation Modeling
- EES 8120 Environmental Nuclear Engr. (Radioactive Waste Mgt.)
- EES 8130 Environmental Radiation Protection Laboratory
- EES 8160 Technical Nuclear Forensics
- EES 8180 Nuclear Culture
- EES 8200 Environmental Systems Analysis
- EES 8320 Air Pollution Meteorology
- EES 8330 Air Pollution Control Systems
- EES 8420 Actinide Chemistry
- EES 8440 Environmental Engineering Chemistry Laboratory I

- EES 8450 Environmental Engineering Chemistry II
- EES 8550 Surface and Subsurface Transport
- GEOL 6150 Analysis of Geological Processes
- GEOL 8030 Geostatistics
- ME 6260 Nuclear Energy
- MATH 6340 Advanced Engineering Mathematics
- MATH 8050 Data Analysis
- PHYS 6520 Atomic and Nuclear Physics
- PADM 8510 Fundamentals of Emergency Management
- PADM 8520 Emergency Management Planning and Preparation
- PHYS 6520 Nuclear and Particle Physics
- PHYS 8550 Physics of Nuclear Medicine
- STAT 8010 Statistical Methods I
- STAT 8040 Sampling

NOTE: Other courses on appropriate subjects may be substituted upon approval of the student's Advisory Committee.

3.6 MS in Hydrogeology

The objective of the Hydrogeology MS degree program is to train students for a career in hydrogeology.

Students are expected to demonstrate strong capabilities in the Earth Sciences including competency in Physical Geology, Structural Geology, and Sedimentology and Stratigraphy. Students who have not taken courses in these Earth Science topics at the undergraduate level must either take them as a graduate student, or have this expectation waived by their graduate committee.

Quantitative skills are important to a successful career in hydrogeology. All graduate students in the hydrogeology program are required to take GEOL 8080 to provide a foundation for groundwater modeling skills. Graduate students who have not taken a course in differential equations are required to take GEOL 6150.

The foundations of nearly all hydrogeology projects are based on data obtained in the field. Hydrogeology graduate students are required to take GEOL 8750 to acquire an introduction to field methods.

Required Courses

- GEOL 8080 Groundwater Modeling
- GEOL 8750 Hydrogeology Field Camp

Other Requirements

Graduate students must take a minimum of two additional 8000-level courses, to be selected from the following:

- GEOL 8010 Field Geophysical Techniques¹
- GEOL 8030 Geostatistics
- GEOL 8050 Advanced Stratigraphy¹
- GEOL 8060 Aquifer Characterization¹
- GEOL 8090 Subsurface Remediation Modeling
- GEOL 8100 Analytical Methods for Hydrogeology¹
- GEOL 8110 Rock Physics¹
- GEOL 8130 Environmental Geochemistry
- GEOL 8140 Environmental Sedimentology¹
- GEOL 8160 Aquifer Systems
- GEOL 8170 Applied Process Simulation
- GEOL 8180 Hydrogeology of Fractured Aquifers¹

¹These courses are inactive as of 2018, but they may be offered in the future.

3.7 Non-Thesis Option for the MS Degrees

3.7.1 EES and Hydrogeology

A non-thesis option is available for the MS degrees in EES and Hydrogeology upon approval by EES Department faculty. The non-thesis option consists of a minimum of 30 semester hours of graduate coursework approved by the student's advisory committee, and students must pass a final oral exam. Coursework by students in the non-thesis option normally includes the courses required for the EES or Hydrogeology MS degree. A minimum of 21 hours must be at the 8000-level.

Students in the non-thesis option must complete a research project supervised by a faculty member, and present the project during their final oral exam. The

research project can be used for up to 3 credits of a Special Problems course (either EES 8810 or GEOL 8810).

Students in the non-thesis option are not eligible for research or teaching assistantship appointments, but are eligible for graduate internships or other sources of support. A student who has received assistantship support at any time while a graduate student in the EEES Department is not eligible for the non-thesis option except under rare circumstances that must be approved by the appropriate Graduate Coordinator and Department Chair.

3.7.2 Biosystems Engineering

A non-thesis option is available for the MS degree in Biosystems Engineering upon approval by the EEES faculty. The non-thesis option consists of a minimum of 30 semester hours of graduate coursework approved by the student's Advisory Committee, and students must pass a final oral exam. The following requirements apply:

- A minimum of 30 hours of graduate course credits (including 1 hour of graduate seminar), with at least one-half at the 8000 level or above;
- 9 graduate credits of coursework with engineering rubric (excluding special topics courses), of which 6 credit hours should be of the BE rubric;
- EXST 8010;
- 3 credit hours of additional coursework that emphasizes advanced mathematics, i.e., courses with the Mathematics, Engineering or Experimental Statistics rubric;
- Attendance BE 6510 (BE seminar) is required one semester;
- Attendance in EES 8610 (EEES seminar) for all other semesters;
- A maximum of 3 credit hours of special topics (regardless of rubric);
- Students in the non-thesis option must complete a research project supervised by a faculty member, and present the project during their final oral exam. The research project can be used for up to 3 credits of a Special Problems course (BE 8810).

Students in the non-thesis option are not eligible for research or teaching assistantship appointments, but are eligible for graduate internships or other sources of support. A student who has received assistantship support at any time while a graduate student in the EEES department is not eligible for the non-thesis option except under rare circumstances that must be approved by the BE Graduate Coordinator and EEES Department Chair.

3.8 Curriculum Development - GS2 Form

All students are expected to develop an area of study consisting of one of the areas of specialization above with the advice and consent of their advisory committee.

The GS2 Form should be completed as soon as the student talks with their advisor and determines the course of study they will pursue; but no later than the end of the second semester for MS students. The GS2 is an electronic form that serves to appoint the Graduate Advisory Committee in Part 1 and notifies the Graduate School of all the classes the student will take to fulfill their degree requirements in Part 2. **It is important to note that any class listed on one's GS2 must be completed before graduation. If changes are necessary, a revised GS2 must be filed.**

Information about the electronic GS2 form and answers to FAQs may be found at:

<https://www.clemson.edu/graduate/students/plan-of-study/index.html>

3.9 MS Thesis (*thesis option only*)

3.9.1 Proposal

The MS thesis proposal is a persuasive document intended to describe the worthiness of the proposed research. It should be a concise document that is at least five pages in length when double-spaced, not including the title page and references. MS students must complete the final draft of their proposal by the end of their second semester. Guidelines for the proposal are described in Section 5.

The proposal is developed with the help of the advisor and advisory committee. The approach and procedure vary somewhat from advisor to advisor, so students should discuss the process with their research advisor early. The purpose of the proposal is to create a research plan. Actual activities may vary as conditions and initial results dictate.

The research proposed should be worthwhile and tractable. At the center of the proposal, there should be a clear hypothesis to be tested and/or a set of objectives. The material before the objectives should give the necessary background and lead to why the hypotheses/objectives are worth pursuing. After the objectives are stated, a research plan should be presented aimed at attaining the objectives. Students should review the central parts of the proposal, especially the objectives, with their advisor, and then produce an initial draft.

The student's advisor will review the first draft and offer suggestions for changes. Upon approval of the advisor, electronic or hard copies will be distributed to the other committee members for their review and approval. A sample proposal title page can be found at:

<http://www.clemson.edu/cecas/departments/ees/about/form-files.html>

Upon approval of the thesis proposal, complete the MS Submission Proposal form at: <https://forms.gle/Yansv3PUoco6r3v97> so that the GS-ResearchApproval form can be submitted to your committee by the Graduate Student Services Coordinator.

3.9.2 Completion of the MS Thesis

The first draft of the thesis should be completed at least eight weeks before the date of the final oral examination. Refer to Section 5 for details for preparing the thesis.

3.9.3 Final Oral Examination for the MS Thesis

The final oral examination is given no later than approximately three weeks before graduation, under the authority of the student's advisory committee in accordance with Graduate School deadlines, found at:

<http://www.clemson.edu/graduate/students/deadlines.html>

The MS thesis committee should receive a final draft at least 10 working days before the scheduled defense.

The student is responsible for scheduling the examination, in consultation with the chair of the committee and its members, and notify the Graduate Student Services Coordinator by completing the Department Exam form at <https://forms.gle/E8Cb21P9FTfZEtrX9>. The student is also responsible for notifying the Graduate School (via the Graduate School web site at <https://www.clemson.edu/graduate/calendar/defense-form.html>) at least 10 days before the defense to place the date and location on the calendar. During the examination, MS thesis students will be expected to orally present the findings of the research, support various aspects thereof, and be questioned on integrated knowledge of related coursework. The Graduate School will be notified of the time and place of the examination at least ten days prior to the time scheduled. Procedurally, the examination consists of a 30- to 45-minute presentation made by the student followed by questions posed first by non-committee members present and then by the members of the student's advisory committee.

Satisfactory performance on the final examination will result in a favorable report to the Deans of Engineering, Computing and Applied Sciences and the Graduate School. The GS7M form will be prepared for the advisory committee by the Student Services Coordinator and will be signed by the committee after all revisions to the thesis have been approved by the committee.

Unsatisfactory performance on the final examination, as determined by the advisory committee, will result in at least one of the following actions: (a)

additional work on the thesis and resubmission of the thesis to the advisory committee for further review; (b) additional study in the environmental engineering & science field and reexamination; or c) failure on the exam. In the case of failure, the advisory committee is required to submit a written report to the Deans of the College of Engineering, Computing and Applied Sciences and the Graduate School that the student failed the final examination. The advisory committee may specify the nature of the reexamination. A second failure on the final examination may, at the discretion of the examining committee, result in the student being declared ineligible for an MS degree at Clemson University.

3.10 MS Non-Thesis Oral Examination

The final oral examination for non-thesis MS students consists of a short (15-20 minute) technical presentation based on the special project and questions on material from five courses that are selected by the student and the advisory committee chair. The examining committee is the same as the advisory committee listed on the student GS2. The non-thesis exam takes place in a closed session.

3.11 Application for Graduation

Early in the semester that the student intends to graduate, the student must apply to graduate through iROAR. Go to "Student Record" and select "Apply to Graduate." Deadlines for each graduation can be found at: <https://www.clemson.edu/graduate/students/deadlines.html>

3.12 Checkout and Exit Interview

Before graduation, students must complete a checkout form and an Exit Interview Form. When the form is completed, the student should contact the Student Services Coordinator and schedule an exit interview. The checkout form ensures that all research materials are provided to the advisor, labs are clean and samples are archived or disposed of properly, etc. The exit interview is part of the assessment process for the faculty to continuously improve the curriculum and graduate experience for the students.

3.13 Jurisdiction/Authority

This Handbook is subject to periodic review and revision by the faculty of the EEES Department. Each MS student is subject to the policies in effect at the time of matriculation in their degree program. If policies change, a student may petition in writing the Department faculty for approval, or disapproval, of changing to the new policies.

3.14 Exceptions to Policy

A student may be granted an exception to this policy for the MS degree if they petition the Department faculty in writing and receive a favorable action.

3.15 Master's Student Checklist

Table 3.2 provides a checklist for milestones in the Master of Science degree program.

Table 3.2: Checklist for Master's Students

What		When	How/Who
1.	Selection of major advisor	Before end of 1 st semester	Notify Student Services Coordinator of choice
2.	Appointment of Advisory Committee	Before end of 1 st semester	In consultation with advisor and committee
3.	Preparation of study program	Before end of 1 st semester	In consultation with major advisor
4.	Filing of Committee Selection and study plan	Before end of 2 nd semester	GS2 Form by student
5.	Approval of thesis or project proposal	Before end of 2 nd semester	Signed thesis or project proposal submitted to graduate student file
6.	Graduation application	After completion of at least 15 hours of course work and early in the semester during which degree is expected	iROAR by student
7.	Submittal of thesis or schedule the non-thesis exam	For thesis: 1st draft at least 8 weeks before date of final examination; final (advisor approved) copies at least 10 days before final examination For non-thesis: Schedule oral exam so that it can be completed well before final grades are due.	By student
8.	Final examination (oral)	At least 3 weeks prior to graduation (see Graduate School schedule for date)	GS7 Form to be filed by advisor after examination is completed
9.	Cap and gown rental	Early during semester in which degree is to be conferred	By student
10	Final Checkout	At least one week prior to graduation	Obtain all required signatures on checkout form and make appointment for exit interview

4.0 POLICIES AND PROCEDURES FOR THE PhD DEGREE

4.1 Introduction

These policies were adopted by the faculty of the Department on 10 March 1997, and govern all students matriculating in the Doctoral program after August 2011. These policies supersede the policies dated 10 March 1997, 17 January 1986 and 2 March 1985. [Amended: 14 November 1986; 15 August 1989; 20 August 1990; 30 August 1990; 1 February 1991; 13 December 1991; 18 August 2003; 26 August 2011; 12 August 2015; 12 August 2016; 10 October 2017; 18 August 2018; 16 September 2019 and 28 August 2023. Academic regulations pertaining to the various degree programs are available on the Graduate School web page:

<http://www.clemson.edu/graduate/students/policies-procedures/index.html>.

4.2 Advisory Committee

Every PhD student must have a major advisor who is responsible for chairing the advisory committee meetings. The major advisor/committee chair must be a Graduate Directing Faculty (see the Graduate School Policies and Procedures Manual for appropriate definitions) and hold a regular or administrative faculty appointment in the EEES Department. The PhD student, in consultation with their major/research advisor, selects the other members of their advisory committee. If desired, an advisory committee co-chair may be selected. Faculty holding Graduate Advising or Graduate Directing Faculty status are eligible to serve as co-chair of the committee.

The PhD advisory committee must consist of a minimum of four members, all of whom must be Graduate Advising or Graduate Directing Faculty. The majority of the PhD advisory committee, including the chair, must be full-time Clemson University regular or administrative faculty. At least one half of the PhD advisory committee must have a primary appointment in the EEES Department. If a student declares a minor, this area must be represented on the advisory committee.

If appropriate, an external advisory committee member (i.e., non-Clemson Faculty) may be selected as described below in Section 4.2.1, subject to the constraints listed above. An external committee member will be given the status of Graduate Advising Faculty and approved to be a regular member of the PhD advisory committee only.

Graduate School policy states that the PhD advisory committee must be formed no later than the beginning of the fourth semester of the doctoral program. However, we strongly encourage PhD students to form their advisory committees sooner as indicated in Table 4.1.

4.2.1 External Committee Members

The appointment process for an external member to a PhD advisory committee must be initiated by the submission of a formal request from a tenured or tenure-track Department faculty member to the corresponding TPR committee. This request must include a current and complete resume from the potential candidate. Although the candidate's resume does not need to be in the exact CECAS format, it should contain the same key information such as: education, complete employment history, all peer reviewed publications, and grants and contracts. Candidates must have an earned PhD in a pertinent field to be approved for serving on a PhD advisory committee. The TPR committee will consider the request for approval as a Graduate Advising Faculty and make a positive or negative recommendation about the appointment to the advisory committee. The appointment must then be approved by a majority of the voting Department faculty.

Once an external advisory committee member has been approved by the Department faculty, a student may submit a request to add the external member as outlined in the Graduate School Policies:

<https://www.clemson.edu/graduate/students/external-advisor.html>

Previously, non-Clemson individuals had to seek approval for appointment as an adjunct professor in the EEES Department before they could serve on graduate student advisory committees. The external committee member procedure described above simplifies this process. Nevertheless, the Department maintains an active list of adjunct faculty members (<https://www.clemson.edu/cecas/departments/eees/people/index.html#associatedfaculty>) who continue to be available for serving as external members of graduate student advisory committees.

4.2.2 Role of the Committee

The PhD Advisory Committee will perform the following functions for students:

- Specify required co-requisite/remedial courses, if deemed necessary
- Approve their plan of study (GS2);
- Supervise their graduate program and dissertation research;
- Administer the qualifying, comprehensive, and final examinations; and
- Make a recommendation to the Graduate School for awarding of the PhD degree.

4.3 Curriculum Development

A plan of course work is developed by the PhD student with the assistance of the research advisor and input from the advisory committee. This is normally

done before the end of the second semester after matriculation, but must be no later than the beginning of the fourth semester. This plan is formally submitted to the Graduate School on the electronic GS2 Form, which consists of two parts. Part 1 is the appointment of the committee and Part 2 is the plan of study. Instructions for the GS2 form are located at:

<http://www.clemson.edu/graduate/students/gs2-hints.html>

PhD students without an MS may opt to include courses, etc., on their GS2 that will satisfy the requirements of an MS degree as well as their PhD program. This option allows the student to obtain an MS degree once the MS degree requirements have been satisfied. Information about this option is shown in Section 4.6 below.

4.3.1 PhD in Environmental Engineering and Earth Sciences

The PhD degree requires at least 30 credits beyond the master's degree and at least 60 credits beyond the bachelor's degree. A minimum of 12 credit hours of non-research, non-seminar coursework and a minimum of 18 hours of dissertation research are required for the PhD. Courses listed on the GS2 Form must be completed prior to graduation. If changes are necessary, a revised GS2 must be submitted. Work in a minor field, if declared, normally requires 12 to 24 hours in courses carrying graduate credit. All resident EEES PhD students must register for EES 9610 (seminar) each term that it is offered.

4.3.2 PhD in Biosystems Engineering

Requirements include:

- A minimum of 18 hours of dissertation research, of which 3 credits must be in Experimental Statistics;
- Submission of 2 manuscripts to peer-reviewed journals;
- A maximum of 3 credit hours of special topics (regardless of rubric); and
- Enrollment in BE 6510 (seminar) once during the PhD program.

A research proposal is due to the graduate committee within the first year of study.

The combination of coursework must represent at least 30 hours beyond the MS degree. Courses listed on the GS2 Form must be completed prior to graduation. If changes are necessary, a revised GS2 must be submitted.

4.4 Qualifying Examination

The qualifying examination will serve to examine the ability of a student to apply the knowledge of Environmental Engineering and Earth Sciences or Biosystems Engineering, with an emphasis in the student's area of

specialization, to contemporary problems encountered during PhD level work. The exam is intended to be a "gateway" to the PhD program in which a student demonstrates that they have the necessary critical thinking skills required to complete the PhD degree and provide convincing evidence of a student's intellectual mastery of their PhD coursework.

- The qualifying exam will be taken no more than 12 months after the student's matriculation into the PhD degree program.
- In order to sit for the qualifying exam, students must have at least a 3.4 GPA after completing 2 semesters and at least 12 credit hours of 6000/8000 level lecture or laboratory courses. Students who do not have greater than a 3.4 GPA are not eligible to continue in the PhD program and may consider matriculating into the MS degree program upon approval of his/her advisor. Students who enter the PhD program with an MS degree may take the qualifying exam without having taken any courses at Clemson University. The material covered on the exam will be the same as for students who have taken EES courses. If a student who enters the PhD program with an MS degree opts to take courses before taking the qualifying exam, then the minimum 3.4 GPA applies.
- The examining committee for the qualifying exam will consist of the Major Advisor plus the other three PhD advisory committee members as described in Section 4.2.
- The format of the qualifying exam shall be at the discretion of the examining committee, but will typically be a written and oral exam. The questions will be devoted to examining the student in his/her focus area. The student may discuss the expected areas and format of the exam with members of the examining committee. Within one week of completing the written exam, the committee will administer an oral exam, which will emphasize follow-up on the written exams.
- Satisfactory performance on the qualifying exam will result in the student being declared eligible to continue in the PhD program and begin working towards their comprehensive exam (a written and oral discussion of the proposed dissertation research).

Unsatisfactory performance on the qualifying examination will be determined at the sole discretion of the examining committee with the student either:

- a) being allowed to be reexamined on all or part of the exam, in oral and/or written format, or
- b) being declared ineligible for the PhD degree in the department. In

either case, the reexamination must be completed within two months of the first try, whereupon the examining committee will determine if the student will continue working towards a PhD degree.

Once the Qualifying Exam dates are confirmed with the student's advisory committee, students must notify the Graduate Student Services Coordinator of their Exam Dates by completing the Department Exam form at <https://forms.gle/E8Cb21P9FTfZEtrX9>. The Student Services Coordinator will prepare the department form to record the results of the qualifying exam: http://www.clemson.edu/cecas/departments/ees/documents/form-files/PhD_QualifyingExam_CompletionForm1.pdf

4.5 Comprehensive Examination

Students who have successfully passed the qualifying exam are eligible to take the comprehensive exam. The purpose of the comprehensive exam is to obtain convincing evidence of a student's preparedness for performing research at the PhD level. The exam consists of a written proposal for the dissertation and an oral defense of the proposal. The proposal and defense will be evaluated by the PhD student's advisory committee. The comprehensive exam should be completed within two years of completing the qualifying exam.

The written proposal will be distributed to the advisory committee at least one week prior to the oral defense. The proposal should:

- introduce the research topic;
- clearly state the research hypothesis and/or objectives;
- establish uniqueness and originality through literature citations;
- describe the methodology to be employed;
- provide preliminary data; and
- establish the environmental significance of the proposed work.

Additional guidance on preparation of the research proposal can be found in Section 5.

During the oral examination, the student will present and defend their dissertation research proposal. The dissertation committee members will ask questions related to the written dissertation proposal, the presentation materials, and other materials relevant to the student's research area as deemed appropriate by the committee.

Satisfactory performance on the comprehensive exam will result in a recommendation to the Graduate School of acceptance of a student's application for admission to candidacy. This is done by submission of forms GS5D and GS-ResearchApproval:

<https://www.clemson.edu/graduate/files/pdfs/GS5D.pdf> and
<https://www.clemson.edu/graduate/files/pdfs/GS-ResearchApproval.pdf>
to the Graduate Student Services Coordinator.

Once the Comprehensive Exam dates are confirmed with the student's committee, students must notify the Graduate Student Services Coordinator of their Exam Dates by completing the Department Exam form at <https://forms.gle/E8Cb21P9FTfZEtrX9>

The Department Graduate Student Services Coordinator will provide the GS5D form and the GS-ResearchApproval form for the advisory committee. *Upon achieving the status of PhD candidate, an annual stipend increase of \$1,500 will follow.* It is the student's responsibility to see that the paperwork is filed with the Student Services Coordinator for this increase.

Unsatisfactory performance on the comprehensive exam will be determined at the sole discretion of the advisory committee. In the event of unsatisfactory performance, the student will be:

- a) allowed to submit a revised proposal and/or repeat all or part of the oral defense; or
- b) declared ineligible for the PhD degree in the department.

A second failure of the comprehensive exam shall result in a student being declared ineligible for the PhD degree at Clemson University.

4.6 En Route Master's Degree

Students who are accepted to the PhD program without having first obtained a Master's degree may be eligible to obtain an en route Master's degree during the course of their PhD program. Qualified students must discuss this option first with their advisor and the appropriate Graduate Program Coordinator. All requirements of the MS degree must be satisfied, and an MS Plan of Study (GS2-14 form) must be filed. Prior to filing the GS2-14, however, the GS2 for the PhD program must be completed and submitted so that the PhD comprehensive exam can be completed. Qualified PhD students for the en route MS generally will fulfill the non-thesis option for the MS as described in Section 3.7 and satisfy the following criteria:

- Complete at least 30 credit hours of appropriate coursework, none of which can be thesis research or seminar. Students requesting an en route MS degree in EES must satisfy the requirements of a focus area as described in Section 3.5;
- Complete at least one credit hour of MS seminar (BE 6510/EES 8610/GEOL 8510);
- Maintain a >3.0 GPA; and

- Complete the PhD comprehensive exam.

Successful completion of the PhD comprehensive exam can be used for up to 3 credits of the required Special Problems course (either EES 8810, GEOL 8810 or BE 8810).

If the MS thesis option is desired instead, the appropriate Graduate Program Coordinator should be consulted.

Upon meeting all of the above requirements, the student will complete the GS2-14 form for submission to the Graduate School. **Note:** normal university deadlines apply.

4.7 Application for Graduation and Diploma Order

Early in the semester that the student plans to defend his/her dissertation and expects to graduate, the student must use iROAR to notify the Enrolled Student Services of their intent to graduate. Go to "Student Record" and select "Apply to Graduate." Check the Graduate School website for the deadline to apply. The student must also notify the Graduate Student Services Coordinator by completing the [Defense Request Form](#).

4.8 Final Oral Examination

An oral examination given at least three weeks before graduation will serve to examine the students on their dissertation research. (See deadlines set by the Graduate School for the specific date for each term at the URL below). The student is responsible for scheduling the defense in coordination with the major advisor and advisory committee. Once the date is set, the Student Services Coordinator must be notified by submitting the [Defense Request Form](#).

A broad and penetrating interpretation of the research project and conclusions are required of the student. The committee members should receive a final draft copy of the dissertation at least 10 working days before the examination. This examination will be conducted under the authority of the PhD advisory committee.

Successful completion of this examination will result in a recommendation (GS7D Form) by the advisory committee to the Graduate School that the PhD degree be awarded. The Student Services Coordinator will prepare the GS7D form for the advisory committee. The completed GS7D must be returned to the Student Services Coordinator (Barbara Smith); do not send the form directly to the Graduate School.

Unsatisfactory performance on the final examination will result in a requirement for complete re-examination (with or without recommendations for additional work) or dismissal. The advisory committee has full discretion to determine the consequences for unsatisfactory performance.

4.9 Dissertation Approval

After the dissertation has been approved by the advisory committee, the dissertation must be submitted on-line to the Manuscript Review Office to obtain format approval:

manuscriptreview-l@clemson.edu

Check the Graduate School website for deadlines. Information about the format may be found at:

<http://www.clemson.edu/graduate/students/theses-and-dissertations/index.html>.

Additional information about formatting can be found in Section 5.

After format approval, the student is responsible for submitting an electronic copy of the dissertation to the Graduate School. An electronic copy is also required by the department.

4.10 Jurisdiction/Authority and Exceptions to Policies

Each PhD student is subject to the policies in effect at the time of matriculation in the PhD program. If policies change, students may petition in writing to the faculty of the EEES Department for approval or disapproval of changing to the new policies.

A student may be granted an exception to this policy for the PhD degree if they petition the Department faculty in writing and receive a favorable action.

4.11 PhD Student Checklist

Table 4.1 provides a checklist of milestones for the PhD degree program. These are general guidelines and may change for students who enter the doctoral program without a Master's Degree.

Table 4.1: Checklist for PhD Students

What	When	How/Who
1. Selection of major advisor	Occurs at the time of admission	By student and advisor
2. Appointment of Advisory Committee	Before end of 2nd semester	In consultation with major advisor
3. Preparation of curriculum	Before end of 2nd semester	In consultation with major advisor and Advisory Committee
4. Filing of curriculum, GS2	Before beginning of 3rd semester	GS2 Form by student
5. Qualifying Exam	Not later than 12 months after entering	Advisory Committee
6. Comprehensive Exam	Upon completion of course work	Advisory Committee
7. Admission to Doctoral Candidacy GS5D Form	After completion of Comprehensive Exam	Research Advisor GS5D Form to be completed by committee
8. Application for Graduation & Diploma	Early in the semester during which degree is to be expected	By student through iROAR
9. Cap & Gown	Early during semester during which degree is to be expected	By student
10. Completion of draft of dissertation	1st draft at least 8 weeks before date of final examination; final (advisor approved) copies at least 2 weeks before final	By student with review by research advisor
11. Final oral exam	At least 3 weeks prior to date on which degree is expected (see Graduate School schedule for last possible date)	GS7D Form to be filed by major advisor after document revisions are completed
12. Approval of dissertation by Graduate School	About 2 weeks before graduation (consult Graduate School Schedule for exact deadline)	By student
13. Final Check Out	At least one week prior to graduation	Student obtains all required signatures; makes appointment for exit interview

5.0 PREPARATION OF PROPOSAL, THESIS, OR DISSERTATION

5.1 General Guidelines

All theses and dissertations shall be prepared in accordance with Graduate School guidelines:

<http://www.grad.clemson.edu/Manuscript/format.php>

This EEES Department Graduate Handbook provides practical guidance on preparing acceptable and effective theses and dissertations. Graduate students should consult this Handbook before beginning the writing phase of their graduate research. Pay particular attention to formatting requirements. Graduate students should follow the ACS Style Guide: A Manual for Authors and Editors edited by Janet S. Dodd, which is available at the Cooper Library or on-line at:

<http://pubs.acs.org/isbn/9780841239999>.

For further guidance on writing reports, papers, or theses, the following books are recommended:

- How to Publish a Scientific Paper by Robert A. Day; and
- Scientific English: A Guide for Scientists and Other Professionals by Robert A. Day.

5.2 Planning

Task planning is a very important part of any research program. The deadlines for the tasks depend on the date of anticipated graduation and are presented in the Graduate School Announcements. A list of the deadlines is also available from the Graduate School web site:

<http://www.clemson.edu/graduate/index.htm>.

Failure to meet any of these deadlines will result in postponement of graduation.

Sufficient time must be allotted for writing the research proposal, thesis or dissertation. It is highly recommended that the student fully complete their thesis or dissertation before leaving the university. Several former students who left without completing their thesis ended up not completing their degree requirements. Experience shows it is very difficult to complete a thesis or dissertation after leaving the university.

5.3 Research Proposal

The MS thesis proposal is a persuasive document intended to document the worthiness of the student's research. It should be a brief, concise document that is at least 5 pages when double-spaced, not including references. A final

draft of the proposal should be completed by May of the first year.

The MS proposal is developed with the help of the student's advisor and committee. The approach and procedure vary somewhat from advisor to advisor, so students should discuss the process with their research advisor early. The purpose of the proposal is to create a research plan. Actual activities may vary as conditions and initial results dictate. The research proposed should be worthwhile and tractable. At the center of the proposal, there should be a clear hypothesis to be tested and/or a set of objectives. The material before the hypotheses/objectives should give the necessary background and lead to why the objectives are worth pursuing. After the objectives are stated, a research plan should be presented aimed at attaining the objectives. Students should go over the central parts of the proposal, especially the objectives, with their advisor, and then produce an initial draft.

The advisor will review the first draft and offer suggestions for changes. Upon approval of the advisor, electronic or hard copies will be distributed to the other committee members for their comments. Generally, committee members do not retain a copy, but the student should check on their preference. The document must have a cover page (located on the Department website under Forms).

The proposal for the dissertation has no set length requirements. PhD students should discuss the proposal in depth with their Major Advisor and Advisory Committee members. The dissertation proposal is part of the comprehensive exam for PhD students.

5.3.1 Proposal Text – Introduction

The introduction should include some brief introductory remarks and a review of the literature that is relevant to the research objectives. The literature review should be current and should be organized to support those objectives. For the dissertation proposal, the literature review may be separate from the introduction and may be published as a review paper.

5.3.2 Research Hypotheses/Objectives

This section should be written first (in conjunction with the student's advisor for a master's thesis). Begin this section with a paragraph summarizing the major goal(s) of the research. The major objective, whenever possible should be stated as a hypothesis with tasks outlined for testing the hypothesis. For example:

Hypothesis: The rate of alkaline hydrolysis of carbaryl is inhibited in the presence of dissolved natural organic matter (NOM).

Tasks:

- Measure the rate constant of the hydrolysis of carbaryl in deionized, distilled water within the pH range of 6 to 10.
- Measure the rate constant of the hydrolysis of carbaryl within the pH range of 6 to 10 and vary the concentration of dissolved NOM from 1 mg C/L to 45 mg C/L.
- Identify reaction products from the above tasks to confirm hydrolysis as the major degradation pathway.
- Analyze data with appropriate models to evaluate the effect of pH and NOM on hydrolysis of carbaryl.

For proposals of PhD work, three potential manuscripts are described with results from the hypotheses/objectives to be examined.

5.3.3 Experimental Plan and Methodology

This section should lay out the experimental approach that will be used to accomplish the tasks listed in the Objectives section. The approach should include the experimental design and a matrix of experiments to be conducted. The methodology should include procedures and analytical protocol or information about the development of those procedures. Information about the data to be collected and the use of the data should be provided, as well as methods of analysis including any statistics to be used.

5.3.4 Preliminary Results

Proposals for PhD work typically will include results from scoping and preliminary experiments that indicate the approach is working. MS proposals generally do not include preliminary results.

5.3.5 Significance of the Proposed Work

This section should be a brief summary of why it is important to conduct the proposed research. What are the expected results and how will they benefit the environmental engineering and science community?

5.3.6 Helpful Hints

Students should check with their advisor on the desired format for references, font, and other formatting items. Check the ACS Style Guide for detailed information.

Whenever possible, use the active voice. For example:

"The reaction produced 1-naphthol, carbon dioxide, and

methylamine.”

Avoid: “1-Naphthol, carbon dioxide, and methylamine were produced in the reaction.”

Avoid starting sentences with numbers. For example:

“I added 125 mL of methylene chloride to the solution before mixing” **or**, “Before mixing, 125 mL of methylene chloride were added to the solution.”

Avoid: “125 mL of methylene chloride were added to the solution before mixing.”

Numbers less than or equal to ten should be spelled out. Numbers of 11 or more can be represented by Arabic numerals. However, if you are referring to an exact amount from a measurement, such as 1.0 mL, use numerals. For example:

“Five aliquots of 2.0 mL were added to each sample.”

Remember that *effect* is a noun and *affect* is a verb. Other words that are often confused are *there* and *their*; *site* (location), *sight*, and *cite* (reference); *loose* (adjective), *lose* (verb), and *loss* (noun); *choose* (present tense) and *chose* (past tense).

Avoid the use of *reduce* to mean decrease because *reduce* has a very specific chemical meaning.

For additional information on technical writing, the student is referred to the following books:

- The ACS Style Guides: A Manual for Authors and Editors edited by Janet S. Dodd;
- How to Publish a Scientific Paper by Robert A. Day; and
- Scientific English: A Guide for Scientists and Other Professionals by Robert A. Day.

5.4 Writing the Thesis or Dissertation

The writing process usually begins toward the end of the research period. The document must be written in a format that is acceptable to the Graduate School (MS or PhD). The Graduate School offers guidelines for formatting the thesis or dissertation at:

<http://www.grad.clemson.edu/Manuscript/format.php>.

5.5 Review and Approval

After the final oral examination and review of the written document by the Advisory Committee, an MS or PhD candidate may be required to do more work. After a successful final oral examination, the committee members will provide any comments or corrections that must be made to the thesis or dissertation. It usually takes less than a week to make the needed corrections.

The advisor and members of the Advisory Committee must sign the GS-7M form. After obtaining the signatures, the student should visit the Thesis and Dissertation web page of the Graduate School:

<http://www.grad.clemson.edu/Manuscript.php>

Follow the directions for uploading the manuscript as a pdf file. The Graduate School will review the formatting and send an e-mail within one or two business days indicating the manuscript has been accepted or needs more attention.

NOTE: Before the thesis can be up-loaded, all signatures (advisor, committee members, and Graduate School) must be present on the GS-7M form.

Here are the TOP 5 STEPS FOR OBTAINING GRADUATE SCHOOL APPROVAL OF THESIS/DISSERTATION:

1. Be enrolled! Students meeting with advisors/faculty, taking comprehensive or final examinations, using library, computer facilities or laboratories must be officially enrolled in at least one credit hour.
2. Follow Graduate School format specifications listed at: <http://www.grad.clemson.edu/Manuscript/format.php>.
3. Avoid common formatting problems
4. Make sure that all margins are set to 1.25 inches
5. Make sure the Table of Contents is formatted correctly:
 - All headings must be identical in content to those in the body of the document;
 - Every entry must have a page number;
 - All major sections (first-level headings) must be included. Lower-level headings can be included, but they're not required;
 - Alignment and spacing of entries must be consistent;
 - The page number for each entry must be right-justified at the right margin;

- There must be ellipses between the entry and the page number. The ellipses may NOT be created with individually typed periods. **Note:** you can use the [ellipses instructions](#) to help format your Table of Contents;
- Do not list "Table of Contents" within your table of contents.

Send an electronic copy of the manuscript to the Graduate School and to the Department Graduate Student Services Coordinator. Deadlines are published at: <http://www.clemson.edu/graduate/students/deadlines.html>

A representative of the Graduate School will check the formatting and provide feedback via e-mail. The Graduate School will check the thesis or dissertation for adherence to format requirements. Contents and grammar should be reviewed by the student's Advisory Committee. However, documents submitted to the Graduate School with significant problems in content and/or grammar will not be approved.

Make corrections noted by the Graduate School and any final revisions required by your Advisory Committee members prior to submitting the final version.

6.0 FINANCIAL INFORMATION

6.1 Financial Assistance

Graduate students are eligible for financial assistance if they are (a) enrolled in full-time graduate studies and (b) in good academic standing, i.e., not on probation. Tuition is paid directly to the University by the department for TAs and by the faculty-member through a research grant for RAs. Students receiving financial assistance must pay all required University fees. The Department is not permitted to pay fees directly to the University; therefore, the stipend contains a fee allowance and is spread over the entire year in the stipend checks. To receive reduced fees for a particular semester, a qualified student must be on an assistantship or fellowship at the beginning of the semester.

Financial support is awarded based on resources available, academic merit, educational and employment discipline as well as on the research interests of the student. If students change their interest area after support has been extended, support eligibility is reviewed. Only PhD students and MS students pursuing research are eligible for assistantships. Non-thesis MS students are not eligible for assistantships, but are eligible for internships or other forms of support.

6.2 Assistantship Award Policy and Funding

Assistantships are awarded by the EEES Department based on many factors, including GPR, GRE scores, recommendations, research experience, previous schools, area of study, application essay, English language ability, and (in some cases) American citizenship.

The EEES Department uses two different sources for funding graduate students: 1) State of South Carolina monies, and 2) funds from contracts, grants and donations. Students supported by state funds normally are assigned teaching assistant duties while those supported by research contract or grant funds are assigned research duties. All assistantships may be subject to time limits as described below (depending upon the degree being pursued) and are contingent upon satisfactory performance and progress toward the degree by the student.

Assistantships for MS students normally extend for a maximum of two years. The same time limit applies to fellowships awarded by the EEES Department.

Assistantships for PhD students normally extend for three years beyond the MS degree. The same applies to fellowships awarded by the Department.

Continuation of assistantships and fellowships is contingent upon satisfactory academic performance, as well as satisfactory performance of assigned duties associated with the assistantship.

All research contract and grant supporting graduate assistantships are subject to continued funding by the contracting agency. If a research contract or grant is terminated before a student has completed the degree program, the department will endeavor (on an individual basis) to provide financial support to allow continuation of the student's program. This might involve teaching assistant responsibilities, where appropriate. The foregoing statement should not be construed as an assurance of funding. The student is expected to complete their degree program in a timely fashion.

All graduate students holding a teaching, research, or graduate assistantship appointment at Clemson University shall be compensated based on a standard full-time equivalent (FTE) rate (12-month basis) established by the faculty of the EEES Department. This rate shall also serve as the basis for all rate adjustments described in the section below. Three standard FTE rates are used; one for Master's students, one for PhD students (i.e., pre-comprehensive exam) and another for PhD candidates (i.e., post-comprehensive exam).

Compensation at a rate exceeding the standard FTE rate is allowed according to the following guidelines:

- Students may be offered an incentive to enroll in a Department graduate program. Such funds are typically offered once. The Department Chair will determine the source of funds.
- Students may receive funding in addition to their FTE stipend in the form of a scholarship from the Dean of the College and/or Clemson University.
- Students may receive compensation derived from a fellowship, traineeship, or similar form of award (e.g., NSF, EPA and NRC fellowships) in which the awardee is selected competitively from a group of applicants on the basis of scholarly excellence. When the value of such a fellowship exceeds the FTE stipend, the fellowship takes the place of the stipend. When the value of the award is less than the FTE stipend, the awarded amount may be added to the FTE stipend up to a total of 1.5 FTE.

NOTE: The student is responsible for submitting the required paperwork to initiate the raise.

6.2.1 Fellowships

There are internal and external sources of fellowship funding. The Department has fellowships that have been established by alumni and other supporters of the department that are used as supplements. The awards are made by faculty and are based on student performance in academics, teaching, and research as well as service to the department and university. Advisors may nominate their students for these awards on an annual basis.

External sources of fellowships include federal agencies, professional societies, and companies. Federal agencies such as the National Science Foundation, the Environmental Protection Agency, National Oceanic and Atmospheric Administration, the Department of Defense, and others have annual competitions for support of graduate study that includes full tuition and a significant stipend. Professional societies also have competitions for financial assistance; usually these awards are supplemental rather than full support. Some of the societies that hold such competitions include the Geological Society of America, American Association of Petroleum Geologists, and Society for Sedimentary Geology, Sigma Xi, Society of Environmental Toxicology and Chemistry, American Water Works Association, Air and Waste Management Association, and others. Companies that offer fellowships include Brown and Caldwell, BMW Group, and others. Contact the Graduate Program Coordinators for more information and advice.

6.2.2 Internships

Another opportunity for financial assistance is an internship. The U.S. Geological Survey and the U.S. Department of Energy are two examples of organizations that commonly sponsor internships. Consulting firms in the area also may have opportunities. Students are encouraged to check with the Graduate Program Coordinators and the Student Services Coordinator about possibilities. Internship announcements are posted on the Department's web site under Student Opportunities:

<https://www.clemson.edu/cecas/departments/ees/students/internships/index.html>

6.2.3 Work Load

The normal graduate assistantship workload is 20 hours per week (average). Students are not allowed to work over 28 hours per week. Students should be aware of both their academic and work obligations and are encouraged to discuss any problems with faculty.

6.2.4 Responsibilities

The responsibilities of RAs vary according to the specific grant project(s) from which they are being paid and are established at the discretion of the faculty member. The work performed by an RA does not necessarily correlate with

their thesis or dissertation research.

Teaching assistants play an important role in the department by teaching the laboratories that parallel the introductory courses in Geology, Environmental Engineering, Biosystems Engineering, and Physical Science, serving more than 400 students per semester. TAs may also be assigned to the graduate laboratory classes or as graders for specific classes. In general, TAs are required to work approximately 20 hours per week. Specific TA duties and time requirements are described below. New TAs are required to participate in training classes by the university and the department.

Teaching: The primary duty for a TA assigned to geology or physical science laboratories is to teach three laboratory sections per week. Different types of labs vary in length and in the number of meetings per week. But, in general, TAs will spend between six and eight hours each week in the classroom. The TA is the instructor of these labs. Therefore, the normal responsibilities and rewards of teaching come with the job. Each year an award is presented to the most outstanding graduate teaching assistant in the department; the recipient is chosen by the faculty based on nominations received from students and faculty involved in teaching introductory courses.

Lab Preparation and Clean-Up: Teaching assistants must prepare for each lab session in two ways. First, they must work through the material ahead of time to develop their lesson plans. This should be done in conjunction with their Lab Supervisor. Weekly meetings with the Lab Supervisor are held to keep labs on track and in step with other similar lab sections. Our goal is to give students a consistent experience no matter which lab TA they have. Second, materials and equipment must be set up for the lab and put away afterwards, and the lab room must also be cleaned after each lab session. The TAs will spend between two and four hours per week with this preparation and clean-up.

Grading, Test Preparation, and Record Keeping: TAs grade all assignments, large and small, given in their labs. Some grading will be required almost every week. More significant grading will occur after major tests. In general, TAs create their own quizzes and homework assignments; major tests will be created cooperatively by all TAs with the guidance of the Lab Supervisor. Accurate and up-to-date records of grades and attendance must be kept by the TAs in a location and format determined by the Lab Supervisor. Time required for these duties varies greatly throughout the semester; a broad range is probably between one and six hours per week.

Office Hours: TAs must hold one office hour for each lab session taught (typically this amounts to three office hours per week).

Other Required Assistance: From time-to-time TAs or lecture instructors will be asked to assist other TAs with activities such as field trips and proctoring examinations. Additionally, because of planned or unplanned absences, a TA may occasionally have to take another TA's labs or office hours. It is the responsibility of the TA to make coverage arrangements with the approval of the Lab Supervisor. These cases are not common and rarely exceed one to two hours per week.

In addition to these weekly duties, new TAs are required to attend university TA training before the semester begins. This normally lasts two days. The Department also holds a required one-day training session during the first week of the fall semester.

Graduate Laboratory TAs: TAs assigned to the graduate laboratories will work closely with the laboratory instructor(s). Typical duties may include preparing chemicals for the laboratory exercise, assembling apparatus, operating analytical instrumentation, troubleshooting instrumentation, instructing student about use of instrumentation, and supervising clean-up after the laboratory exercise. Specific duties will be assigned by the course instructor.

Graders: Graders will work with the course instructor. Typical duties may include preparing homework assignments, preparing and posting homework keys, grading homework, grading quizzes, grading exams, keeping records of grades, and holding office hours. Often courses with assigned graders have weekly homework and/or quizzes. Specific duties will be assigned by the course instructor.

6.2.5 Start of Pay

Students are appointed to a graduate assistantship at the beginning of the first semester if the student is present and available for a work assignment at that time. The university is on a semi-monthly pay cycle. Employees are paid on the 15th and the last day of the month. New employees will have a two-week lag before being paid. The lag pay is paid out after termination of assistantship. Otherwise, pay will begin when the student is available for work. Students with continuing research assignments should report to their research advisor. All other students should report to the Graduate Program Coordinator.

New graduate assistants must report to the departmental staff, to make an appointment with the College Human Resources staff to complete hiring paperwork. International students will need an Employment Verification Letter signed before going for their Social Security card.

International students should have their offer letter with them upon arrival. They will need to check in at the International Office (108 Long Hall). After the student has been in the US for 10 days they should then go to the Social Security Administration in Anderson, SC, for a Social Security Number or SS letter or they should meet with the Social Security Administration representative in Martin Hall on the dates indicated by the Graduate School. Then an appointment must be made with the Foreign National Payment Coordinator in the International Office in 108 Long Hall who will complete the necessary paperwork to assist the student with getting on the payroll. International students should be sure to bring the following:

- U.S. Visa;
- Unexpired foreign passport;
- I94; and
- IAP66/I20.

It is mandatory to call for an appointment before going to the Foreign National Payments Coordinator's office. The telephone number is 864-656-5589; Email address: is@clemson.edu.

6.2.6 Termination of Pay

Pay for any session will end when the student leaves Clemson University or is no longer available for work assignments. Normal termination dates for fall and spring semesters for students not continuing into the next session is Graduation Day. Any deviations from these dates must be approved by the student's research advisor or the Department Chair.

6.2.7 Reduction of Pay

Normally, 20 hours per week will be submitted on each payroll for each half-time graduate assistant. However, less than 20 hours may be submitted for a student, with the pay reduced accordingly, if the amount of time worked by the student consistently deviates from the required 20 hours per week average. Due to the procedure in which time sheets are currently used, it may be necessary to implement any pay reductions in the pay period following the one in which the work deficiency actually occurred. Pay also may be withheld from students who violate the vacation policy, as stated below in the section on "Vacations."

6.2.8 Summer Enrollment

Students receiving any assistantship or fellowship **must** enroll in six credit hours for the long Summer Session. Any student not on an assistantship but using faculty time and/or university facilities must register for a minimum of

three credit hours each session (including any student actively working on a thesis, dissertation or enrolled in non-thesis special project). Only students not active and not physically present as a student at Clemson need not register (See Table below).

6.2.9 *Students without Assistantships*

Students who enter a graduate program in the EEES Department without an assistantship can apply for future consideration with the Department Chair. The probability of receiving financial assistance in such cases is not high.

6.2.10 *Deferment of Fees*

Graduate assistants may choose to defer fees. This is accomplished easily by registering online. Persons in the fee assessment area will have a list of all graduate assistants. Anyone listed may sign a note to defer these costs and they will be deducted from the first six full paychecks of the semester. It is not possible to defer fees for summer sessions. These must be paid by the student for each summer session. The Department is not permitted to pay fees directly to the university; therefore, return of fees to graduate assistants is spread over the entire year and included in stipend checks.

To defer fees:

<https://www.clemson.edu/finance/student-financials/billing.html>

7.0 GENERAL DEPARTMENTAL INFORMATION

Students should not hesitate to ask questions concerning departmental policies and procedures. The Graduate Student Services Coordinator's task is to assist students with such questions.

7.1 Notices

Notices of interest to graduate students will be e-mailed directly to students. To ensure receipt of printed mailings, each student should have a current address and telephone number on file with the department. The department maintains a mail slot for each graduate student in the mail room in the Computer Lab (Room 144) of the Rich Laboratory. Graduate students who have a desk in Brackett have a mail slot in Brackett 201.

7.2 Vacations

Student vacation time can vary, but the following schedule is typical: three days at Thanksgiving and two weeks at Christmas. Students supported by an assistantship must consult with their advisor about scheduling other vacation time.

7.3 Stipend Pay

New students going on the payroll for the first time will have a two-week lag before they will be paid. This "lag pay" is paid out after the student's termination from the University.

7.4 Building Access

Building access requests for Rich Laboratory and CETL should be directed to Barbara Smith, Graduate Student Services Coordinator (Rich Lab 149). For Brackett Hall, requests for access to the graduate office should be directed to Briana Peele (Brackett 445). For other locations (e.g., the Biosystems Research Complex), consult with your advisor.

Request for Rich Lab student/CETL desk keys should be directed to Barbara Smith, Graduate Student Services Coordinator.

Request for Brackett student desk keys should be directed to Briana Peele, Office Manager (Brackett 445A).

7.5 Building Security

Rich Laboratory and CETL: During normal working hours all doors will remain locked and should not be propped open. Access to the building is available using your TigerOne card. All students entering or leaving the buildings should ensure that the outside doors remain locked.

Brackett Hall: Brackett Hall doors are locked at all times. Access is available using your TigerOne card. Security is a major concern to all. **Always lock the graduate offices when leaving after 4:30 PM and on weekends! This applies to the mail room, computer room, etc.** The laboratories located in Brackett are locked and require permission from the various faculty responsible (see information below in Facilities and Equipment for details about the labs).

7.6 Parking

Ample parking is available at the Rich Laboratory and CETL – a parking permit is not required. The semi-circular parking area between the two buildings is for visitors only. Parking on campus requires a permit that can be purchased at Parking Services (656-2270).

7.7 Emergencies

The Clemson University Police Department (656-2222) is to be called for all major emergencies: fire, medical, police. They will ensure that the proper authorities are dispatched.

In case of tornado warning, take shelter in the auditorium of **Rich Laboratory**. Use stairwells; do not use the elevator.

Go immediately to the first floor of **Brackett Hall** via the back corner stairwell. Meet in the first-floor hallway at the back side of the building outside of rooms 130-135.

In case a fire, exit the building immediately. Use stairwells; do not use the elevator.

7.8 Campus Shuttle Bus

Clemson University supplies a shuttle bus to transport students between the main campus and the Rich Laboratory during fall, spring and summer semesters. Trips are scheduled from 8:00 a.m. until 7:00 p.m. Monday through Friday (except during holidays and Fall Break). The shuttle makes one trip per hour from Epsilon Zeta Drive (located between Hendrix Center and Edwards Hall) to the Research Park. The shuttle leaves the Hendrix Center on the hour and arrives at the Research Park at approximately 20 minutes after the hour. Stops are at AMRL, Rich Lab, ITC (Computer Center), and the Library Depot. The return shuttle to campus leaves on the half-hour. Additional information may be found at:

<https://www.clemson.edu/campus-life/parking/transit/campus-services/research-park.html>

7.9 Desks

It is the goal of the EEES Department to provide a desk for each graduate student. However, due to the limited available space, it may not be possible to accommodate each student. Therefore, a priority system for Rich Lab and CETL is used which first assigns a desk to each graduate assistant and graduate fellow, then to each unsupported MS thesis student, and then allocates desks to all other students on a temporary use basis. For Brackett, priority is given to hydrogeology TAs who teach on campus. After that, students are assigned space as it becomes available. New students should see Barbara Smith for Rich Laboratory and CETL desk assignments and Briana Peele for desk assignments in Brackett Hall. Due to limited availability, students will not be assigned desk space in more than one location.

NOTE: Study facilities for graduate students are intended solely for studying and interacting with students. They are not to be used for socializing or temporary housing. Students abusing these privileges will forfeit them.

7.10 Room Use Policies

The following rooms are to be used by reservation only:

- in Rich Laboratory: the auditorium, classrooms, conference room and the VIP office;
- in CETL: the conference room; and
- in Brackett Hall: the conference room (342).

To make reservations, contact an administrative staff member in the building that the room is located in. Please note that no food or drink is to be taken into or consumed in the Rich Laboratory auditorium.

7.11 Computer Laboratory

The department maintains well-equipped computer laboratories for student use in Brackett 434 and Rich 144. The labs contain desktop computers with associated printers and peripherals. The computers are connected to the Internet and can be used to access the university mainframe. Doors are to be locked if the labs are unoccupied. Any problems with the machines should be reported to Betty Cowans in Rich Lab and Briana Peele in Brackett Hall.

There are several campus computer labs where both PC and Unix-based machines are available to all students at Clemson. The labs are operated by CCIT, the university-wide computer support group. The labs are scattered at various locations across campus, including one on the first floor of Brackett Hall. You need a university username and password to access computers in those labs.

7.12 Computer Center Account

Each graduate student is automatically assigned a unique computer I.D. providing access to the centralized computer facilities upon acceptance to the University. Notification of this assignment should have been received prior to orientation via U.S. postal service. This User ID is also published in the university telephone directory. In addition to the regular User ID, students can create a google account (UserID@g.clemson.edu). Students are allowed continuous use of the g.clemson.edu email account when they graduate. Should you decide to do this, you must either check both of these e-mail addresses or forward the clemson.edu e-mail address to the g.clemson.edu to make sure that you receive important information sent to you.

The Division of Computing and Information Technology (CCIT) offers numerous instructional short courses. Visit the website below for details:

<http://dcit.clemson.edu/menus/student.html>

7.13 Office Supplies

The department does not furnish office supplies to graduate students for personal use. All research contract-related use of office supplies, including letterhead stationery, must be authorized by the faculty advisor.

7.14 Student Advisory Council

Graduate students in the EEES Department have a Student Advisory Council comprised of students representing each of the research groups. A chair is elected from the members of the Council. The Council meets periodically to discuss issues of mutual concern. It also meets with the EEES Department Chair to jointly consider opportunities for quality improvements.

7.15 Student Hosts

The EEES Department will provide each new student with a host to help answer questions concerning graduate studies, housing, roommate matching, what there is to do in Clemson, finances, registration, classes, professors, etc. Contact the Student Services Coordinator at barbar2@clemson.edu to be assigned a host.

7.16 Mail

All personal mail is to be directed to a student's home address. The department is not to be used as one's mailing address. Outgoing mail, both U.S. and campus mail, can be placed in the appropriate receptacles in the reception area of Rich Laboratory. In Brackett, outgoing mail may be placed in the slots on the 2nd floor near the elevator and graduate student office.

The department maintains a mail slot for each graduate student in the

Computer Lab (Room 144) of the Rich Laboratory. Graduate students who have a desk in Brackett have a mail slot in Brackett 201.

7.17 Departmental Copy Machines

Graduate students may use the copy machine located in the Rich Lab Computer Lab and in the Brackett mailroom in accordance with the following guidelines. The copier located in the Rich Lab copy/work room is for faculty, staff and TA use only.

The copier machine in the Brackett mailroom is available for work-related copying. This includes duplication of lab exercises, class handouts, tests, articles, reports, book excerpts, etc., that are relevant to a project or thesis research being conducted by graduate research assistants.

7.18 Departmental Seminars

During the fall and spring semesters, the EEES Department sponsors a weekly seminar on Friday at 2:30 p.m. Students and faculty from the Department give presentations about their research or other topics of interest to the department. Invited speakers from industry, government, and other academic departments are also included. Seminar is held in the Rich Laboratory auditorium in the fall and on campus in spring. Suggestions for speakers are always welcome. Please send ideas to the faculty member coordinating the seminar. All students and faculty are expected to attend. If a student cannot attend a particular seminar, they should inform the faculty member coordinating seminar and their advisor ahead of time. All graduate degree programs in the EEES Department require that all resident students enroll for seminar credit for the fall and spring semesters. Attendance and other criteria for receiving credit will be given at the beginning of seminar each semester. Doctoral students are required to give at least one seminar each year. EES 9610 is offered both summer sessions in Rich 150 to provide an opportunity for all doctoral students to present.

7.19 Telephone Land Lines

Two telephones are located in the Rich Laboratory for student use. Those are 656-3275, and 656-1001. CETL has a phone in the basement (656-1751). There are no student phones in Brackett. Incoming calls, including those from prospective employers, should be directed to these telephones. Graduate students making research-related long-distance calls at the request of an advisor should use the advisor's nine-digit authorization code. Students are authorized to place long-distance telephone calls only with the permission of the appropriate advisor.

Telephone Numbers to Know:

- EEES Department, Rich Lab 656-3276

- EEES Department, Brackett 656-3438
- Graduate School Office (E-108 Martin Hall) 656-4172
- Michelin Career Center (316 Hendrix Center) 656-0440
- Campus Police (Orange Aid Building) 656-2222
- International Student Services (108 Long Hall) 656-3614

Departmental telephone numbers and room numbers are available via the EEES Department home page.

7.20 Student Travel

Department-specific travel information and guidelines are set in accordance with Clemson University Travel Procedures and Guidelines. The complete Guidelines Index, including authority references and guidelines specific to university administration, are available in the [Clemson University Travel Procedure & Guidelines](#).

Any questions regarding travel should be directed to Kim Neptune in Rich Lab, Room 152 (carmiet@clemson.edu). Outlined below are departmental procedures:

To prepare for travel, a student employees should follow these steps:

1. Create a profile in Concur. Here are the directions to create your profile, expense delegate and e-receipt in Concur:
 - Click to set up [Profile](#).
 - Click to add [Expense Delegate](#).
EEES Expense delegate: carmiet@clemson.edu
 - Click to [Activate E-Receipts](#).

2. Before travelling, the student employee must create a travel request in Concur. Create travel requests a minimum of 14 days before U.S. travel and a minimum of 60 days before international travels.

NOTE: You may submit your travel request when completed.

- Click to create a [Travel Request](#).

3. After returning from your trip, create a travel report within 7 days.

NOTE: Do not hit submit after completing the travel report. Send your expenses by e-mail to Kim Neptune (carmiet@clemson.edu).

- Click to create a [Travel Report](#).
- Click to add [Per Diem/Travel Allowance](#) to travel report.

Student employees can access information on what constitutes an allowable and non-allowable travels expense by reviewing [Clemson University Travel Procedure and Guidelines](#). These guidelines also have information on lodging, airfare, baggage, mileage, transportation, and other expenses related to travel.

4. The Travel Report form is submitted by students who are not employees. Travel forms are available on the EEES web site. If you have trouble using the electronic forms, please see one of the staff for assistance.

When individuals file for reimbursement of travel expenses they are stating:

- They have followed the University's travel policies;
- They have not received reimbursement for these expenses from any other entity outside the University;
- None of the expenses are of a personal nature; and,
- All supporting documentation is on file with their department or business officer.

Use of Purchase Cards (P-Cards): Some travel expenses can be charged to the department p-card. Examples of allowable expenses that can be charged to the department p-card are:

- Membership Dues
- Subscriptions
- Conference /Registration Fee (excluding meal package)
- Rental Cars
- Airfare (*This should be booked through Concur*)

Individuals should contact Ms. Lori Alexander for assistance with travel related p-card purchases with a minimum of 3 business days (as much as possible) for making reservations or bookings. Please do not wait for the day the booking or reservation is due to contact Ms. Alexander.

Under the Progressive Discipline Policy of the University, any employee who falsifies records or documents or willfully violates written rules, regulations or policies can be suspended or terminated from their job.

Travel reimbursements must be filed as soon as the trip is completed and within the same fiscal year in which the trip occurred. Travel reimbursement requests must be filed within 60 calendar days of the completion of the trip. Student employees will create this request in [Concur](#). These requests should be submitted at least quarterly. Any reimbursement request that is not submitted within 60 days or quarterly will require the traveler to submit and receive

approval of a written request stating the reason for the delay with approval by the Dean/Department Chair or the Business Officer and the Directory of Procurement Services. Reimbursement will be made upon completion of the travel.

For students who are non-employees, multiple trip reimbursement requests for trips of a repetitive nature should be claimed on a travel log form (see above).

Excess costs, circuitous routes, delays or luxury accommodations unnecessary or unjustified in the performance of an assignment are not considered exercising prudence.

Travel by commercial airlines will be in coach or tourist class, except where exigencies require otherwise. The purchase of special seating is an unallowed expense and will not be reimbursed.

Transportation to or from points of arrival and departure will be by the most economical method.

The [Clemson University Travel Procedure and Guidelines](#) covers all of the issues related to reimbursement for travel expenses, including:

- Expenses for spouses,
- What constitutes unauthorized costs,
- Meals,
- Lodging,
- Miscellaneous expenses,
- Foreign travel,
- Travel by personal automobiles and rental cars, and
- Registration fees.

If you have any questions on any issue regarding reimbursement related to travel, please contact Kim Neptune in Rich Lab, Room 152 (carmiet@clermson.edu).

7.21 Departmental Laboratory and Field Equipment

Teaching Lab (Rich 113)

With permission from Daekyun Kim (Rich 130B) the Teaching Lab is available for use during the summer when no classes are offered. The lab must be cleaned and available for instructional use at least one week before classes begin. Equipment and supplies from the Teaching Lab may be used if prior permission is obtained from Daekyun Kim. A logbook is available for check out of equipment. All equipment must be returned in good working order. Supplies

must be replaced.

Instrumentation Lab (Rich 114)

The Instrument Lab is a joint use facility. All users must comply with procedures to record instrument use in log books (electronic or paper) and keep the common areas clean. Instrument use requires prior approval by the instrument care taker or Daekyun Kim (Rich 130B).

A wide range of other equipment for chemical analysis is also available on campus. Much of the analytical equipment in other departments can be used for thesis research by students in the Department by making arrangements through their advisor.

Petrophysics Lab (Rich 128)

The department maintains a petrophysics lab in 128 Rich Lab. The purpose of this lab is to measure hydraulic properties of aquifer samples and soils. The lab contains a suite of flexible wall permeameters for measuring saturated permeability. In addition, the lab contains a Hassler cell for making permeability measurements under confining pressure and a Boyle's Law helium porosimeter. A capillary pressure vessel is also available. Ask Dr. Murdoch about using this lab.

Thin Section Preparation Lab (Brackett B04)

This laboratory is located in the basement of Brackett Hall (Room B04). It contains several rock saws, a trim saw, a thin-section cutoff saw, and a thin-section grinder. Laps are available for final polishing of samples. These instruments allow the complete preparation of standard thin sections for petrographic study, or polished sections for microprobe analysis.

The lab also contains two sieve shakers and associated sieve pans for grain-size distribution analyses. See Scott Brame about using the saws or polisher or Dr. Murdoch if you need to use a sieveshaker.

Petrographic microscopes are located Brackett 323. One microscope has a 35 mm camera for taking photomicrographs, and another has a video camera linked to a TV monitor to display images from the microscope. An automated Swift Model F point-counting stage is also available for obtaining modal analyses. The department also owns a digital camera with a special microscope adapter. Consult Dr. Coulson or Dr. Murdoch before using the microscope equipment.

Field Equipment

The department has a variety of field equipment that can be used for geophysical and hydrogeological studies. The equipment is stored at various locations in the department and elsewhere on campus. Some of the Equipment is used in the Hydrogeology Summer Field Camp. Ask Dr. Moysey if you are interested in using the geophysical instruments and Dr. Murdoch about the hydrogeology field equipment.

Geophysical instruments

- Pulse Ekko 100 low frequency ground penetrating radar Pulse Ekko 1000 high frequency GPR
- GR-110 Exploranium portable gamma ray scintillometer EM-34 electromagnetic ground conductivity meter Surface electrical resistivity instrument
- Fluxgate magnetometer
- Drilling Rig
- CME 45 drill rig
- Augers (4" solid stem; 8" hollow stem) Diamond bit core barrel
- Hydraulic hammer
- Geoprobe sampling equipment
- Well Pumping Test Equipment
- 5 Parascientific precision transducers Druck portable transducer
- 5 In situ Troll water level data recorders 15 kw Kubota generator, Honda generator
- 25, 7.5, 5, 3, and 1/3 hp submersible pumps
- 2 Campbell Scientific CR10X data acquisition systems 2 Grunfos variable rate sampling pumps

Vadose Zone Equipment

- Portable mini-Permeameter 2 Guelph permeameters
- 7502B time domain reflectometry soil moisture device

Water Chemistry

- pH meters
- DO meters
- conductivity meters
- turbidimeters
- temperature probes
- ORP probes

Stream Gauging

- Swoffer current meter Ohio current meters
- Pygmy meter

Borehole Geophysics

- Logging instrument with caliper tool and capabilities for measuring single point resistance
- Gamma ray
- Temperature

Hydraulic Fracturing Equipment

A specially designed system for creating and monitoring shallow hydraulic fractures is available. This system consists of a slurry mixer and pump with related equipment for controlling the fracturing process and monitoring associated ground deformation. Dr. Murdoch is in charge of this equipment.

Bob Campbell Geology Museum

The Bob Campbell Geology Museum is located in the South Carolina Botanical Gardens adjacent to the Heritage Corridor Visitor's Center. Patrick McMillan is Director of the Geology Museum (see Appendix A). The museum contains displays of natural mineral and fossil specimens and faceted gemstones with a combined worth exceeding \$2,000,000. The Bob and Betsy Campbell Geological Collection, which includes a splendid fluorescent mineral display, and the Paul H. Benson, Jr. Collection of gemstones and cabochons, are the two most prominent exhibits.

The chief purpose of the Bob Campbell Geology Museum is to acquire and display geological materials of scientific, historic, aesthetic, and educational value. It serves also to stimulate interest in the study and research of geological materials through providing access to specimens for observation and analysis. The museum contributes to the University's public outreach programs by developing educational exhibits and offering guided tours. Each year thousands of K-12 students visit the museum on class field trips.

7.22 Departmental Shops

The EEES Department maintains two well-equipped machine shops staffed by Rodney Merck and Rodney Morgan. Any request for services of the departmental technician must be made in writing (the work order request form can be found on the department website:

<http://www.clemson.edu/ces/ees/form-files/index.html>).

Under no circumstances is anyone to use any of the department's machine shop equipment without prior authorization and instruction as to proper use of the equipment.

7.23 Receiving Supplies

Supplies will normally be delivered to the receiving room in the Rich Laboratory

or to room 445 in Brackett Hall. When they are checked in, a copy of the packing list will be placed in the package and your name will be placed on the outside. If the contents do not match the packing list, notify Daekyun Kim at daekyuk@clemson.edu or Lori Alexander at llalexa@clemson.edu

NOTE: Do not pick up any boxes that have not been checked in.

7.24 Rich Laboratory Cantina Policy

Every Cantina user should abide by the following rules: (a) rinse all recyclable materials before throwing them in the container; (b) do not leave dirty dishes by or in the sink (all dishes should be dried and stored in the cabinet); (c) cover food when using microwave; (d) clean microwave and toaster oven of food spills; (e) clean tables after use; and (f) do not leave food in the student refrigerator for more than 1 week (g) clean accidental spills you make.

7.25 Recycling and Resource Recovery

EEES Department faculty, staff, and students, out of a spirit of environmental sensitivity, collect and recycle aluminum, glass, two kinds of plastic, newspaper, white paper, and cardboard. Recycling containers are located in the hallways of buildings on- and off-campus.

7.26 Professional Memberships

Application forms for membership in various professional organizations may be obtained from appropriate faculty. A professional organization provides networking opportunities for future employment, and as a student member, usually a reduced membership fee. Membership also gives opportunities for attending conferences and presenting research results to a regional, national, or international audience. Students are encouraged to be active members of the joint student chapter of the American Water Works Association (AWWA) and Water Environment Federation (WEF). See David Ladner for more information. Graduate students are welcome to be involved in the Geology Club (see Alan Coulson), Engineers without Borders (see Mark Schlautman), and other student organizations.

7.27 Policy on Alcohol

Alcoholic beverages are prohibited for any activity held in facilities within the College of Engineering, Computing, and Applied Sciences, including the L.G. Rich Environmental Research Laboratory and Brackett Hall.

7.28 Final Checkout

Graduate students leaving for any reason should do as follows:

- Complete departure checkout list

- Return all equipment and supplies to appropriate locations
- Clean assigned laboratory space
- Submit an electronic copy of your thesis or dissertation to the Graduate School
- Return all borrowed materials
- Make an appointment with the Student Services Coordinator, Barbara Smith (barbar2@clermson.edu) for your exit interview. You will need to complete your Interview Form prior to scheduling your appointment. This form can be obtained from the website or the Student Services Coordinator. **No student will be cleared with the Graduate School for graduation until the Checkout Form has been completed.**

8.0 GENERAL SAFETY AND HEALTH POLICIES

8.1 Chemical Hygiene Plan

The Chemical Hygiene Plan details Departmental policy and regulations concerning health and safety. This plan is required reading for all Rich Laboratory personnel. A copy of the Chemical Hygiene Plan is located in each laboratory area and at:

<http://www.clemson.edu/research/safety/chemsafety/chem-hygiene.html>

Direct any questions on safety to your research advisor, the Department Laboratory Manager (Daekyun Kim), or the Research Safety Specialist (Laura He). New students will undergo safety training at the beginning of the fall semester each year. Students shall not begin work in the laboratory without first completing safety training.

8.2 Rich Laboratory Operating Policies

The following laboratory operating policies are designed to ensure a safe and secure working environment, and to provide a research environment that nurtures the acquisition of experimental results of the highest quality.

- No food or drink is to be brought into or consumed in any laboratory.
- To facilitate cleaning, nothing is to be stored on laboratory floors.
- Only scientific charts and similar educational or reference materials are to be hung from laboratory ceilings or walls.
- Nothing is to be affixed to the glass of the laboratory doors.
- No laboratory doors including the exterior doors are to be propped open.
- Nothing, including carts, is to be stored or left in the hallways.
- The instrument room is to be used exclusively for sample analysis. Samples, standards, etc. are to be prepared in a student's assigned laboratory and transported to the instrument room for analysis using a laboratory cart. In addition, samples are not to be left in the instrument room for any reason. Carts are to be used to transport samples back to the laboratory of origin.
- All laboratory benches are to be cleaned at least weekly; more frequently if needed.
- All laboratories are to be left clean and orderly prior to departing for the day.
- When conducting wet research in the laboratories, plastic containment trays are to be used, insofar as possible, to capture spills.
- All samples, bottles, standards, etc. are to be dated and

identified as to contents and person responsible. The contents are to be properly disposed of and the bottles cleaned when no longer needed.

- A record of use is to be maintained for all hazardous chemicals used.
- Gloves and laboratory coats shall not be worn outside laboratories.
- All analytical balances are to be left clean after each use.
- Lights are to be turned off whenever vacating a room.
- All memos, notices, etc. are to be posted on the official bulletin board in the Cantina at Rich Lab or in the computer room (434) in Brackett Hall
- Suitably sized posters or photos may be affixed to student carrel walls using non-damaging tape or hangers.
- Student carrels are to be maintained clean and free of refuse.
- All refuse that cannot easily be placed in a trash receptacle is to be carried to and placed in the dumpster located by the parking lot opposite the loading dock.
- Both university vehicles are to be parked in their assigned spaces.
- The key code to the exterior doors is to be kept strictly confidential within the EEES Department community. Any hint of a breach in confidentiality is to be reported to Daekyun Kim or Briana Peele immediately.
- Recycle paper and cans are to be placed in the appropriate containers.

8.3 Personal Protective Equipment

8.3.1 Eye and Face Protection

Eye and face protection devices which meet OSHA requirements and American National Standards for industrial eye protection should be the minimum eye Protection used for activities where there may be flying or falling particles or chemical splashes. Either safety or prescription glasses with side shields must be worn in any laboratory at all times, unless an exception has been made by the departmental representative. Visitors to any laboratory must wear safety or prescription glasses, preferably with side shields.

The wearing of contact lenses is strongly discouraged. Soft contact lenses are susceptible to absorption of vapors and may aggravate some chemical exposures, particularly if they are worn for extended periods. Manufacturers of soft lenses generally recommend they not be used in certain atmospheres.

8.3.2 Body Protection

Protection of the body from contact with solid and liquid contaminants will require some protective clothing. Such protective clothing may include boots,

gloves, pants, coats, and head covers. Complete protection of the skin from contact with gases and vapors requires full-body protection such as an encapsulating suit.

Whenever in a laboratory, all students, faculty, and staff must ensure that arms, legs, and torso are covered at all times. For example, one can wear either (a) long pants and a long-sleeved shirt, (b) a knee-length, long-sleeved laboratory coat, or (c) long pants and a waist-length laboratory coat. In addition, rubber and plastic aprons must be used whenever corrosive or irritating chemicals are handled. Because plastic aprons can accumulate static electricity, their use must be avoided in areas where flammable solvents could be ignited. Protective clothing will have to be discarded and replaced if they cannot be effectively decontaminated.

Clothing materials should be selected for resistance to the chemicals to which they will be exposed, and for appropriate resistance to permeations. Glove materials are discussed in Appendix H of the Chemical Hygiene Plan.

8.3.3 Footwear

Closed-toed shoes must be worn at all times (e.g., sandals, flip flops, and bare feet are not permitted). Shoes made of low permeability material such as leather are strongly recommended. Sneakers offer little protection against falling objects or chemical spills. High-heeled shoes pose a hazard and are not to be worn when working in laboratories.

8.3.4 Hazardous Waste Management

The concern for safe disposal of chemical waste has increased dramatically in recent years. Legal and regulatory requirements, reinforced by public opinion, spurred the handling of hazardous wastes in a responsible way. Even laboratory personnel who work with relatively small amounts of chemicals have begun to recognize that the chemical waste generated during their experiments are their responsibility and that waste management systems are necessary. No chemicals shall be discarded in the dumpster. Instead contact Laura He at Rich Lab or, if on campus, please complete the waste request form at the following link:

<http://www.clemson.edu/research/safety/hazardouswaste/>

The Resource Conservation and Recovery Act (RCRA) of 1976 mandated a system for managing hazardous waste. Regulations adopted by the Environmental Protection Agency (EPA) carry out that mandate and now extend through South Carolina State Law to those who generate, store, transport, treat, and dispose of hazardous waste. The South Carolina agency responsible for enforcing EPA regulations is the Department of Health and Environmental Control (DHEC).

The L.G. Rich Environmental Research Laboratory, like most research laboratories, generates and stores small quantities of hazardous waste. The EEES Department has a Hazardous Waste Management Plan for ensuring that laboratory waste is managed to prevent harm to public health and the environment and to conform to the public's expectations and the government's requirements for proper waste management. The Hazardous Waste Management Plan is a separate part of the Student Handbook. All laboratory students are required to adhere to these regulations. Direct any questions you may have concerning this to your faculty advisor or the CHO.

In Brackett Hall, the most likely areas where exposure to hazardous chemicals may occur are:

- Labs 424, 426, and 427, used by Biosystems and Environmental Engineering students, TAs, and RAs; and
- Labs 423 and 425, used by students and TAs in the Introductory Geology and Physical Science Labs

Labs 424, 426, and 427 contain concentrated acids and solvents. Exposure to the chemicals should be minimized through use of protective gear such as lab coats, eye wear and gloves.

In the introductory geology labs, dilute hydrochloric acid is used to test for carbonate rocks. Although this is a very dilute solution, it is used by all the students and should be treated carefully. The location and accessibility of eyewashes in each lab should be ascertained. The physical science labs use several chemicals as well; although some are household chemicals, they should not be treated casually.

8.3.5 Radiological Materials Procedures

The South Carolina Department of Health and Environmental Control (SC DHEC) through a Radioactive Materials License regulates the use of radioactive materials in the department. The provisions of the license are implemented through the Clemson University Radiation Safety and Waste Management Manual. This manual is a separate part of the Graduate Student Handbook and is located on the EEES Department web site:

<https://www.clemson.edu/cecas/departments/eees/>

It contains detailed information on the acquisition, use, and disposal of radioactive materials. For exposure concerns and radioactive waste disposal please contact the Radiation Safety Officer (RSO), Konstantin Povod or follow this link: <http://www.clemson.edu/research/safety/radsafety/>

8.3.6 Other Hazards

The department maintains several items of laboratory equipment for which safety is a concern with regard to their operation. Most notable are the rock saws and sieve shakers in the thin section preparation lab located in the basement of Brackett Hall (room B04). These should not be operated without prior instruction.

In the field, pumps and generators used in aquifer performance tests constitute a potential hazard. Students may also be in close proximity to drilling rigs. Hard hats are required to be worn at all times when a drill rig is being operated.

The use of geologic hammers is another source of accidents. Protective eyewear and clothing should be worn when attempting to break rocks or to collect samples, as rock chips may fly off and strike the user or other persons standing nearby.

9.0 PURCHASING

The procedure all students will follow for processing chemicals and supplies is described below.

9.1 Introduction

Lori Alexander orders research supplies and equipment required by Rich Laboratory personnel and Briana Peele orders supplies required for Brackett Hall personnel (and other Department personnel on campus). General office supplies, books, etc., are ordered by the administrative staff. All chemicals or supplies are to be ordered from contract vendors in BuyWays, if possible. Contact Lori Alexander or Daekyun Kim if you need assistance activating your BuyWays account.

The department order form is used to order items not found in BuyWays: <http://www.clemson.edu/ces/ees/form-files/index.html>

9.2 Primary Vendors

The State of South Carolina has awarded contracts for laboratory equipment and supplies to the following (and others; look for an orange C beside the vendor name in BuyWays):

- VWR Scientific Products; and
- Fisher Scientific Company

10.0 ETHICS

All graduate students in the EEES Department are required to abide by a code of ethics. This code is shown below. A signed copy must be signed and submitted to Barbara Smith either physically or via email – barbar2@clemson.edu

ENVIRONMENTAL ENGINEERING AND EARTH SCIENCES

CLEMSON UNIVERSITY

POLICY ON RESEARCH ETHICS

The effectiveness of the research infrastructure throughout the world is based on the personal and professional integrity of the people involved. The basic assumption that is central to all research endeavors is that researchers have done what they say that they have done. The Department of Environmental Engineering and Earth Sciences is part of that infrastructure and the research conducted here must withstand the highest scrutiny. Consequently, we must all ensure that our scholarly work is conducted and reported with the highest ethical standards. We must be careful in our record keeping and diligent in our efforts to always attribute credit where it belongs. In particular, we must guard against any activity that would bring the integrity of the department or the individuals within it into question. Among the activities to be avoided are:

Falsification of Data - ranging from fabrication to deceptively selective reporting of results or methods, including the purposeful omission of conflicting data with intent to falsify results;

Plagiarism - representation of another's work as one's own;

Misappropriation of Others' Ideas - the unauthorized use of privileged information, however obtained.

The undersigned attests that they recognize the importance of maintaining the highest ethical standards in research and covenants with the other members of the department to conduct their research and professional life in a manner consistent with those ideals.

NAME _____

SIGNATURE _____

DATE _____

11.0 FACULTY AND STAFF

The current faculty and staff are listed on the EEES Department web site:

<https://www.clemson.edu/cecas/departments/ees/people/facultydirectory/index.html>