## SOUTH DAKOTA MINES

## PHYSICS GRADUATE PROGRAM HANDBOOK

(Revision for AY2021)

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## Introduction

The [Academic Catalog](https://ecatalog.sdsmt.edu/index.php) of the South Dakota School of Mines & Technology (SD Mines) contains general information concerning the Graduate Education, the [Physics Ph.D.](https://ecatalog.sdsmt.edu/preview_program.php?catoid=23&poid=2337&returnto=5794) and [Physics M.S.](https://ecatalog.sdsmt.edu/preview_program.php?catoid=23&poid=2318&returnto=5794) Programs, graduate degree requirements, and descriptions of graduate courses. This handbook specifies requirements of the Physics Graduate Program and is intended to supplement the catalog information.

The Physics Graduate Committee, consisting of Physics Department faculty participating in the Physics Graduate Program, determines the policies of the program. These policies are implemented by the Physics Graduate Program Coordinator following administrative guidance of the Physics Department Head and from the university Office of Graduate Education.

All graduate students in the program should familiarize themselves with pertinent information contained in the [Academic Catalog](https://ecatalog.sdsmt.edu/index.php) and this handbook.

The following nomenclature is used in this document:

**Advisor:** A person who offers advice from a position of wisdom and authority, and may guide the student in choosing classes and research topics. The Major Professor generally fulfills this role.

**Major Professor = Supervisor:** The person who has the official task to oversee the student’s research and thesis/dissertation preparation, and serves as chairperson of the student’s Graduate Advisory Committee. An important duty of the Major Professor is to ensure that academic standards and requirements are met and satisfied. The Program Coordinator usually serves as a temporary faculty advisor to new students before they select a Major Professor.

**Graduate Teaching Assistant (GTA):** Student compensated to assist with instruction within laboratory sections, grade homework assignments or exams, or perform other assigned instructional or outreach duties.

**Graduate Research Assistant (GRA):** Student compensated to conduct services to collaborative research projects and supervised research, generally relating to the student’s degree research.

## Graduate Student Advising and Program Coordination

The Physics Graduate Program Coordinator organizes a graduate student orientation before the beginning of the fall semester. All new students are required to participate.

The Program Coordinator will assist all new graduate students with course registration and provide them with information about the graduate program. Students must select a Major Professor that is a faculty member at SD Mines’ Department of Physics. If a student wishes to change the Major Professor, the procedure described in the [Graduate Education Policy](https://ecatalog.sdsmt.edu/content.php?catoid=23&navoid=5941) must strictly be followed and requires the student to submit the “[Change of Major Professor Form](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/Change-of-Major-Professor-Form/)” to the Office of Graduate Education. In case a student needs to change Major Professor, the Program Coordinator must be notified in advance. The Program Coordinator may serve as their temporary faculty advisor until a new Major Professor is identified.

## Program of Study and Selection of Research Topic

All graduate students are required to submit a proposed Program of Study (PoS, see details in the [Program of Study Cover Page and Instructions](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/POS-Cover-Page/)). The first PoS must be submitted electronically by the student to the Office of Graduate Education before midterm of the second semester of study. The university Office of Graduate Education will use the PoS to verify completion of degree requirements.

To complete the PoS the student has to select a Major Professor and form a Graduate Advisory Committee in consultation with the Major Professor. SD Mines’ graduate education guidelines and requirements for supervision and composition of the Graduate Advisory Committee are described in the [Supervision of Advanced Degree Programs](https://ecatalog.sdsmt.edu/content.php?catoid=23&navoid=5780#supervision_advanced_degree). In addition to the university policy, the physics graduate program requires that the committee includes at least one professor from the [Physics Department of the University of South Dakota](https://www.usd.edu/arts-and-sciences/physics/faculty).

In the PoS, up to 12 and 24 graduate-level course credits taken by the student at other institutions may be acceptable for M.S. and Ph.D., respectively. All transferred credits need to be requested by completing the "[Transfer Credits from Outside Institution Form](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/Transfer-Credits-From-Outside-Institution-Form-Aug20/)" signed by the Major Professor, the Department Head or Program Coordinator, and the Dean of Graduate Education with approval by the student’s Graduate Advisory Committee (if applicable). All graduate course credits earned at SD Mines are eligible for use, but are subject to approval by the student’s Graduate Advisory Committee and the Department Head or Program Coordinator. Substitution of SD Mines thesis credits (XXX-798) for dissertation credits (XXX-898) is limited to 6 unless justified by the student’s Graduate Advisory Committee and approved by the Dean of Graduate Education.

To ensure a timely submission of the PoS, all incoming graduate students need to make appointments with physics faculty members before or at the beginning of their first semester. They should discuss possible research topics for their degree project, the prospects for future GRA support, and whether they would be a good fit to join a specific research group. The research topic should be decided in accordance with the interests of the student and the future Major Professor taking into account the strategic priorities of the Physics Department as well.

## Stipends

Financial assistance is available to graduate students through graduate teaching assistantships (for GTAs) and/or graduate research assistantships (for GRAs). To request financial assistance, students should contact the Physics Department Head. A GPA of 3.0 and satisfactory research performance are required to maintain an assistantship. Although the Physics Department will undertake every effort to ensure that all eligible continuing students retain stipends, granting stipends to eligible continuing students depends on the available funds for assistantships and will be reviewed at the beginning of each fiscal year.

## 1. Graduate Teaching Assistantships

Teaching is considered an important part of graduate education. Therefore, students are strongly encouraged to serve as Graduate Teaching Assistants (GTAs) for a minimum of two semesters at a full GTA load. A full GTA load is defined as 20 hours per week. Typical GTA tasks are instructing lab courses, grading homework assignments of upper level undergraduate or graduate courses, and teaching introductory physics recitations.

GTAs should also coordinate their research workload with their Major Professors.

## 2. Graduate Research Assistantships

Ph.D. students must deliver substantial research results in order to succeed. They should consult their Major Professors in determining their research foci, deliverables, technical requirements, workload and schedule. All students serving as GTAs are required to work closely with their Major Professors and collaborators in their research projects and deliver quality results to maintain the assistantship and/or obtain external funding.

**3. Extended Personal Leave**

Teaching assistants are required to be present and engaged from the first week of the semester and complete their assignments before the end of the semester. Graduate students engaged solely in research are expected to be fully engaged in research during the entire time they are paid. A graduate student wishing to take extended time off should not expect to be paid during their absence. Detailed university and SD Board of Regent funding policies can be found at [Funding Policies](https://ecatalog.sdsmt.edu/content.php?catoid=23&navoid=5775).

## General Program Requirements

SD Mines’ [Master’s Degree Requirements](https://ecatalog.sdsmt.edu/content.php?catoid=23&navoid=5781) and [PhD Degree Requirements](https://ecatalog.sdsmt.edu/content.php?catoid=23&navoid=5782) in SD Mines’ academic catalog apply to the Physics Graduate Programs. All graduate students should pay particular attention to the following requirements:

1. A full time graduate student is defined as a student registered for nine or more credit hours per semester during the academic year. All international students must be registered full-time to maintain student status with the U.S. government.
2. The minimum registration required to receive reduced tuition with a qualifying assistantship in a fall or spring semester is nine credits. A last-semester assistantship can be held with two credits registration. Registration requirement reverts to nine credits if student’s graduation is postponed to the following semester.
3. Two credits are considered full-time during the summer for Office of Graduate Education purposes, including awarding assistantships and fellowships.
4. Once the student has selected a research topic, they will be expected to register for a number of research credit hours agreed to by their Major Professor.
5. Satisfactory completion of a Qualifying Exam and a Comprehensive Exam (Ph.D. students only).
6. A minimum total of credit hours beyond the bachelor’s degree, divided among coursework and research credit hours. Course grades below “C” cannot be credited toward the graduate degree requirements. Research grade S "Satisfactory" is a pass grade, U "Unsatisfactory" is a fail, and NP "Normal Progress" is a grade that is pending based on research work in progress. “NP” grade must be converted to “S” in all semesters before student diploma can be released.
7. Satisfaction of academic standards as prescribed in the [Graduate Education Policies](https://ecatalog.sdsmt.edu/content.php?catoid=20&navoid=4602) in SD Mines’ academic catalog. In particular, to qualify for a Ph.D. or M.S. degree, a student must earn a minimum 3.00 cumulative GPA as calculated from all courses that appear on the graduate transcript.
8. A dissertation that represents results that are original and relevant to the field of study, and that are publishable in a peer-reviewed publication (Ph.D. students only).
9. Successful defense of the dissertation (Ph.D. students) or thesis (thesis M.S. students).

Ph.D. students in the physics graduate program are eligible for a non-thesis M.S. degree. The required coursework and research credits are described in the [Physics M.S.](https://ecatalog.sdsmt.edu/preview_program.php?catoid=23&poid=2318&returnto=5794) section in the university catalog. Students are strongly encouraged to apply for M.S. diploma release by submitting a separate PoS once required credits are reached. The Office of Graduate Education must receive the application before the Ph.D. student’s admission to candidacy.

## Ph.D. Examinations

Ph.D. students are required to pass a **qualifying exam** that tests their general knowledge in physics, as well as a **comprehensive exam** that tests their specific knowledge of the literature in the proposed research field, and the strength of their dissertation proposal (originality and feasibility). The two exams are described in further detail below.

1. **Qualifying Exam** This exam is given once a year in August. Ph.D. students are expected to take the qualifying exam prior to the start of their third year in the program. The qualifying exam is a nine-hour in-class examination administered in three-hour sessions over two consecutive days. It consists of 15 problems equally divided into three sessions:

Session-1: Classical Mechanics/Thermodynamics/Statistical Physics

Session-2: Electromagnetism

Session-3: Quantum Mechanics/Nuclear and Particle Physics

A student may obtain a pass, fail, or partial pass on the examination. A partial pass is awarded upon satisfactory performance in one or two subjects. In the case of a partial pass, the student may be given the opportunity to re-take the next available qualifying exam and complete only the subjects that were not passed. Failing to attempt to pass one of the subjects in the exam is considered a fail for that subject. Students are generally allowed only two attempts at the qualifying exam (excluding the free-shot discussed below). A student who fails the second attempt may submit a written petition for a third and final attempt to the Department Head for approval. The decision on the petition must be submitted to the Office of Graduate Education within two weeks of the announcement of the qualifier results.

A student entering the physics graduate program is eligible for a free-shot qualifying exam. The free-shot is designed to help new students understand the expectations of the Qualifying Exam and does not count as a student’s first attempt at the Qualifying Exam. If the student passes the free-shot qualifier in any subject, it counts as passing of a normal-term qualifier. Such students are still required to complete and pass the coursework on the subject(s). If the student fails, they will be subject to the customary qualifier policy. Students who decide to attempt the free-shot qualifier must communicate their decision to the Program Coordinator as early as possible and not later than one week before the exam.

After receiving the qualifying exam results from the Program Coordinator, each student must fill the “[Qualifying Exam Reporting Form](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/Qualifying-Exam-Reporting-Form-Aug2020/)” by consulting their Major Professor and the Program Coordinator. Results of this qualifying exam must be filed with the Office of Graduate Education by a department representative within two weeks of completion of the exam.

2. **Comprehensive Exam** Students usually take the comprehensive exam within one year after they pass the qualifying exam. The comprehensive exam requires that the student submit a *written research proposal* and complete an *oral presentation* of their proposal in the presence of the student’s Graduate Advisory Committee. The proposal is to be prepared by the student with the guidance of the Major Professor. The topic must be the student's anticipated dissertation research. Both the research proposal and the presentation must be in clear English.

The research proposal must be a product of the student not that of the Major Professor or the student's Graduate Advisory Committee. It should be no more than 40 double-spaced, typewritten pages of text, including nomenclature, references, figures, and appendices. It is recommended that the proposal be organized in the form shown in the [Appendix](#_Appendix_-_Recommended) of this handbook.

The research proposal must be reviewed by the Major Professor before submission to the full Graduate Advisory Committee. The committee members may help the student by pointing out any problems relating to scope and format. However, the final approval of the proposal will come only after the subsequent oral presentation and a vote by all members of the graduate advisory committee.

Copies of the final proposal must be submitted at the same time to the student's Graduate Advisory Committee and Program Coordinator at least two weeks prior to the comprehensive exam. A date will be set for the oral presentation by the student consulting their Graduate Advisory Committee members.

The oral presentation should closely reflect the contents of the written proposal and should last no longer than 40 minutes without interruptions. The majority of the presentation should be a detailed description of the student’s proposed research program. The originality and potential significance of the proposed research should be emphasized. The oral presentation is open to faculty, researchers, students, and guests.

Following the oral presentation, the student will be expected to respond to questions from the attending faculty, students and guests. Those questions may extend into a broad range of topics to assess the breadth of the student’s knowledge.

A verbal exam will follow the presentation and will be conducted in a closed session by the student's Graduate Advisory Committee chaired by the student's Major Professor. The total time of the comprehensive exam should not be longer than 90 minutes unless the student's Graduate Advisory Committee need more time to conclude.

## Admission to Candidacy

Upon successful completion of the comprehensive examination, the student must complete the “[Admission to Candidacy and Report of Comprehensive Exam](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/Admission-to-Candidacy-and-Report-of-Comprehensive-Exam-Aug2020/)” form. The form must be signed by all members of the student’s Graduate Advisory Committee and the Department Head or Program Coordinator and filed to the Office of Graduate Education. The student will officially enter Ph.D. Candidacy after the form is approved by the Dean of Graduate Education.

## Dissertation

The student's research and the resulting dissertation are of major importance in the awarding of a Ph.D. degree. The written research results are expected to be of publishable quality. The student’s Major Professor may specifically require publication of peer-reviewed journal articles or in conference proceedings based on the student’s research results.

The university [Ph.D. Degree Requirements](https://ecatalog.sdsmt.edu/content.php?catoid=23&navoid=5782) gives detailed instructions concerning the dissertation and the time schedule that must be followed during the semester of intended completion of the Ph.D. requirements. Guidelines for writing and formatting the dissertation are also available from the Office of Graduate Education. Students in the Physics Graduate Program must follow these guidelines. For each academic year, the Office of Graduate Education provides a document with the Graduate Education Deadlines (e.g., [Academic year 2020-2021](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/Graduate-Education-Deadlines-2020-21/)). All the deadlines must be strictly followed. It is the student’s responsibility to submit a quality document to minimize revisions.

## Defense of Dissertation

The student will be required to give an oral presentation (40-50 minutes), open to the public, on the major findings of their research. Following the oral presentation, the student will be expected to respond to questions from the general audience. A verbal exam will follow the presentation and questions part. The verbal exam will be chaired by the student's Major Professor with only the student's Graduate Advisory Committee members in attendance. The committee members will question the student to test both the quality and completeness of the research and the student’s mastery of their dissertation topic.

Normal defense time is during the spring or fall semester. Students who plan to defend in summer must file a petition by submitting the [Petition for Summer Defense Form](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/Petition-for-Summer-Defense-Form-Aug20/) for approval. Immediately following the defense, the Graduate Advisory Committee will complete and sign the “Defense Results Report” form distributed to the Graduate Division Representative prior to the defense. The committee has to judge if the student has demonstrated competence in the discipline and can choose from the following options regarding the dissertation and defense:

* The work is accepted with minor corrections and requires no further review. The student will complete any minor style and grammatical corrections indicated by the committee before the document is submitted to the Office of Graduate Education for final checkout.
* The work is accepted with revisions that require review by the committee. The revisions may affect the grammar, style, format, structure, or organization of the work but do not fundamentally alter the data collected, the interpretation of the results, or the conclusions. They may include addressing frequent issues with grammar or style, re-writing or expanding existing sections, creating new tables/figures, or revising existing tables/figures. The committee believes that the revisions could reasonably be completed within three weeks of full-time effort.
* The work requires substantial revisions and all or part of the defense must be repeated. Substantial revisions fundamentally alter the organization, structure, data methods, interpretation, or conclusion of the work, or involve extensive revisions expected to take more than three weeks of full-time effort. The committee has the latitude to determine the length and format of the re-defense appropriate to the type and scope of the revisions, from a simple committee meeting to a full re-defense. Regardless of format, however, the re-defense must be scheduled with the Graduate Office.

The Major Professor will provide the student with a summary of the required revisions and corrections in writing. A copy of the summary must be attached to the Defense Results Report. The Graduate Division Representative will deliver the signed Defense Results Report to the Office of Graduate Education.

## Master of Science Degree

The Physics Graduate Program is designed with the premise that the Ph.D. is the typical terminal degree. However, under some circumstances students in the program may complete with a M.S. degree. These circumstances and degree options are:

* Ph.D. students who have completed the coursework and obtained enough research credits, but not yet admitted to Ph.D. candidacy, are eligible for the non-thesis M.S. option. All continuing Ph.D. students are strongly encouraged to fill out the paperwork to earn the non-thesis M.S. degree on the way to their Ph.D.
* Students who failed the qualifying exam or cannot complete the research and dissertation required for a Ph.D. degree are eligible for the non-thesis M.S. option.
* Self-funded students who prefer a terminal M.S. degree may choose either thesis or non-thesis option.

Awarding of a Physics M.S. degree is contingent on satisfying the thesis or non-thesis requirements specified in the [Physics M.S.](https://ecatalog.sdsmt.edu/preview_program.php?catoid=23&poid=2318&returnto=5794) section of SD Mines’ academic catalog.

## Master of Science – Thesis and Defense

The thesis option of the M.S. degree requires a M.S. thesis proposal. The proposal must consist of a 1 – 2 page summary of the planned project including a scientific justification and a statement of the project’s significance. The proposal should also include a work plan with a timeline. It should be submitted for review to all members of the student’s Graduate Advisory Committee no later than three weeks before the end of the semester prior to the semester of the student’s graduation. The members of the student’s Graduate Advisory Committee must express their consent or any concerns in writing, e.g., in an email, to the student’s Major Professor within one week after receipt of the proposal. After the committee has formally accepted the student’s proposal, the student needs to complete the “[Masters Proposal Reporting Form](https://www.sdsmt.edu/Academics/Graduate-Education/Docs/Masters-Proposal-Reporting-Form-Aug2020/)” and submit it to their Major Professor and the Department Head or Program Coordinator for signatures. A department/program representative must file the form with the Office of Graduate Education within two weeks of acceptance of the proposal.

Further requirements for the M.S. thesis and defense are detailed in the university Graduate Education Policy, see [Thesis Option Requirements](http://ecatalog.sdsmt.edu/content.php?catoid=17&navoid=3659#thesis_option_reqs).

## Appendix - Recommended Outline for the Ph.D. Research Proposal

NOTE: The written proposal should be no longer than 40 double-spaced, typewritten pages of text, including nomenclature, references, figures, and appendices.

1. Cover page

2. Summary including:

2.1 Research objectives

2.2 Significance of the proposed research

2.3 Student's original contributions

3. Literature survey including:

3.1 The general literature in the field

3.2 Specific literature on the proposed topic

3.3 Up-to-date status in the field

4. Proposed research program, including:

4.1 Research objectives

4.2 Expected significance

4.3 Broad design of experiments and/or modeling to be undertaken (including student’s preparation and preliminary results if applicable)

4.4 Description of proposed experimental and/or numerical methods

4.5 Relation of the proposed program to the goals of the research cited in the literature survey

5. Extension of the research to future work

6. A clear and concise statement of the student's original contributions

6.1 Work scope on experiment, analysis, calculation, data, simulation and service

6.2 Schedule for completion of research

6.3 Expected results, conference presentations and journal publications

7. Nomenclature

8. References

9. Appendices (if necessary)

A-1. Copy of the reference most pertinent to the proposed research program

A-2. Other relevant materials