PHYSICAL SCIENCES

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Introduction
Graduate study with concentrations in chemistry, earth science, physics, and physical sciences is offered within the Master of Science degree.
The requirements for each of these concentrations are described separately. Each is designed to promote a high level of competence and understanding of the subject matter. These programs prepare a student to continue graduate studies at the doctoral level and obtain or maintain employment in the chosen field with government agencies, industry or education.

General Admission Requirements and Qualifying Entrance Examinations
At the time of application a degree aspirant’s previous academic work is evaluated. GRE general test scores will be required for admission starting spring 2016. Upon admission to the program any existing deficiencies are identified and recommendations are made to address them by the graduate advisor for the applicant’s program concentration of choice. All students are required to pass the qualifying exam(s) for their discipline prior to the completion of 12 hours of graduate degree program work. If one or more parts of the exam are not passed, the student may be given another opportunity either by additional testing or coursework to satisfy this requirement. Specific qualifying exam requirements vary depending on the program concentration; therefore, students should consult with the appropriate graduate advisor for details. Admission requirements specific to the various concentrations within the Physical Sciences are outlined under the Admission Requirements headings for each concentration (Chemistry, Earth Science, Physics, and Physical Sciences).

General Degree Requirements
These degree program concentrations require that the student write either a thesis or a research report addressing a selected topic. The thesis option requires successful completion of a minimum of 30 semester hours of approved graduate work. The research report option requires successful completion of a minimum of 32 semester hours of approved graduate work. Both options require successful completion of 15-25 semester hours in the major field(s). Specific
course requirements will be determined by the individual candidate in consultation with the candidate's advisor and graduate committee. The candidate must pass an oral examination over the thesis or research report. The following summarizes the requirements.

**Thesis Option Hours**
Thesis and Research ................................................................................................................... 3-8
(only 6 credit hours of thesis allowed)
Major field courses (see each concentration) ................................................................. 15-25
Approved electives ........................................................................................................... 5-10

**Total (minimum)** ............................................................................................................. 30

**Research Report Option Hours**
Graduate Research .............................................................................................................. 3-6
Major field courses (see each concentration) ................................................................. 15-25
Approved electives ........................................................................................................... 5-12

**Total (minimum)** ............................................................................................................. 32

**MS Degree, Physical Science, CHEMISTRY CONCENTRATION**
The MS concentration in chemistry is designed to prepare graduates for employment in industrial or governmental sectors, for continued graduate work at the doctoral level, or for teaching. Program variations may be tailored to emphasize biochemistry/biotechnology, environmental chemistry or chemistry education in addition to a more traditional chemistry curriculum.

**Admission Requirements**
Accepted applicants must have completed a bachelor’s degree (BA or BS) from an accredited college or university with a major in chemistry or closely related field. If an applicant does not have a major in chemistry, then course work equivalent to six lecture courses and four laboratory courses in chemistry are expected. Exceptions will be considered on an individual basis, and applicants may be admitted on a provisional status.

**Qualifying Examinations Requirement**
Qualifying examinations will be scheduled during the first five class days of the semester. Each student must pass a qualifying examination in two of the four following principal areas of chemistry: biochemical, inorganic, organic or physical chemistry; see Core Requirements for analytical chemistry. Students will have two opportunities to pass each area examination. If an examination is failed twice, the requirement must be satisfied by completing the department’s designated course work in the appropriate area with a minimum grade of “B-“. If an examination is failed on the first attempt and the designated substitute course is offered that semester, the student may elect to waive a second attempt to pass the examination and satisfy the requirement by completing the designated course with a minimum grade of “B-“. Any course(s) taken to satisfy qualifying examination requirements will not count toward the hours required for the MS degree. Meeting the Qualifying Examinations Requirement, either by passing the examination or completion of the designated substitute course, will make the student eligible for
degree-candidacy status. The courses designated to substitute for Qualifying Examinations are the following:
CH 500 Topics in Chemistry: Survey of Organic Chemistry 3 hrs
CH 525 Descriptive Inorganic Chemistry 3 hrs
CH 560 Fundamentals of Biochemistry 3 hrs
CH 620 Elements of Physical Chemistry 3 hrs
Course substitutions may be considered by the chemistry faculty in individual cases.

**Degree Requirements**
Per University Graduate School guidelines, a student must earn a cumulative 3.0 grade point average in all courses used for the degree. A minimum of 60 percent of the credit hours must be in courses numbered 700 or higher. For complete degree requirements consult the current graduate policies at [http://www.emporia.edu/dotAsset/2e1716aa-9218-4ec1-8215-e0b7feb0b327.pdf](http://www.emporia.edu/dotAsset/2e1716aa-9218-4ec1-8215-e0b7feb0b327.pdf).

Two degree options are available. The *thesis option* requires a minimum of 30 credit hours and the *report option* requires a minimum of 32 credit hours. The Core Requirements are the same for both options. Due to prerequisites that may not have been met with courses in a student’s background, more than 30 or 32 hours may be required.
A student is expected to select her/his research advisor no later than the end of her/his first semester. The committee should be selected by mid-term of the second semester. Prior to graduation a student will submit a satisfactory written thesis or report and make a public oral presentation and defense of the thesis or report.

**Core Requirements** (total of 8 hours)
CH 728 Chemical Literature 2 hrs
(This course serves as the departmental orientation course and should be taken during the first semester.)
CH 730 Chemistry Seminar (first 2 semesters as graduate student, 1 hr/semester) 2 hrs
CH 676 Analytical Chemistry 4 hrs
(If the student’s record includes successful completion of an undergraduate course in quantitative analysis, including laboratory, and the student passes the departmental Analytical Chemistry Qualifying Examination, the student will be awarded passing credit on the transcript for CH 676.)

**Thesis option** .............................................................................................................. **Total of 30 hours**
Core requirements (described above) 8 hrs
Research 8 hrs
CH 829 Graduate Research (3-5 hrs)
CH 875 Thesis M.S. (3-5 hrs)
Chemistry electives (see below) 8-14 hrs
Cognate electives 0-6 hrs

**Report option** .............................................................................................................. **Total of 32 hours**
Core requirements (described above) 8 hrs
Research 6 hrs
CH 829 Graduate Research (6 hrs maximum)
Chemistry electives (see below) 12-18 hrs
Cognate electives 0-6 hrs

**Chemistry electives**
CH 500 Topics in Chemistry (* except Survey of Organic) 1-5 hrs
CH 506 Environmental Chemistry 3-4 hrs
CH 508 Industrial Chemistry 1-3 hrs
CH 578 Water Analysis 3 hrs
CH 627 Intermediate Chemistry 3 hrs
CH 745 Nuclear Techniques 3 hrs
CH 660 Biochemistry I 3 hrs
CH 661 Laboratory Methods in Biochemistry 2 hrs
CH 662 Biochemistry II 3 hrs
CH 700 Advanced Topics in Chemistry(*) 1-5 hrs
CH 720 Physical Chemistry I 3 hrs
CH 721 Physical Chemistry Laboratory 2 hrs
CH 722 Physical Chemistry II 3 hrs
CH 723 Advanced Physical Chemistry Laboratory 2 hrs
CH 724 Topics in Physical Chemistry: (*) 3 hrs
CH 725 Advanced Inorganic Chemistry 3 hrs
CH 726 Advanced Inorganic Chemistry Laboratory 1-3 hrs
CH 760 Nucleic Acids Biochemistry 3 hrs
CH 765 Advanced Biotechnology Laboratory 4 hrs
CH 772 Topics in Organic Chemistry: (*) 1-3 hrs
CH 773 Qualitative Organic Analysis 3 hrs
CH 776 Topics in Biochemistry: (*) 1-3 hrs
CH 777 Instrumental Methods of Analysis 5 hrs
CH 778 Topics in Analytical Chemistry: (*) 1-3 hrs
CH 801 Trends in High School Chemistry Curricula 3 hrs
CH 802 Modern Developments in Chemistry 3 hrs
CH 826 Topics in Inorganic Chemistry: (*) 1-3 hrs
CH 871 Topics in Advanced Physical Chemistry 1-3 hrs
*The topic in a given semester will be announced in the course schedule. The courses may be repeated for credit when different topics are offered.
Other chemistry courses may be considered for inclusion in a student’s program on an individual case basis.

**Cognate Electives**
Up to 6 hours of cognate courses (numbered 500 and above) relevant to a student’s educational goals may be included in the MS degree plan. Such courses may be selected from those offered in earth science, geology, physics, physical science, biological sciences, mathematics, computer science, education, or other disciplines. The selection of Cognate Electives must be approved by the student’s academic advisor prior to enrollment in the cognate course.

**MS Degree, Physical Science, EARTH SCIENCE CONCENTRATION**
The graduate earth science concentration is designed to provide a broad, flexible, and interdisciplinary background in the earth, environmental, and geological sciences. It is especially well-suited for candidates with career goals in government service, teaching, and/or industry. It can also prepare one for entry into doctoral study.

**Admission Requirements**
The minimum expected undergraduate preparation in earth science is course work equivalent to the BSE degree with certification in earth/space science, or a BA or BS degree with an earth science, physical geography, geology, or physical science major. Deficiencies in course background may be addressed concurrent with degree program course work.

**Application for Admission**
To apply for admission to the earth science concentration, applicants are required to do the following:
1) Submit an application for admission; see [http://www.emporia.edu/grad/appinstr.htm](http://www.emporia.edu/grad/appinstr.htm) for an electronic application form.
2) Provide official transcripts from each undergraduate institution attended. Transcripts must be sent to: Graduate School, Campus Box 4003, Emporia State University, Emporia, Kansas, 66801.
3) Provide a statement of relevant background, fields of interest in earth science, and career goals. This should be sent to: Graduate Advisor, Earth Science Department, Campus box 4030, Emporia State University, Emporia, KS, 66801.
4) The priority date to submit applications for the upcoming academic year is March 1. Later applications may be considered.
5) A faculty committee will review applications and select candidates for admissions. Each candidate will be matched with a prospective faculty advisor.
6) Students admitted into the degree program will be expected to maintain continuous enrollment during the academic year (Fall and Spring semesters). Students may petition for a leave of absence for special circumstances, e.g., military service, medical conditions, family emergencies, or other extraordinary situations.
7) In some cases these procedures and their schedule may be modified for students with special circumstances.

**Qualifying Examinations**
At the time of application a degree aspirant’s previous academic work is evaluated. Upon admission to the program any existing deficiencies are identified and recommendations are made to address them by the graduate advisor for the applicant’s program. All students are required to pass the qualifying exam(s) for their discipline prior to the completion of 12 hours of graduate degree program work. If one or more parts of the exam are not passed, the student may be given an additional opportunity either by additional testing or coursework to satisfy this requirement. Additional information is available from a graduate advisor or the Physical Sciences Office, Cram Science Hall room 133.

**Graduation Requirements**
Students are required to either 1) complete a minimum of 30 credit hours including a thesis (a maximum of 8 hours may be research and thesis combined), or 2) complete a minimum of 32 credit hours including a research project (a maximum of 6 hours may be research). Students must
complete at least 15 hours of courses in earth science (ES or GO courses) exclusive of the thesis or research project. At least six hours of graduate credit must be taken from the following allied sciences: biology, chemistry, computer science, geography, mathematics, or physics.

**Graduate Committee**
Each individual who is pursuing a graduate degree in earth science must have his/her work approved and supervised by a graduate committee. This graduate committee is appointed by the recommendation of the department, and is generally chaired by the student's research advisor. A student's graduate committee must approve the program of study, including the outline of the research topic. Before the degree is awarded, the committee will examine the candidate orally over the thesis or research report and related topics.

**Presentation of Research**
A student is expected to present his/her research at a professional scientific conference or meeting. The presentation may take the form of a poster display, oral lecture, field-trip guide, workshop or other suitable format.

**MS Degree, Physical Science, PHYSICAL SCIENCE CONCENTRATION**
The physical science concentration is an option for in-service teachers or non-teaching professionals. If an in-service teacher, the physical science concentration is designed to provide graduate work to enhance the chemistry, earth/space science, physics and/or physical science background of a licensed teacher. This concentration can also be preparatory for additional graduate work at the doctoral level in science education. A non-teaching physical science concentration is designed to provide graduate work to those professionals for whom a broad foundation in the physical sciences is appropriate.

**Admission Requirements**
For in-service teachers, the required undergraduate preparation is completion of course work equivalent to the Departments of Physical Sciences undergraduate requirements for secondary teaching licensure in one of chemistry, earth/space science, physics, or closely allied field. For non-teaching professionals, the required preparation is a bachelor’s degree with similar preparation from an accredited institution.

**Program Options**
Two program options are available for students wishing to pursue this degree concentration.

**Program Option A** is designed for those individuals who want to take the maximum number of hours of course work within the disciplines and who will be full-time graduate students during the academic year.

**Required Courses/Degree Requirements Hours**

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Sciences (CH, ES, GO, PH, or PS)</td>
<td>15-25</td>
</tr>
<tr>
<td>Nature of the Scientific Enterprise</td>
<td>2</td>
</tr>
<tr>
<td>CH, PH, ES, PS Thesis hours</td>
<td>3-5</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>CH, PH, ES, PS Research hours</td>
<td>3-5</td>
</tr>
</tbody>
</table>
Approved electives, if needed, to bring the total hours to 30 (thesis) or 32 (research report) will be decided by the graduate committee and candidate.

Minimum hours required, thesis option ................................................................. 30
Minimum hours required, research report option .................................................. 32

Program Option B is designed for those individuals who want to do course work within the disciplines and also gain additional competence in science education techniques and curriculum development. This program is specifically designed to be completed during summer sessions, and potentially augmented with academic-year course work.

Required Courses/Degree Requirements Hours
PS 730 Nature of the Scientific Enterprise ............................................................. 2
PS 768 Workshop in Physical Science Teaching ................................................... 1-3
PS 801 Modern Developments in the Physical Sciences ........................................ 3

Approved Electives Hours
First Physical Science Discipline .......................................................................... 12
Second Physical Science Discipline ...................................................................... 6

Thesis Option Hours
Thesis (offered under several course numbers e.g., CH, ES, PH, and PS) .............. 3-5
ER 851 Research Design and Writing ................................................................. 3

Minimum hours required, thesis option ................................................................. 30

Research Report Option Hours
Graduate Research or Research Problem (offered under several course numbers) .... 3-6
ER 752 Analysis of Research .................................................................................. 3

Minimum hours required, research report option .................................................. 32

MS Degree, Physical Science, PHYSICS CONCENTRATION
The physics concentration is designed to serve the needs of those planning to advance in a teaching career, enter industrial or governmental work, or continue graduate education at the doctoral level. Students benefit from small classes, a student-oriented faculty, research opportunities, and a flexible curriculum.

Admission Requirements
For admission to the physics concentration program, the applicant must have completed at least two physics courses for which introductory physics is a prerequisite and must have a demonstrated proficiency in calculus. Students may be admitted on a provisional status, and will be informed upon admission of any specific deficiencies which must be addressed.
Qualifying Examination
Students are required to pass a qualifying examination covering specific topics in physics including classical mechanics, electromagnetism, waves, optics, thermodynamics, atomic physics, subatomic physics and special relativity. (Two semesters of introductory physics and one semester of modern physics can provide adequate preparation for the exam.) This examination will be administered prior to the completion of 12 graduate credit hours. More information on the qualifying examination is available from the Physical Science Office, Cram Science Hall, Room 133.

Graduate Committee
Students pursuing a graduate degree must have their work approved and supervised by a graduate committee. This graduate committee is appointed by the recommendation of the department. The student’s research advisor will generally serve as the chairperson of the committee. A student’s graduate committee must approve the program of study including the outline of the research topic.

Degree Requirements
Two degree options are available. In the more research-intensive thesis option, students are required to complete a minimum of 30 credit hours including a thesis (a maximum of 8 hours may be research or thesis). Per university Graduate School requirements, the research report option requires a minimum of 32 credit hours (a maximum of 6 hours may be research). Per university Graduate School requirements, a student must earn a cumulative 3.0 grade point average in all courses used for the degree. A minimum of 60 percent of the credit hours must be in courses numbered 700 or higher. Students must present the results of their thesis or research project at a scheduled departmental seminar. Immediately following the seminar, the student’s graduate committee will examine the candidate orally over the thesis or research report and related topics.

Required Courses
A master’s degree program with a physics concentration requires a minimum of 15 credit hours in physics courses. Advanced-level courses in classical mechanics, electromagnetism, and an advanced laboratory course are required as a common core for all graduate students, e.g., PH 760, Mechanics I and PH 762, Electricity and Magnetism I are required. The advanced laboratory requirement can be met with any physics laboratory course at the 500-level or above. The degree program will include additional hours of approved electives to meet the minimum number of hours required.

Seminar Participation
Students are expected to attend and participate in scheduled physics seminars during the entire period of full-time graduate study, whether enrolled in such seminars for credit or not. A maximum of two credit hours in seminar may be applied toward the degree.