MS in Physical Science Annual Program Review
Calendar Year 2007

Program Description

The Masters of Science in Physical Science (MSPS) program has areas of emphasis in Chemistry, Geology, Mathematics, Physics, Geobiophysical Modeling, and Environmental Assessment and Policy (EAP). The program provides opportunity for graduates from a variety of disciplines to improve the depth and breadth of their scientific and mathematical knowledge and skills through instruction and research. The approach is both specific to each discipline and integrated across disciplines with an emphasis on problem solving.

The Physical Science program originated as a means for public school science teachers to increase their knowledge of science, and in many cases to add the physics, or other, certification to their teaching credentials. As an interdisciplinary approach to science education, the program uses faculty and research facilities from all departments within the College of Science. The program has from the beginning featured a very flexible approach to student scheduling that has allowed each student's Plan of Study to be unique to his/her needs. The graduates from the program have the technological skills to fulfil the University's mission of workforce and economic development with an interdisciplinary outlook relevant for today's society.

In 1998 the Geobiophysical Modeling option was added to the MSPS program as a natural growth process of the courses in remote sensing and image processing. The courses (PS 410/510 and BSC 410/510 in remote sensing; PS 411/511, and BSC 411/511 in image processing) have grown out of coursework introduced as special topics courses in the early 1980's. A Practicum course (PS 470/570) was added later to extend the project development and problem solving capabilities of the students. Paperwork for additional of new courses at the 600-level was started in the committee structure during fall term 2007. These new courses will enhance the program at a higher level of course offerings and subject material. Special Topics PS 650-651 numbers will be used to highlight current technology topics such as sensor systems and image processing capabilities dealing with timely scientific and technical issues. Independent Study PS 660-661 numbers will allow individuals to work on selected high level projects suitable for the student's program. PS 670, Practicum, is a course focused on project definition, project problem solving and project presentation at the 600-level. All of these courses are designed for the student to learn sophisticated software programs. IDRISI and ERMapper are applied to satellite images, aerial images and/or GIS data to solve specific problems related to urban development, environmental pollution, ecological, and transportation studies, as examples. Majors in this track of the MSPS use courses from across the College of Science offerings and the Department of Geography to complete their Plan of Study. Recent graduates in this track have been very competitive as they enter the job market gaining initial annual salaries up to $65k. The flexibility built into the original MSPS program for teachers has served the purposes of each new track in the program.

Software grants worth millions of dollars over the past several years from ERMapper in San Diego, CA.; ESRI in Redlands, CA; and IDRISI at Clark University in Massachusetts, have provided the basis of a computerized environment for the digital image processing portion of the Geobiophysical Modeling curriculum. The physical facilities and the analog optics portion of the curriculum have been an extension of the College of Science and the laboratory courses for the Department of Physics and Physical Science. The digital component is funded by software grants and limited digital instrument parts for upgrades as a one-time purchase through a Rahall Transportation Institute grant. Over a period of a year, as many as five one-day workshops have been conducted on Image Based Mapping applied to transportation problems.

An additional track has emerged from the growth and maturity of the undergraduate Integrated Science and Technology (ISAT) program. This program is now providing students for the MSPS program with a background in Environmental Assessment and Policy (EAP). This track has created a separate source of students working toward the MSPS degree.

Another source of students for the program is a 2+2 program with technology students from the Community and Technology College (CTC). Some of these graduates with an Associate Degree are now completing a BS degree through the Board of Regents (BOR) program. Once they have completed the BOR program with a satisfactory GPA they are eligible to apply for admission to the Graduate School. Some of these students accepted into the MSPS graduate program are now working to complete the Geobiophysical Modeling track.

The MSPS program works as an umbrella for all of these tracks. The flexibility built into the program allows each student to build on his/her strengths and needs. Each of the tracks is science and technology oriented and, in particular, has a significant component of computer technology and its applications in the21st century society. Again, the mission in workforce and economic development is served by each of the tracks. Appendix I is an Assessment of Student Outcomes for the MS in Physical Science program.

The faculty Steering Committee for this degree program consists of the faculty listed below. Each of the eight faculty have specific interests in the program with one of the eight faculty acting as Chair. The current membership is:

Dr. James Brumfield, Biological Sciences and Physics and Physical Science
Dr. Michael Little, Integrated Science and Technology
Dr. Ralph Oberly, Physics and Physical Science, Steering Committee Chair
Dr. Nicola Orsini, Physics and Physical Science
Dr. Dewey Sanderson, Geology
Dr. Judith Silver, Mathematics and Associate Dean of COS
Dr. Charles Somerville, Biological Sciences
Dr. Ashok Vasheasta, Physics and Physical Science

The Steering Committee has worked on the structure of the degree program and on generating consistent documents for students that state the requirements for each track of the program. Ultimately, a brochure for publicizing the benefits of participating in the program will be generated for student recruitment. Appendix II is a flow chart for directing students in the Geobiophysical Modeling track of the program. Appendix III lists the typical requirements for students working to increase their Physics background and possibly add the Physics teaching certification to their license.

There have been 48 graduates in the MSPS program since the 1999 calendar year. There were twelve graduates in the calendar year 2007. These graduates have been distributed among the tracks within the program. There are 10 currently enrolled students working toward graduate credit and their degree. Appendix IV lists the number of graduates from this program in each calendar year starting with 1999. For example, graduates are working for RTI, ESRI, West Virginia state government, and industry. Six are teaching physics or physical science in area high schools.

Assessment Activities:

A. Program Goals/Competencies:

1. To continue to recruit and retain students eligible for admission to the Graduate School with an interest in all tracks of the MSPS program. To be eligible for admission to the Graduate School a student must have a baccalaureate degree from an accredited college or university and an undergraduate GPA of at least 2.5 or equivalent. Students who qualify but do not have a sufficient background in the physical sciences are required to take courses at the undergraduate level to make them eligible for the program.

2. To provide students with a firm grasp of the fundamental principles of the discipline. All degree candidates take both written and oral examinations to graduate. The written exam is comprehensive in their major. The oral exam without a thesis is based on the coursework and the written exam. The oral exam with a thesis is based on the research work and results of the thesis. In-service teachers working to add a teaching certification are required to pass a content specialization exam administered by the state, but results of this exam do not affect graduation with MS in Physical Science.

3. To provide students with the ability to define a problem, and then to formulate and carry out a solution to the problem using physical principles, mathematical modeling and/or computer-software skills. Many of the physical science courses include laboratory work that illustrates physical principles and techniques for problem solving. Knowledge of the operation and capabilities of the specialized apparatus within the laboratories of the College of Science is a valuable resource in scientific problem solving. Many of the courses demand that students select, define, and formulate a problem that has a software solution. Knowledge of the software introduced in the image processing courses is a valuable resource in problem solving. Many of the students in the program elect the thesis option which is inherently a problem-solving experience.

4. To provide students in all tracks of the MS in Physical Science program extensive knowledge of computer software. Depending on the track this could include word processing, educational

applications, curve fitting for laboratory data, and/or image processing procedures, analysis and modeling.

5. To provide students with extensive opportunities to express their ideas through both written and oral reports of their work. Laboratory courses routinely expect students to submit coherent and persuasive laboratory reports. Project oriented courses have written and oral reports of project work required for completion of the course. Students electing the thesis option must write the thesis and defend it to an oral committee.

6. To provide students with critical thinking and problem solving skills. Application of these skills to real problems of interest in scientific laboratories, government agencies, and industrial laboratories is an essential part of the learning process. Certainly, problem solving using GIS and image processing techniques are essential to modern data processing and analysis in formulating models and their solutions.

B. Learning Outcomes/Data Collection:

Appendix I gives a matrix representation of the expectations and results for the students competencies. This is a matrix from the March 2002 report with updated and corrected information. An evaluation form to be filled out by recent graduates has been adopted and used by the Steering Committee. Results were listed in the recent five-year review, 2006. The form is Appendix II.

Courses are routinely evaluated by the faculty as they are in progress and each time that a syllabus is written for an upcoming course. As an example, the core courses in the Geobiophysical track (PS 410/510, BSC 410/510, PS 411/511, and BSC 411/511) are team taught by faculty in Physics and Physical Science and Biological Sciences. Grades in the two courses are arrived at by two exams during the semester each worth 25% of the course grade. One of the exams has a practical exam component over the software exercises that are part of the weekly activities for the students. The software (IDRISI and ERMapper) packages have exercise books that the students are expected to work through. The pace of a student doing the exercises is up to the individual, but they must have the book completed by the end of the semester. The rest of the course grade is based on the student's presentations on his/her project. The student is to select a software oriented project of interest to the student and his/her major area. For example, a student with an environmental assessment background may chose to define the habitat of a crayfish with a critical dependence on water quality for survival. In the first semester course, remote sensing, the students are expected to write a formal grant proposal defining the project, specifying the data needed to complete the project and proposing what software and other procedures are needed to manipulate the data, and then to analyze the results. Typically, during the second semester the student would pursue the project, work with faculty to obtain the appropriate data and then present the results. In each semester, the written final project report is 25% of the grade and the student's oral (power point required) report and defense of the project is 25% of the grade. The faculty in these courses work together to revise the syllabus sheets each year. The revisions reflect changes in textbook materials, updates of software packages, and availability of image data.

The course content and the revision process is judged on the success of the graduates in obtaining jobs utilizing the skills gained in the courses. To the knowledge of the program faculty all recent graduates, but two, from the program are currently employed in jobs with a direct connection to the technical training in the program. (The two exceptions are a graduate who is disabled because of being legally blind and a graduate who has kept his job from before his graduate program.) This is consistent with the mission of the University to promote workforce and economic development.

C. Results:

Recommendations for Improving the Program:

1. The program has been created, and has grown to its current status while never having a budget for its operation. Operation of the program is based on using space from the participating departments for courses and research activities. In particular, Science 259 is used every year as the classroom for the core courses in the Geobiophysical Modeling track. Research projects are also completed using the computers and software located in this laboratory. Graduate student assistantships are funded through RTI grants. Some of the major software packages have been obtained on a *maintenance only* grant from the software providers. Operation of the program would be much smoother and less stressful if a modest line item budget existed through the COS. The Acting Dean in 2005 inserted a line item in the upcoming budget request for the COS, but the administration deleted the request.

2. Maintain a Steering Committee administration that is involved daily with the program as is the current committee membership.

3. Additional courses at the 600 level need being added to the curriculum offerings in order to provide relevant courses for active students in the program. New course forms for PS 650-651 of Special Topics, PS 660-661 Independent Study, and PS 670 Practicum are in the committee structure.

4. The teacher component of the program needs to have course offerings reinstated during the summer terms C and D in order to revitalize the original track within the program. Summer teaching budgets in recent years have eliminated this segment of the curriculum. The courses are needed during the summer months when teachers are available for career enhancement and upgrading certification. Without the addition of these summer courses this component of the program will soon be lost. This would reduce our effort toward providing properly certified science teachers for schools in West Virginia. The need for physical science teachers is a critical need within the State of West Virginia.

5. The administration needs to look ahead to the age of the faculty contributing to this program. The faculty in the image processing core courses are near retirement age. Adding new faculty to

the departments who would be qualified to step into these core courses is a timely need. The program would be greatly strengthened by the addition of such faculty and continuity for the students would be assured.

II. BOT Initiative 3 Compliance:

Pertains to undergraduate programs only.

III. Plans for the current year:

1. Generation of a program publicity brochure that will inform students potentially interested in the program of its existence and out-line the requirements for students in the program. The initiation of a website to publicize the program and the activity of students in the program is scheduled. It is anticipated that a great deal of flexibility will remain in each track so that students can continue to develop a curriculum that is suited to each student's background and needs.

2. Circulation of the evaluation document, Appendix V, to the graduates from the program over the past two years. Update the data given in the recent five-year review to include responses from the recent graduates.

3. Continue to evaluate each course within the program as it is offered. The individual courses and tracks are basically set. The success of the curriculum will continue to be based on faculty-student consultation between a student and his/her adviser, or a faculty advisory committee.

4. As mentioned above, create new courses at the 600-level to provide additional course topics for students in the program.

5. Continue on-going discussions with the Chair of the Department of Biological Sciences. These discussions are directed at ways to use resources efficiently between the MSPS program and the graduate program within the Biological Sciences.

IV. Assistance Needed:

Each year time is needed to collect data from graduates. A line item budget for the program would allow more flexibility in hardware and software development.

V. What one most important thing has the department/program learned through this process?

Partial release time for the person responsible for the report would be of great value.

The program is in great need of its own budget.

MSPS graduates are entering the job market with skills that are in great demand. They are being offered highly competitive salaries by government, education and industrial employers.

Appendix I

Assessment of Student Outcomes

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Appendix I

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Component /course/ Program level

Student Outcome	Person or Office Responsible	Assessment Tool or Approach	Standards/Benchmark	Results/Analysis	Action Taken
A good grasp of fundamental principles of their discipline.	Instructors/advisors	Comprehensive exam for those students in the course option. Defense of thesis for those students in the thesis option.	Student should be able to answer questions covering a range of important topics in the emphasis area and do so in some depth. Student should be able to organize and write a to organize and write a complete report of a significant research problem, validate hypothesis and defend the thesis to experts in the subject.	Going back to the calendar year 1999 there have been 29 graduates from the program distributed among the tracks. The past four years there has been an average of six graduates per year. There are currently 32 students enrolled in the program. Many of the graduates have elected to do a thesis. A small number of students have left the program to transfer to another program or to seek employment.	
Ability to plan and carry out an investigation or research project.	Course instructors/thesis supervisors.	Reports on objects type laboratory exercises, independent study projects and/or a research thesis.	Successful completion of a number of courses requiring an open-ended project, independent study porject and/or successful defense of a thesis.	Many students complete the degree program with the thesis optionl.	The core courses in the geobiophysical track all require project work. All basic science courses require knowledge of experimental technique and the completion of writen courses.

Student Outcome	Person or Office Responsible	Assessment Tool or Approach	Standards/Benchmark	Results/Analysis	Action Taken
Computer Skills	Course instrucotre/thesis advisors	Regular course assisnments, independent study projects, thesis.	Must be able to use general (i.e. word processing, spreadsheet, database) and discipline specific computer software to archieve and retrieve data, analyze information and present it effectively to porfessionals as well as the general public.	All students completing the program have an appropriately high level of communication shill.	Faculty in the program are working to upgrade computer hardware and software. This is especially important in the core and laboratory courses where computer skills are critical. New courses are being added at the 600-level which include completion of computer projects.
Communication Skills	Course instructor/thesis advisors	Regular course assignments, independent study projects, thesis.	Students must be able to communicate their thinking and defend their answers to questions, both orally and in writing, and to faculty as well as other students.	All students completing the program have an appropriately high level of communication skill.	Courses require written and oral reports. Laboratory courses require extensive written reports. Instructors are encouraged to take WAC training. Students are encouraged to present research results at professional meetings and for publication.
Critical thinking skills	Course instructor/thesis advisors	Regular course assignments, written and oral reports on indedendent study projects, comprehensive exam or thesis research. Content specialization test for teacher recertidication.	Students must demonstrate critical thinking skills in completing regular class assignments, independent study projects, comprehensive exam or thesis.	All students completing the degree program have demonstrated their ability to think critically about the subject matter in their emphasis area.	

Appendix II

Geobiophysical Modeling Course Flow Chart

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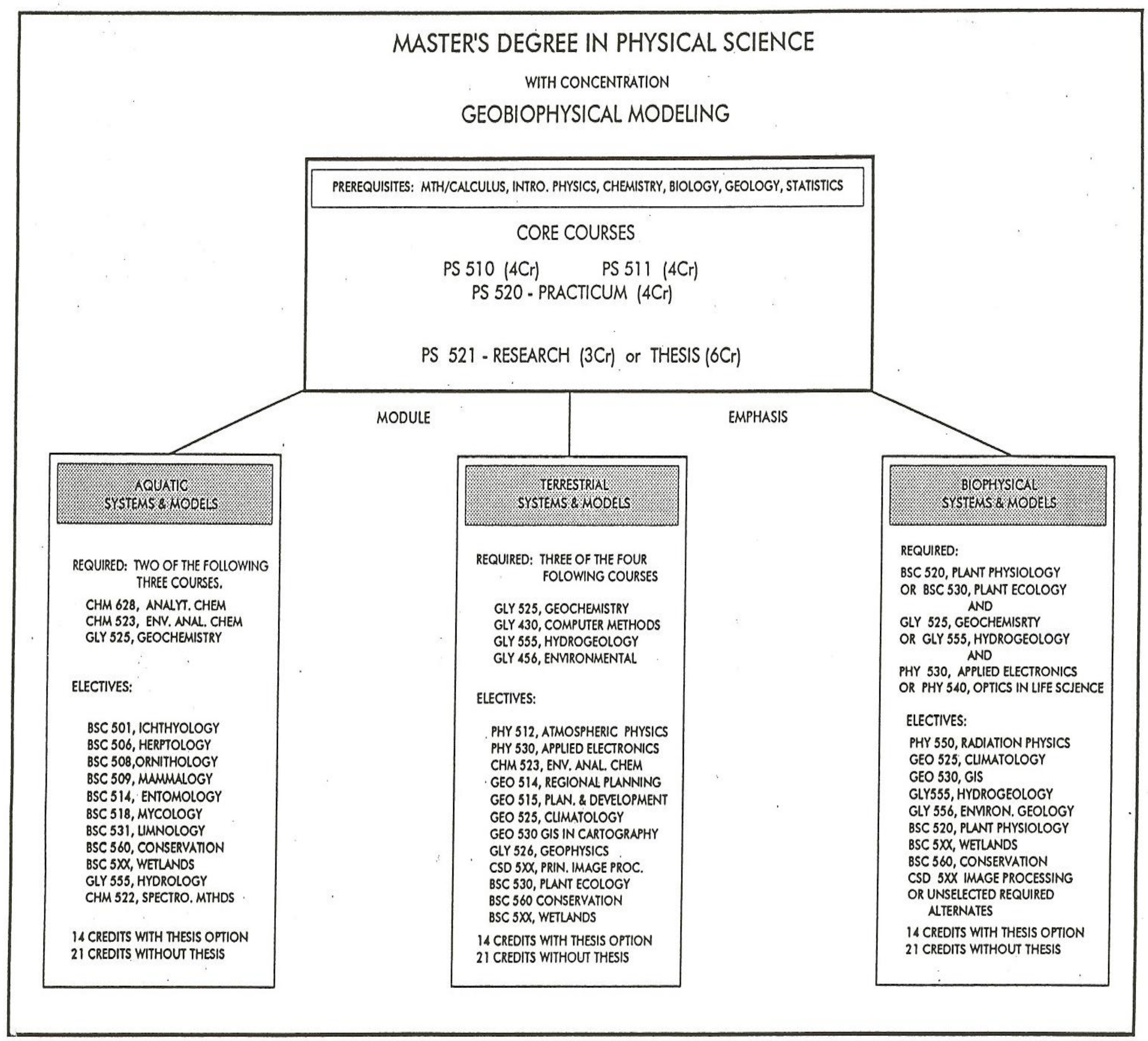
MASTER'S DEGREE IN PHYSICAL SCIENCE
WITH CONCENTRATION
GEOBIOPHYSICAL MODELING
PREREQUISITES: MTH/CALCULUS, INTRO. PHYSICS, CHEMISTRY, BIOLOGY, GEOLOGY, STATISTICS
CORE COURSES
PS 510 (4Cr) PS 511 (4Cr)
PS 520 - PRACTICUM (4Cr)
PS 521 - RESEARCH (3Cr) or THESIS (6Cr)
MODULE
EMPHASIS
AQUATIC SYSTEMS & MODELS
REQUIRED: TWO OF THE FOLLOWING THREE COURSES.
CHM 628, ANALYT. CHEM
CHM 523, ENV. ANAL. CHEM
GLY 525, GEOCHEMISTRY
ELECTIVES:
BSC 501, ICHTHYOLOGY
BSC 506, HERPTOLOGY
BSC 508,ORNITHOLOGY
BSC 509, MAMMALOGY
BSC 514, ENTOMOLOGY
BSC 518, MYCOLOGY
BSC 531, LIMNOLOGY
BSC 560, CONSERVATION
BSC 5XX, WETLANDS
GLY 555, HYDROLOGY
CHM 522, SPECTRO. MTHDS
14 CREDITS WITH THESIS OPTION
21 CREDITS WITHOUT THESIS
TERRESTRIAL SYSTEMS & MODELS
REQUIRED: THREE OF THE FOUR FOLOWING COURSES
GLY 525, GEOCHEMISTRY
GLY 430, COMPUTER METHODS
GLY 555, HYDROGEOLOGY
GLY 456, ENVIRONMENTAL
ELECTIVES:
PHY 512, ATMOSPHERIC PHYSICS
PHY 530, APPLIED ELECTRONICS
CHM 523, ENV. ANAL. CHEM
GEO 514, REGIONAL PLANNING
GEO 515, PLAN. & DEVELOPMENT
GEO 525, CLIMATOLOGY
GEO 530 GIS IN CARTOGRAPHY
GLY 526, GEOPHYSICS
CSD 5XX, PRIN. IMAGE PROC.
BSC 530, PLANT ECOLOGY
BSC 560 CONSERVATION
BSC 5XX, WETLANDS
14 CREDITS WITH THESIS OPTION
21 CREDITS WITHOUT THESIS
BIOPHYSICAL SYSTEMS & MODELS
REQUIRED:
BSC 520, PLANT PHYSIOLOGY
OR BSC 530, PLANT ECOLOGY
AND
GLY 525, GEOCHEMISRTY
OR GLY 555, HYDROGEOLOGY
AND
PHY 530, APPLIED ELECTRONICS
OR PHY 540, OPTICS IN LIFE SCIENCE
ELECTIVES:
PHY 550, RADIATION PHYSICS
GEO 525, CLIMATOLOGY
GEO 530, GIS
GLY555, HYDROGEOLOGY
GLY 556, ENVIRON. GEOLOGY
BSC 520, PLANT PHYSIOLOGY
BSC 5XX, WETLANDS
BSC 560, CONSERVATION
CSD 5XX IMAGE PROCESSING
OR UNSELECTED REQUIRED ALTERNATES
14 CREDITS WITH THESIS OPTION
21 CREDITS WITHOUT THESIS

Appendix III

Physics Teacher Certification

Course Requirements and Electives

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MS-PS Program Track
Physics Teacher Certification

This track is used by working science teachers who obtain certification in Physics 9-12 Comprehensive and/or get an in-field MS which increases their salary. A few local students get this degree to simply increase their background in science.

Required Science Courses:

General Physics, PHY 201, 202, 203, 204 (or substitute PHY 211, 213 for PHY 201, 203)
(Not available as graduate hours.)
Modern Physics for Teachers, PS 648
Modern Physics Laboratory, PHY 521
Mechanics for Teachers, PHY 547
Astronomy and Astronomy Laboratory, PS 400, 400L

Recommended Electives:

Electronics for Teachers, PS 649
Thermal Physics, graduate Independent Study/Special Topics
Optics, graduate Independent Study/Special Topics
Optics Laboratory, PHY 505

Accepted Electives:

Virtually any course in Chemistry (CHM), Geology (GLY), Mathematics (MTH), Physics (PHY), Physical Science (PS), or other science areas as approved by an academic advisorl.

Appendix IV

MS in Physical Science Graduates per Calendar Year

MS in Physical Sciences Annual Review

Appendix IV

MS in Physical Science Annual Report

The data below show the numbers of graduates from the MS in Physical Science program per calendar year. The data starts with the year 1999 because it shows the level of graduates before and after the introduction of the Geobiophysical Modeling track as a major contributor to the program.

Year	Number of Graduates
1999	2
2000	2
2001	3
2002	7
2003	3
2004	6
2005	8
2006	5
2007	12

Appendix V

Survey Document for Graduates from the Program
(to be modified)

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STUDENT EVALUATION OF THE BS IN PHYSICS

Please help us evaluate the program by responding to the following questions (all information will be held strictly confidential) and returning the completed form to:

Nicola Orsini, Ph.D.
Professor and Chairman
Marshall University – COS
Department of Physics & Physical Science
One John Marshall Drive
Huntington, WV 25755-2570

Tel: 304-696-2756
Email: orsini@marshall.edu

Name:

Highest Degree Obtained & Institution:

Current Address:

Email:

Employer Name & Address:

Business Email:

Job Title:

Annual Salary:

What type of employer do you work for?

Does this employment utilize your Physics training?

Please comment on your experience at our school.

Please share with us your recent professional achievements and/or publications. (Email attachments are welcome.)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The program provided a sound understanding of the fundamental principles of the discipline.					
The program required planning and carrying out independent investigations or research.					
The program helped develop lab skills that are important in my profession.					
Computers were used extensively in the program to collect, graph and analyze data.					
The program employs current practices, methods and technologies.					
The program helped develop computer skills that are important in my profession.					
A number of courses in the program required written reports.					
A number of courses in the program required oral reports or presentations.					
The program helped develop skills in communicating both verbally and in writing.					
The program helped develop critical skills and problem solving abilities.					
The knowledge and skills acquired through the program are important in advancing my career opportunities.					

1. Do you perceive any course or other component of the program to be in need of improvement?____

2. Has the completion of this program helped your career in any way? Please be specific.____

3. Did graduating from this program increase your earnings? Please give either the increase in salary or your salary (20-25,000 etc.) following your graduation.____

4. Please make any additional comments that you think might help us improve this program.____