



## SECTION V: Proposed Changes to an Existing Program or Program Policies

Insert here a statement of the exact changes to be made: (1) Modify undergraduate pre-requisite course list to include alternative classes for an introduction to quantum mechanics. (2) Changed the curriculum defining the non-thesis MS degree to reduce course hours by three hours and to more highly specify specific courses required in the degree. (3) Modified the requirement for MEPH 5611 Research Communication seminar to exclude non-traditional students working more than 20 hours per week in local technical positions.

Check if either of these boxes apply and provide the necessary signature:

- Program change proposal adds courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_
- Program change proposal deletes courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_

Check all the boxes that apply and complete the required sections of the form:

- Change of Name and Code (Complete only sections I, II, V and VII.)
- Change Course Requirements: (Complete all sections of the form except "Proposed Name" in II, section III, and section IV.)
- Change Delivery Site/Method (Complete all sections of the form except "Proposed Name" in II, section III, and section IV.)
- Change Total Hours (Complete all sections of the form except "Proposed Name" in II, section III, and section IV.)
- Change in Program Policies

## SECTION VI: Justification

*Justify this change and state its likely effect on any other degree program (including those outside the school or college). Identify any program or program components (other than courses) to be eliminated if this program is implemented. (Program and course change forms must also be submitted for such related changes.)*

**- The undergraduate deficiency change is to widen the courses that may be used to meet the intent of all microEP students having at least a conversational awareness of quantum mechanics regardless of their field of research.**

**- The requirements for the non-thesis option have been reduced from 39 hours total to 36 hours total, with the following additions to specifying the exact curriculum elements:**

**- 3 hours of technical elective replaced by the requirement that a non-thesis student take the PhD candidacy exam (a 10-day examination creating a 15 page NSF style proposal) as new course MEPH 5863. This will give a standard evaluation of a non-thesis student's ability to integrate a wide variety of information into a potential solution to a new major technical need.**

**- 3 hours of technical elective replaced by a second course in some aspect of management of a technology-based work environment in order to increase the student's ability to efficiently apply his or her technical knowledge in the professional workplace.**

**- 3 hours of technical elective replaced by a Design of Experiments class, a subject area that is heavily used in the type of technical positions that MS students compete for in the industrial marketplace (and is a topic therefore that is of high interest to hiring managers regardless of industry type).**

**- The reduction of hours from 39 to 36 is to follow the changes to the non-thesis course hour requirements of the science and engineering departments that are the primary partner departments to this interdisciplinary graduate program:**

- Biological Engineering: No non-thesis option.**
- Chemical Engineering: 30 coursework hours.**
- Civil Engineering: 30 coursework hours plus 3 hour independent study report.**
- Computer Engineering: 30 coursework hours plus 3 hour independent study report.**
- Electrical Engineering: 30 coursework hours.**
- Industrial Engineering: 30 coursework hours, or 27 coursework plus 3 project.**
- Mechanical Engineering: 30 coursework hours plus 3 hour independent study report.**
- Biology: No non-thesis option. Requires 24 course hours plus six hours thesis.**
- Chemistry: No non-thesis option. Requires 24 course hours plus six hours thesis.**
- Physics: 36 course hours, including one 3 hour independent study with report.**

**- The MEPH 588V Special Project course was mistakenly restricted in the table from the Professional Path and Academic MS degree descriptions. It should be listed in the table as an elective to match its description in the text.**

**- Non-traditional students working in technical positions in local industry are exposed to multiple development topics as part of their normal work and thus do not benefit strongly from these student research presentations.**

## SECTION VII: Catalog Text and Format

*In the box below, insert the current catalog text which is to be changed, with changes highlighted with the color yellow. Include all proposed changes identified in Section V. Only changes explicitly stated in Section V will be considered for approval by the University Course and Programs Committee, the Graduate Council and the Faculty Senate. If you are proposing a new program, give proposed text with all of the elements listed below. If you are proposing modified text, include these elements as appropriate.*

**Include the following elements, in order, in the catalog text for proposed undergraduate program(s) or program changes:**

- State complete major/program name
- Briefly define or describe the major/program or discipline.
- Identify typical career goals or paths for graduates. (Optional)
- State admission requirements (if any) for entry or entry into upper/advanced level of major/program.
- Identify location in catalog of university, college/school, and department/program requirements which the student must meet in addition to hours in the major, but do not restate these requirements.
- State course requirements in the major and any allied areas, giving number of hours and specific courses; specify electives or elective areas and give numbers of hours and courses in elective pools or categories; identify any other course requirements.
- State any other requirements (required GPA, internship, exit exam, project, thesis, etc.).
- Identify name and requirements for each concentration (if any).
- Specify whether a minor or other program component is allowed or required and provide details.
- State eight-semester plan requirements

**For minors, state requirements in terms of hours, required courses, electives, etc.**

**For graduate program/units, include elements (as needed) parallel to those listed for undergraduate programs above.**

**For Law School program/units, prepare text consistent with current catalog style.**

**For centers, prepare text consistent with current catalog style.**

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### Degrees Conferred:

M.S., Ph.D. in Microelectronics-Photonics (MEPH)

This multidisciplinary program prepares students for careers in the development and manufacturing of micro- to nanoscale materials, processing, and devices in such industries as biosensing, photonics, telecommunications, microelectronics, and MEMs. Typical students in this program will be full-time students residing on campus, but provisions may be made to support remotely located part-time students already engaged in professional careers.

**Philosophy of Graduate Education:** All entering graduate students from June 1 through May 31 of the following year are formed into a Cohort. Cohort members form a natural work group during their first twenty-four months of graduate school, and the Cohort receives training in how to effectively apply their academic knowledge in professional group environments such as research- or teaching-based academic departments, large governmental research labs, or industrial settings. The Cohort training also fosters a supportive graduate community atmosphere that enhances the likelihood of academic success of all the program's graduate students.

The techniques used for this training have been developed at the University of Arkansas under the financial sponsorship of the NSF Integrative Graduate Education and Research Training (IGERT) program, and the

Department of Education's Fund for Improvement of Post Secondary Education (FIPSE) program. Through these methods, our graduate students exit our degree programs with the equivalent of one and a half years of on-the-job training in management techniques useful in a technology-based professional career setting.

**Prerequisites to Degree Program:** Applicants to the program must satisfy the requirements of the Graduate School as described in this catalog and have the approval of the Graduate Studies Committee of the Microelectronics-Photonics program (GSCMEP).

Candidates typically have completed a Bachelor of Science degree in either engineering or science, and candidates' academic backgrounds will be evaluated by the GSCMEP for suitability to the graduate program. To be admitted to graduate study in Microelectronics-Photonics (microEP) without deficiency, candidates are required to have completed a math course sequence through differential equations, a calculus-based physics course sequence through introduction to quantum mechanics, an introduction to quantum mechanics through courses such as PHYS 3603, PHYS 3614, or CHEM 3504, and an introduction to electricity and magnetism or electronic circuits. Other undergraduate deficiencies may be identified during the evaluation process, and degree completion will be contingent on successful completion of these identified deficiencies.

Prospective students from foreign countries in which English is not the native language must submit nationally recognized standardized testing results on written English proficiency for consideration by the Graduate School during the admission process. Students may be given conditional admittance pending demonstration of English language skills in appropriate courses at the University of Arkansas. Students wishing to apply for graduate assistantships that require direct contact with students in a teaching or tutorial role must meet the Graduate School's English Language proficiency test requirements for such GA positions.

**Requirements for the Master of Science Degree:** Students choosing this degree program will be assigned an initial adviser upon acceptance to the program. This adviser will be their Cohort Manager during that academic year. Students will work with the Director of the Microelectronics-Photonics program to define their M.S. path to best support their career goals after graduation, with three curricula paths available to Microelectronics-Photonics students:

- Non-thesis path: Students who are funded by personal resources or by graduate assistantships not associated with research or educational grants may complete an M.S. degree with additional course work in place of independent research. While there may be specific narrow career options where this is an appropriate path, the Microelectronics-Photonics program strongly recommends the Professional or Academic paths as providing a much better overall career preparation for working in a technical position. Students completing this path cannot be accepted for the Ph.D. Microelectronics-Photonics program.
- Professional path: Students who plan to enter the technical marketplace after M.S. completion will find this path most beneficial as it requires independent graduate-level research in collaboration with an external technical organization. The research may be in the form of a traditional M.S. six-hour research topic and thesis, or may instead be in the form of two three-hour independent research efforts resulting in written reports with the clarity, style, analysis, and conclusions expected of a journal paper submission. Both the thesis and the written reports will be orally defended before the appropriate student committee. Students in this path will also be required to complete at least one internship of at least six weeks duration to experience a non-academic technical environment. Students completing this path may be considered by the GSCMEP for admission to the Ph.D. Microelectronics-Photonics program based on the strength of their academic course grades, their independent research depth, and the quality of the written research document.
- Academic path: Students who plan to complete an academic campus-based research thesis will take this path, although the research topic may include funding and collaboration with outside technical organizations. Students who complete all requirements for M.S. graduation, including an independent research project and thesis acceptable to their thesis committee, will be eligible without GSCMEP review for admission to the Ph.D. Microelectronics-Photonics program.

Students will form either a theses committee or and advisory committee after they have chosen their M.S. path, defined any independent research areas, and been accepted into a research group if appropriate. A thesis committee will be made up of at least three faculty members, with at least one faculty member each from the Fulbright College of Arts and Sciences and the College of Engineering (the student's research professor will chair the thesis committee). The advisory committee will include at least one GSCMEP member, the supervising faculty member for a research experience, and the student's cohort leader. If the student is in the Professional path, then either committee must also include at least one technical professional from the partner

external organization as an adjunct faculty member or an ex officio committee member.

Students in this degree program can choose an Academic path, a Professional path, or a Non-thesis path. The course hours to meet the minimum requirements for each paths are as follows:

Subject Area	Academic Path/Hours	Professional Path/Hours	Non-Thesis Path/Hours
Science	6	6	6
Engineering	9	9	9 <del>42</del>
<a href="#">MEPH 5383</a> Research Commercialization	3	3	3
<a href="#">MEPH 5863</a> MS NT Written Candidacy Exam	Not Available	Not Available	3
Design of Experiments (such as BENG 5703) 2 <sup>nd</sup> course in management of technology	Elective Not available	Elective Not Available	3 3
<a href="#">MEPH 5811</a> /5911/6811/6911 Open Seminar	>=3	>=3	>=3
<a href="#">MEPH 5821</a> Ethics	In Ph.D. Curriculum	1	Recommended
<a href="#">MEPH 5832</a> Proposal Writing and Management	In Ph.D. Curriculum	Recommended	Recommended
Technical Elective	6	6	6 <del>45</del>
DEPT 600V Research Thesis	6	(Option) 6	0
<a href="#">MEPH 5513</a> Applied External Research	Not Available	(Or Option) 3 + 3	Not Available
<a href="#">MEPH 5523</a> Applied Internal Research	Not Available	(Or Option) 3 + 3	Not Available
<a href="#">MEPH 588V</a> Independent Project	Not Available Elective	Not Available Elective	(<=3 as technical elective)
<a href="#">MEPH 555V</a> External Technical Internship	Recommended in Ph.D. studies	1 <=V <=3	Not Available

If a University of Arkansas undergraduate student is pursuing a Bachelor of Science degree in a department that has implemented an accelerated B.S./M.S. program (typically allowing six hours of graduate-level course work to be shared between the two degrees), the student may implement the same acceleration for a B.S. departmental degree/M.S. Microelectronics-Photonics degree set. Both the undergraduate department and the Microelectronics-Photonics program Director must approve the shared courses prior to enrollment.

Each student's curriculum must also address a need for a focus field. Each student completing a Microelectronics-Photonics degree must define a curriculum containing the following core requirements in the focus field to cover five aspects of micro- to nanoscale materials and devices. In the Applications aspect, every student must complete [ELEG 4203](#) Semiconductor Devices (Irregular). In the Materials aspect, students must take at least one course emphasizing the nature of the materials applied in their chosen focus field. In the Fabrication aspect, students must take at least one course emphasizing the theory of micro- or nanoscale fabrication in their focus field. In the Fabrication Practice aspect, all students are highly encouraged to complete at least one course containing hands-on laboratory fabrication experience. In the Management of Technology aspect, every student must complete [MEPH 5383](#) Research Commercialization and Product Development (Sp).

The Graduate Handbook of the Microelectronics-Photonics Graduate Program will contain a current list of approved courses in each of these areas that will allow students to optimize their curriculum within their focus field. Students may choose a course not listed in the handbook to fill an aspect's required course with the permission of their thesis committee and the Microelectronics-Photonics Director. Students who have acquired the knowledge contained in these courses through prior education may petition the Microelectronics-Photonics program Director for permission to substitute other classes for these core courses.

Additional core courses to develop operations management skills also have been defined for Microelectronics-Photonics students. During year one of their graduate studies at the University of Arkansas, students are required to take [MEPH 5811](#) 1st Year Operations Seminar - Infrastructure Management (Fa) and [MEPH 5911](#) 1st Year Operations Seminar - Personnel Management (Sp) in the fall and spring semesters and [MEPH 5821](#) Ethics for Scientists and Engineers (Su) in their first summer. During year two, students are required to take [MEPH 6811](#) and [MEPH 6911](#) Operations Management Seminars in both fall and spring semesters and [MEPH 5832](#) Proposal Writing and Management (Su) in their second summer. In addition, all cohort members participate in two days of industrial-style inventiveness and team training during the week directly preceding the start of fall classes. Three to five of these seven credit hours may be used in M.S. curricula, shown in the table, and the remaining credit hours may be applied as Ph.D.-level technical electives.

Students are required to attend monthly Microelectronics-Photonics Research Communication Seminars during the first three semesters of their M.S. degree program, and will enroll in [MEPH 5611](#) Research Communication Seminar of MS Students (Sp, Fa) in their third semester. Students working more than 20 hours per week in a local technology-based professional position approved by the  $\mu$ EP Director will not be required to be enrolled in this class or attend the monthly seminars as a condition for graduation.

Research thesis hours will be chosen from the department of the student's research adviser (e.g., [PHYS 600V](#), [ELEG 600V](#), etc.) and will require a written thesis successfully defended in a comprehensive oral exam given by the thesis committee.

A research thesis is required for Academic path students, and is optional for Professional path students. Professional path thesis research must include direct collaboration with an external technical organization.

A student in the Professional path may substitute two Applied Research efforts for a thesis under [MEPH 5513](#) (External location) or [MEPH 5523](#) (Internal on-campus location), provided each semester's research is of graduate-level quality and is reported at the end of the semester through a written paper and in an oral presentation to the advisory committee (note that the written paper must match the clarity, style, analysis, and conclusions expected of a journal paper submission). Regardless of where the research is performed, it must include direct collaboration with an external technical organization.

Independent project hours in support of the Non-thesis path may be either [MEPH 588V](#) Special Problems in Microelectronics-Photonics (Irregular) or a departmental Special Problems course number, and will require a written project report modeled after a professional journal submission that is then defended in a comprehensive oral exam given by the advisory committee.

If a student is taking either a special problems independent study course (such as [MEPH 588V](#)) or a special topics course (such as [MEPH 587V](#)) to meet partial requirements for their M.S. degree, then the instructor must supply the Microelectronics-Photonics program office with a syllabus of that class to be included in their program records. The syllabus must include at least the course title, semester, instructor name, a list of specific course objectives, sources of content knowledge, and method by which the student's mastery of the learning objectives is demonstrated.

Each student is required to enroll in at least one hour of course work each fall and spring semester until the M.S. degree is issued. If all required course work has been completed, the student may enroll in one hour of master's thesis, or in one hour of a special problems course for credit only.

**Requirements for the Doctor of Philosophy Degree:** <Removed from this document for clarity>

**SECTION VIII: Action Recorded by Registrar's Office**

PROGRAM INVENTORY/DARS

PGRM \_\_\_\_\_ SUBJ \_\_\_\_\_ CIP \_\_\_\_\_ CRTS \_\_\_\_\_

DGRE \_\_\_\_\_ PGCT \_\_\_\_\_ OFFC&CRTY VALID \_\_\_\_\_

REPORTING CODES

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