Date Submitted: 06/21/19 12:02 pm

Viewing: MATEMS ~~MEPHMS~~ : Materials Engineering, ~~Microelectronics-Photonics,~~ Master of Science in Materials Engineering

Last approved: 01/30/17 11:38 am

Last edit: 07/17/19 9:58 am

Changes proposed by: rickwise

Catalog Pages Using this Program

Microelectronics–Photonics (MEPH)

Submitter: User ID: rickwise Phone: 575-2875

Program Status Active

Academic Level Graduate

Type of proposal Major/Field of Study

Select a reason for this modification

Reconfiguring an Existing Degree—(LON)

Are you adding a concentration?

Yes ~~No~~

Concentration(s):

In Workflow

1. **GRAD Dean Initial**
2. **GRAD Dean Initial**
3. **Provost Initial**
4. **Director of Program Assessment and Review**
5. **Registrar Initial**
6. **Institutional Research**
7. **GRSD Chair**
8. **MSEN Chair**
9. **GRAD Dean**
10. **ARSC Dean**
11. **ENGR Dean**
12. **Global Campus**
13. **Provost Review**
14. **University Course and Program Committee**
15. Graduate Committee
16. Faculty Senate
17. Provost Final
18. ADE Licensure Approval
19. Provost's Office--Documentation sent to System Office
20. Higher Learning Commission
21. Board of Trustees
22. ADHE Final
23. Provost's Office--Notification of Approval
24. Registrar Final

25. Catalog Editor Final

Approval Path

1. 06/21/19 1:26 pm Pat Koski (pkoski): Approved for GRAD Dean Initial
2. 06/21/19 1:29 pm Pat Koski (pkoski): Approved for GRAD Dean Initial
3. 07/03/19 9:25 am Terry Martin (tmartin): Approved for Provost Initial
4. 07/12/19 1:34 pm Alice Griffin (agriffin): Approved for Director of Program Assessment and Review
5. 07/15/19 3:57 pm Lisa Kulczak (lkulcza): Approved for Registrar Initial
6. 07/15/19 4:03 pm Gary Gunderman (ggunderm): Approved for Institutional Research
7. 07/17/19 9:52 am Pat Koski (pkoski): Approved for GRSD Chair
8. 07/17/19 9:59 am Rick Wise (rickwise): Approved for MSEN Chair

9. 07/17/19 10:01 am Pat Koski (pkoski): Approved for GRAD Dean
10. 07/19/19 8:49 am Jeannie Hulen (jhulen): Approved for ARSC Dean
11. 07/19/19 2:33 pm Norman Dennis (ndennis): Approved for ENGR Dean
12. 07/22/19 11:40 am Suzanne Kenner (skenner): Approved for Global Campus
13. 07/24/19 1:50 pm Terry Martin (tmartin): Approved for Provost Review

History

1. Mar 13, 2015 by Rick Wise (rickwise)
2. Jan 30, 2017 by Charlie Alison (calison)

Action	Code	Title
Add new	**NSMD**	**Nanoscale Materials & Devices**
Add new	**MPMD**	**Microelectronic-Photonic Materials & Devices**
Add new	**ENMD**	**Energy Materials & Devices**
Add new	**BIMD**	**Biological Materials & Devices**
Add new	**MAMO**	**Materials Modeling**
Add new	**MSTM**	**Mechanical & Structural Materials**

Are you adding a track? No

Are you adding a focused study? No

Effective Catalog Year Fall 2020

College/School Code Graduate School and International Education (GRAD)

Department Code **Materials Science and Engineering (MSEN)** ~~Department of Graduate Dean (GRSD)~~

Program Code **MATEMS** ~~MEPHMS~~

Degree Master of Science **in Materials Engineering**

CIP Code

14.1801 ~~40.1002~~ - Materials **Engineering.** ~~Chemistry.~~

Program Title

Materials Engineering, ~~Microelectronics-Photonics,~~ Master of Science **in Materials Engineering**

Program Delivery Method

On Campus

Is this program interdisciplinary?

Yes ~~No~~

College(s)/School(s)

College/School Name
Fulbright College of Arts and Sciences (ARSC)
College of Engineering (ENGR)

Does this proposal impact any courses from another College/School?

No

What are the total hours needed to complete the program? **33**

Program Requirements and Description

Requirements

Master of Science in Materials Engineering:

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 **Materials**

Science & Engineering ~~Microelectronics-Photonics~~ program **(GSCSMSEN) .** ~~(GSCMEP).~~

Candidates ~~typically~~ have completed **an ABET-accredited or equivalent** ~~a~~ Bachelor of Science degree in ~~either~~ engineering ~~or science,~~ and **candidates'** ~~candidates'~~ academic backgrounds will be evaluated by the **GSCSMSEN** ~~GSCMEP~~ for suitability to the graduate program. To be admitted to graduate study in **Materials Science and Engineering (MSEN)** ~~Microelectronics-Photonics (microEP)~~ without deficiency, candidates are required to have completed a math course sequence through differential **equations and an** ~~equations, an~~ introduction to quantum mechanics through courses such as **PHYS 3603 Introduction to Modern Physics, PHYS 3613 Modern Physics,** ~~PHYS 3603, PHYS 3614,~~ or **CHEM 3504 Physical Chemistry I.** ~~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 in Materials Engineering 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 **MSEN Program** 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 Materials Engineering students:** ~~to Microelectronics-Photonics students:~~

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 GSCSMSEN ~~GSCMEP~~ **review for admission to the MSEN Ph.D. program.** ~~**Ph.D.**~~

~~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.~~**Students completing this path may be considered by** ~~Microelectronics-Photonics program based on~~ the **GSCSMSEN for admission to the MSEN Ph.D. program based on the** strength of their academic course grades, their independent research depth, and **the** ~~the~~ quality of **the** ~~the~~ written research document.

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 MSEN ~~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 into** ~~for~~ **the MSEN Ph.D. program.** ~~**Ph.D.**~~

~~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 **thesis** ~~theses~~ committee or **an** ~~and~~ advisory committee after they have chosen their M.S. path, defined any independent research areas, and **have** 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.~~**The advisory** ~~If the student is in the Professional path, then either~~ committee **will** ~~must also~~ include at least one **GSCSMSEN member, the supervising** ~~technical professional from the partner external organization as an adjunct~~ faculty member **for a research experience, and one additional faculty member. If the student is in the Professional path, then either** ~~or an ex officio~~ 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:

Requirements for the Master of Science Degree

Subject Area	Academic Path/Hours	Professional Path/Hours	Non-Thesis Path/Hours
~~Science~~	~~6~~	~~6~~	~~6~~
~~Engineering~~	~~9~~	~~9~~	~~9~~
~~MEPH 5383 Research Commercialization~~	~~3~~	~~3~~	~~3~~
~~MEPH 5393 Product Development Process~~	~~N/A~~	~~N/A~~	~~3~~
~~Design of Experiments (such as BENG 5703)~~	~~Elective~~	~~Elective~~	~~3~~
~~Second course in management of technology~~	~~N/A~~	~~N/A~~	~~3~~
~~MEPH 5811/5911/6811/6911 Oper Seminar~~	~~>=3~~	~~>=3~~	~~>=3~~
~~MEPH 5821 Ethics~~	~~In Ph.D. Curriculum~~	~~1~~	~~Recommended~~

Subject Area	Academic Path/Hours	Professional Path/Hours	Non-Thesis Path/Hours
~~MEPH 5832 Proposal Writing and Management~~	~~In Ph.D. Curriculum~~	~~Recommended~~	~~Recommended~~
~~Technical Elective~~	~~6~~	~~6~~	~~6~~
~~DEPT 600V Research Thesis~~	~~6~~	~~(Option) 6~~	~~0~~
~~MEPH 5513 Applied External Research~~	~~Not Available~~	~~(Or Option) 3 + 3~~	~~Not Available~~
~~MEPH 5523 Applied Internal Research~~	~~Not Available~~	~~(Or Option) 3 + 3~~	~~Not Available~~
~~MEPH 588V Independent Project~~	~~Elective~~	~~Elective~~	~~(<=3 as technical elective)~~
~~MEPH 555V External Technical Internship~~	~~Recommended in Ph.D. studies~~	~~1 <=V <=3~~	~~Not Available~~
MEEG 591V Special Topics (Introduction to Manufacturing) (Core)	**3**	**3**	**3**
MSEN 5322 Materials Characterization (Core)	**2**	**2**	**2**
MSEN 5313 Fundamentals of Materials Science (Core)	**3**	**3**	**3**
MSEN 5383 Research Commercialization and Product Development (Core)	**3**	**3**	**3**
MSEN 5811 / MSEN 5911 / MSEN 6811 / MSEN 6911 Operations Management Seminar Series (Core)	**4**	**4**	**4**
MSEN 6323 Materials Engineering Design (Core)	**3**	**3**	**3**
Technical Electives from Concentration List	**9**	**9**	**9**
MSEN 600V Research Thesis	**6**	**(Option) 6**	**0**
MSEN 5513 Applied Research in External Technical Organizations	**Not Available**	**(Or Option) 3 + 3**	**Not Available**
MSEN 5523 Applied On-Campus Collaborative Research with External Technical Organizations	**Not Available**	**(Or Option) 3 + 3**	**Not Available**
MSEN 555V Internship in External Technical Organization or GNEG 5811 Alternating Cooperative Education	**Optional (hours do not apply to degree requirement)**	**>/= 1**	**Optional (hours do not apply to degree requirement)**
MSEN 5821 Ethics for Scientists and Engineers	**1 (Applied in Ph.D. curriculum)**	**1**	**1**
Additional Technical Elective	**0**	**0**	**>/=2**
MSEN 5253 Emerging Technologies in Industry	**Recommended in PhD studies**	**Recommended in PhD studies**	**3**
MSEN 5393 Product Development Process	**N/A**	**N/A**	**3**

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. Materials Engineering degree set.** ~~departmental degree/M.S.Microelectronics-Photonics degree set.~~Both the undergraduate department and the **MSEN Program** ~~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 5203 Semiconductor Devices.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.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.~~ **As part** ~~Students may choose a course not listed in the handbook to fill an aspect's required course with the permission~~ of **each student's curriculum, nine hours of coursework must be taken through one of the following concentrations. Courses not listed in the concentration list, but clearly pertaining to** ~~their thesis committee and~~ the **concentration area, may be substituted with the approval of the student's research adviser and the MSEN Program** ~~Microelectronics-Photonics~~ Director. Students who have acquired the knowledge contained in **any of the required** ~~these~~ courses through prior education may petition **the MSEN Program** ~~the Microelectronics-Photonics program~~ Director for permission to substitute other classes for these **required** ~~core~~ courses. Additional core courses to develop operations management skills also have been defined for **MSEN** ~~Microelectronics-Photonics~~ students. During year one of their graduate studies at the University of Arkansas, students are required to take **MSEN 5811 1st year Operations Seminar - Infrastructure Management** ~~MEPH 5811 1st Year Operations Seminar - Infrastructure Management~~ and **MSEN 5911 1st Year Operations Seminar - Personnel Management in** ~~MEPH 5911 1st Year Operations Seminar - Personnel Management in~~ the fall and spring semesters and **MSEN 5821 Ethics for Scientists and Engineers in** ~~MEPH 5821 Ethics for Scientists and Engineers 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 in their second summer.~~ **During year two, students are** ~~Students who begin their graduate studies at the University of Arkansas during the spring semester will be~~ required to take **MSEN 6811 2nd Year Operations Seminar - Management and Leadership and MSEN 6911 2nd Year Seminar - Advanced Management and Leadership** ~~MEPH 5811~~ in the fall **and spring semesters, respectively. Students who begin their graduate studies at the University of Arkansas during the spring semester will be required** ~~semester following their completion of MEPH 6911 or~~ to take **MSEN 5811** ~~MEPH 5811 concurrently with MEPH 6811. 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 **semester following their completion of MSEN 6911 or to take MSEN 5811 concurrently with MSEN 6811.**

~~classes.~~

~~Th ree 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 **MSEN** ~~Microelectronics-Photonics~~ Research Communication Seminars during the first three semesters of their M.S. degree program, and will enroll in **MSEN 5611 Research Communication Seminar of MS Students in** ~~MEPH 5611 Research Communication Seminar of MS Students in~~ their third semester. Students working more than 20 hours per week in a **non-local** technology-based professional position approved by the **MSEN** ~~Microelectronics-Photonics~~ 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's section (MSEN 600V) and** ~~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 **MSEN 5513 (External** ~~MEPH 5513 (External~~ location) or **MSEN 5523 (Internal** ~~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 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 **MSEN 588V)** ~~MEPH 588V)~~ or a special topics course (such as **MSEN 587V)** ~~MEPH 587V)~~ to meet partial requirements for their M.S. degree, ~~then~~ the instructor must supply the **MSEN** ~~Microelectronics-Photonics~~ program office with a syllabus of that class to be included in their program records. **The** ~~They~~ syllabus must include at least the course title, semester, instructor name, a list of specific course objectives, **a list of student learning outcomes,** sources **of** ~~of~~ content knowledge, and method by which the student's mastery **of** ~~of~~ the **learning** ~~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.

Students should also be aware of Graduate School requirements with regard to master's degrees.

Master of Science in Materials Science:

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 Materials Science and Engineering program (GSCSMSEN) .

Candidates typically have completed a Bachelor of Science degree in the physical or natural sciences and candidates' academic backgrounds will be evaluated by the GSCSMSEN for suitability to the graduate program. To be admitted to graduate study in Materials Science and Engineering (MSEN) without deficiency, candidates are required to have completed a math course sequence through differential equations and an introduction to quantum mechanics through courses such as PHYS 3603 Introduction to Modern Physics, PHYS 3613 Modern Physics, or CHEM 3504 Physical Chemistry I. 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 in Materials Science Degree: Students choosing this degree program will be assigned an initial adviser upon acceptance to the program. Students will work with the MSEN Program Director to define their M.S. path to best support their career goals after graduation, with three curricula paths available to Materials Science students:

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 GSCSMSEN review for admission to the MSEN Ph.D. 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 GSCSMSEN for admission to the MSEN Ph.D. program based on the strength of their academic course grades, their independent research depth, and the quality of the written research document.

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 MSEN 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 into the MSEN Ph.D. program.

Students will form either a thesis committee or an advisory committee after they have chosen their M.S. path, defined any independent research areas, and have 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 GSCSMSEN ~~GSCMEP~~ member, the supervising faculty member for a research experience, and one additional faculty member. 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. ~~student's cohort leader.~~

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:

Requirements for the Master of Science Degree

Subject Area	Academic Path/Hours	Professional Path/Hours	Non-Thesis Path/Hours
MEEG 5343 Computational Materials Science	**3**	**3**	**3**
MEEG 591V Special Topics (Introduction to Manufacturing) (Core)	**3**	**3**	**3**
MSEN 5322 Materials Characterization (Core)	**2**	**2**	**2**
MSEN 5313 Fundamentals of Materials Science (Core)	**3**	**3**	**3**
MSEN 5383 Research Commercialization and Product Development	**3**	**3**	**3**
MSEN 5811 / MSEN 5911 / MSEN 6811 / MSEN 6911 Operations Management Seminar Series (Core)	**4**	**4**	**4**
Technical Electives from Concentration List	**9**	**9**	**9**
MSEN 600V Research Thesis	**6**	**(Option) 6**	**0**
MSEN 5513 Applied Research in External Technical Organizations	**Not Available**	**(Or Option) 3 + 3**	**Not Available**
MSEN 5323 Applied On-Campus Collaborative Research with External Organizations	**Not Available**	**(Or Option) 3 + 3**	**Not Available**
MSEN 555V Internship in External Technical Organization or GNEG 5811 Alternating Cooperative Education	**Optional (hours do not apply to degree requirement)**	**>/= 1**	**Optional (hours do not apply to degree requirement)**
MSEN 5821 Ethics for Scientists and Engineers	**Applied in Ph.D. Curriculum**	**1**	**1**
Additional Technical Elective	**0**	**0**	**>/=2**

Subject Area	Academic Path/Hours	Professional Path/Hours	Non-Thesis Path/Hours
MSEN 5253 Emerging Technologies in Industry	Recommended in PhD studies	Recommended in PhD studies	3
MSEN 5393 Product Development Process	Not Available	Not Available	3

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. Materials Science degree set. Both the undergraduate department and the MSEN program Director must approve the shared courses prior to enrollment.

As part of each student's curriculum, nine hours of coursework must be taken through one of the following concentrations. Courses not listed in the concentration list, but clearly pertaining to the concentration area, may be substituted with the approval of the student's research adviser and the MSEN program Director. Students who have acquired the knowledge contained in any of the required courses through prior education may petition the MSEN program Director for permission to substitute other classes for these required courses.

Additional core courses to develop operations management skills also have been defined for MSEN students. During year one of their graduate studies at the University of Arkansas, students are required to take MSEN 5811 1st year Operations Seminar - Infrastructure Management and MSEN 5911 1st Year Operations Seminar - Personnel Management in the fall and spring semesters and MSEN 5821 Ethics for Scientists and Engineers in their first summer. During year two, students are required to take MSEN 6811 2nd Year Operations Seminar - Management and Leadership and MSEN 6911 2nd Year Operations Seminar - Advanced Management and Leadership in the fall and spring semesters, respectively. Students who begin their graduate studies at the University of Arkansas during the spring semester will be required to take MSEN 5811 in the fall semester following their completion of MSEN 6911 or to take MSEN 5811 concurrently with MSEN 6811.

Students are required to attend monthly MSEN Research Communication Seminars during the first three semesters of their M.S. degree program, and will enroll in MSEN 5611 Research Communication Seminar of MS Students in their third semester. Students working more than 20 hours per week in a non-local technology-based professional position approved by the MSEN 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 student's research adviser's section (MSEN 600V) 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 MSEN 5513 (External location) or MSEN 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.

If a student is taking either a special problems independent study course (such as MSEN 588V) or a special topics course (such as MSEN 587V) to meet partial requirements for their M.S. degree, the instructor must supply the MSEN 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, a list of student learning outcomes, 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.

Students should also be aware of Graduate School requirements with regard to master's degrees.

Concentration in Biological Materials & Devices

Choose nine hours of the following:		9
BENG 4123	Biosensors & Bioinstrumentation	
BENG 5103	Advanced Instrumentation in Biological Engineering	
BENG 5743	Biotechnology Engineering	
BMEG 5213	Tissue Mechanics	
BMEG 5313	Advanced Biomaterials and Biocompatibility	
ELEG 4253	Nanotechnology in Engineering & Medicine	
ELEG 5773	Electronic Response of Biological Tissues	
MEEG 5253	Bio-Mems	
MEEG 5343	Computational Material Science	
MSEN 6323 Materials Engineering Design	Course MSEN 6323 Materials Engineering Design Not Found	
PHYS 5613	Introduction to Biophysics and Biophysical Techniques	

Concentration in Energy Materials & Devices

Choose nine hours from the following:		9
CHEM 5283	Energy Conversion and Storage	
ELEG 5223	Design and Fabrication of Solar Cells	
MEEG 5343	Computational Material Science	
MSEN 5713 Advanced Nanomaterials Chemistry	Course MSEN 5713 Advanced Nanomaterials Chemistry Not Found	
MSEN 5733L Fabrication at the Nanoscale	Course MSEN 5733L Fabrication at the Nanoscale Not Found	
MSEN 6323 Materials Engineering Design	Course MSEN 6323 Materials Engineering Design Not Found	

Concentration in Mechanical & Structural Materials

Choose nine hours of the following:		**9**
MEEG 5033	Advanced Mechanics of Materials I	
MEEG 5123	Finite Elements Methods II	
MEEG 5163	Advanced Product Design	
MEEG 5303	Physical Metallurgy	
MEEG 5343	Computational Material Science	
MSEN 6323 Materials Engineering Design	Course MSEN 6323 Materials Engineering Design Not Found	
PHYS 5713	Condensed Matter Physics I	
PHYS 6713	Condensed Matter Physics II	

Concentration in Microelectronic-Photonic Materials & Devices

ELEG 5203	Semiconductor Devices	3
Choose six hours from the following:		**6**
ELEG 5213	Integrated Circuit Fabrication Technology	
ELEG 5223	Design and Fabrication of Solar Cells	
ELEG 5243L	Microelectronic Fabrication Techniques and Procedures	
ELEG 5273	Electronic Packaging	
ELEG 5293L	Integrated Circuits Fabrication Laboratory	
ELEG 5313	Power Semiconductor Devices	
ELEG 5323	Semiconductor Nanostructures I	
ELEG 5333	Semiconductor Nanostructures II	
ELEG 5353	Semiconductor Optoelectronic Devices	
ELEG 5363	Semiconductor Material and Device Characterization	
ELEG 5383	Introduction of Integrated Photonics	
ELEG 5393	Electronic Materials	
ELEG 5543	Introduction to Power Electronics	
MEEG 5263	Introduction to Micro Electro Mechanical Systems	
MEEG 5343	Computational Material Science	
MSEN 6323 Materials Engineering Design	Course MSEN 6323 Materials Engineering Design Not Found	
PHYS 5713	Condensed Matter Physics I	
PHYS 5734	Laser Physics	
PHYS 5753	Applied Nonlinear Optics	
PHYS 5773	Introduction to Optical Properties of Materials	
PHYS 6613	Quantum Optics	
PHYS 6713	Condensed Matter Physics II	

Concentration in Nanoscale Materials & Devices

Choose nine hours of the following:		9
CHEM 5443	Physical Chemistry of Materials	
ELEG 4303	Introduction to Nanomaterials and Devices	
MEEG 5323	Physical and Chemical Vapor Deposition Processes	
MEEG 5333	Introduction to Tribology	
MEEG 5343	Computational Material Science	
MSEN 5713 Advanced Nanomaterials Chemistry	Course MSEN 5713 Advanced Nanomaterials Chemistry Not Found	
MSEN 5733L Fabrication at the Nanoscale	Course MSEN 5733L Fabrication at the Nanoscale Not Found	
MSEN 6323 Materials Engineering Design	Course MSEN 6323 Materials Engineering Design Not Found	
PHYS 5713	Condensed Matter Physics I	
PHYS 5723	Physics at the Nanoscale	
PHYS 5783	Physics of 2D Materials	
PHYS 6713	Condensed Matter Physics II	

Concentration in Materials Modeling

Choose nine hours of the following:		9
CVEG 5383	Finite Element Methods in Civil Engineering	
MEEG 5123	Finite Elements Methods II	
MEEG 5343	Computational Material Science	
MEEG 5733	Advanced Numerical Methods	
MSEN 6323 Materials Engineering Design	Course MSEN 6323 Materials Engineering Design Not Found	
PHYS 5093	Applications of Group Theory to Physics	
PHYS 5363	Scientific Computation and Numerical Methods	
PHYS 5713	Condensed Matter Physics I	
PHYS 6713	Condensed Matter Physics II	

Are Similar Programs available in the area?

No

Estimated Student Demand for Program: **40** ~~35~~

Scheduled Program Review Date: **2020-2021** ~~2020~~

Program Goals and Objectives

Program Goals and Objectives

Program Goals and Objectives
1. Provide students with interdisciplinary education and training in materials science and engineering to meet the needs of emerging technology industries. **2. Place students in interdisciplinary groups performing rigorous and challenging research to prepare them for careers in industrial research teams, national labs, and academic positions.** **3. Prepare students to be effective in technology management and entrepreneurship.** ~~Clarification of curriculum requirements for students entering the program in the spring semester.~~

Learning Outcomes

Learning Outcomes
1. Conduct independent investigations in an interdisciplinary environment, expanding the breadth and depth of state-of-the-art knowledge in the field of materials, materials processing, and devices enabled by advances in materials. **2. Master knowledge, practices, and skills from traditional graduate level programs in Physics, Chemistry, Electrical Engineering, Chemical Engineering, Mechanical Engineering, Biological Engineering, and Biomedical Engineering, regardless of prior traditional educational background.** **3. Communicate effectively deep level knowledge of their work to persons well-versed in their field, detailed technical concepts to persons with strong technical backgrounds outside of their field, and general concepts and applications to the general public.** **4. Work efficiently in interdisciplinary team environments, fully supporting team goals through active membership or through team leadership as appropriate.** **5. Implement intellectual property management and research commercialization processes, encouraging migration of ideas from formulation to societal benefit during their professional careers.** **6. Execute duties found in entry-level professional positions with the operational skills equivalent to at least one year's experience in that position.** ~~No change~~

Description and justification of the request

Description of specific change	Justification for this change

Description of specific change	Justification for this change
Reconfiguration of the Microelectronics-Photonics MS program into the MS in Materials Engineering (MATEMS) programs and MS in Materials Science (MATSMS). A separate CIM block will need to be created for the MS in Material Science curriculum. Also, each concentration listed above will need to be created for both the MATEMS and the MATSMS as well.	Program has developed with a clear focus on materials science and engineering which is a nationally recognized degree. Given a world-class materials research building and facilities, faculty trained in materials and research on materials, the marketability of our graduates can be improved by granting them degrees in Materials Science and Materials Engineering. With an established track record (grants, MS graduates produced, publications, facilities, etc.), the program should soon be recognized as a top national program. This will further attract top students and faculty, result in more research funding, and garner increased interest from industry

Upload attachments

MEPHMS - Reconfiguration - Curriculum.docx

MEPHMS - Reconfiguration - Ltr of Notification.pdf

Reviewer Comments

Alice Griffin (agriffin) (07/03/19 1:22 pm): Attention Registrar Staff: No new students admitted into the MEPHMS after summer 2020. Allow students in MEPHMS program to complete through summer 2025.

Alice Griffin (agriffin) (07/03/19 2:19 pm): Updated course titles in program requirements.

Alice Griffin (agriffin) (07/08/19 1:31 pm): Entered "9" to reflect hours in the Materials Modeling concentration.

Alice Griffin (agriffin) (07/08/19 2:08 pm): Hyper-linked courses in program requirements where appropriate.

Alice Griffin (agriffin) (07/08/19 2:13 pm): Inserted course titles into parts of the program requirements.

Alice Griffin (agriffin) (07/12/19 1:33 pm): Revised curriculum format in consultation with submitter. Renamed documents to match BOT naming convention.

Alice Griffin (agriffin) (07/12/19 1:34 pm): A separate CIM block will need to be created for the MS in Material Science curriculum. Also, each concentration listed above will need to be created for both the MATEMS and the MATSMS as well.

Gary Gunderman (ggunderm) (07/15/19 4:03 pm): CIP (14.1801) matches MSENPH, approved.

Rick Wise (rickwise) (07/17/19 9:58 am): Added the requirement of student learning outcomes in course syllabi.

Key: 254