Engineering Faculty Document No. *07-18*

To: The Faculty of the College of Engineering
From: School of Materials Engineering
Subject: New Graduate Course, MSE 60000 Materials Engineering Fundamentals

The faculty of the School of Materials Engineering has approved the following new course. This action is now submitted to the Engineering faculty with a recommendation for approval.

MSE 60000
Sem. 1, Lecture 3, cr. *3*

Course description: Fundamental relationships between the internal structure, properties and processing in all classes of engineering materials. Comprehensive coverage spanning physical, chemical, thermal, mechanical, electrical, magnetic, and optical responses. The course is intended for materials researchers from all backgrounds, as well as engineers working in product design, development and manufacturing who seek a deeper understanding of the full spectrum of engineering materials.

Reasons: Materials Engineering is an interdisciplinary field that attracts graduate students from a broad range of educational backgrounds including: chemistry, physics and other engineering disciplines. MSE 60000 is designed to provide a broad foundation in Materials Engineering fundamentals such that incoming students from a range of disciplines will possess a basic understanding of the field upon which they may build with further study. The foundation provided by MSE 60000 will benefit both the students and the Materials Engineering program by ensuring that the MSE graduate students possess the fundamental knowledge of the field needed to be an effective teaching assistant for MSE undergraduate courses. MSE 60000 will also serve as a distance education course offered through Engineering Professional Education.

David Bahr, Head, School of Materials Engineering

Office of the Registrar
FORM 40G REV. 8/16

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF A GRADUATE COURSE
(50000-60000 LEVEL)

DEPARTMENT: Materials Engineering EFFECTIVE SESSION: Fall 2017

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [x] 1. New course with supporting documents (complete proposal form)
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	MSE	Subject Abbreviation	
Course Number	60000	Course Number	
Long Title	Materials Engineering Fundamentals		
Short Title	Materials Engr Fundamentals		

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

TERMS OFFERED (Check All That Apply)
- [x] Fall
- [ ] Spring
- [ ] Summer

CAMPUS(ES) INVOLVED
- [ ] Calumet
- [ ] Cont Ed
- [ ] Ft. Wayne
- [ ] Indianapolis
- [ ] N. Central
- [ ] Tech Statewide
- [x] W. Lafayette

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To [ ] Or [ ]
   Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ] No [ ]
4. Thesis Credit: Yes [ ] No [ ]

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
   Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Fees [ ] Coop [ ] Lab [ ] Rate Request
   Include comment to explain fee
6. Registration Approval Type
   Department [x] Instructor [ ]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

Schedule Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3	16	100
Recitation				
Presentation				
Laboratory				
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS): (Note: If description will not fit in space provided, please create a separate document and attach it to this form.)

Fundamental relationships between the internal structure, properties and processing in all classes of engineering materials. Comprehensive coverage spanning physical, chemical, thermal, mechanical, electrical, magnetic, and optical responses. The course is intended for materials researchers from all backgrounds, as well as engineers working in product design, development and manufacturing who seek a deeper understanding of the full spectrum of

*COURSE LEARNING OUTCOMES: (Note: If course learning outcomes will not fit in space provided, please create a separate document and attach it to this form.)

1. Perform calculations to quantify material properties and microstructural characteristics. 2. Recognize the effect of composition and microstructure on material properties. 3. Take information from a known situation and apply it to a new situation. 4. Predict property response or microstructural changes based on imposed conditions. 5. Assess the interplay of two or more material properties.

Calumet Department Head	Date	Calumet School Dean	Date	Calumet Director of Graduate Studies	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date	Fort Wayne Director of Graduate Studies	Date
Indianapolis Department Head	Date	Indianapolis School Dean	Date	IUPUI Associate Dean for Graduate Education	Date
North Central Department Head	Date	North Central School Dean	Date	North Central Director of Graduate Studies	Date
West Lafayette Department Head	10/24/17	West Lafayette College/School Dean	Date	Date Approved by Graduate Council	Date
Graduate Area Committee Convener	Date	Graduate Dean	Date	Graduate Council Secretary	Date
				West Lafayette Registrar	Date

OFFICE OF THE REGISTRAR

Grad Form 40G must include the Graduate Council's supporting document, which is available at http://www.purdue.edu/registrar/forms/form_40_Intro.html

Detailed Graduate Course Proposal for Academic Review

Note: The detailed course proposal is intended for academic review by the appropriate area committee of the Graduate Council. It supplements the Form 40G that is intended for administrative review of the Graduate School and Registrar.

To: Purdue University Graduate Council

From: Faculty Member: Elliott Slamovich
Department: Materials Engineering
Campus: West Lafayette

Date: October 24, 2017

Subject: Proposal for New Graduate Course

Contact for information if questions arise:
Name: Elliott Slamovich
Phone: 494-6853
Email: elliotts@purdue.edu
Address: ARMS 2307

Course Number: MSE 60000
Course Title: Fundamentals of Materials Engineering
Short Title: Fundamentals of Materials Engineering

Course Description:

Fundamental relationships between the internal structure, properties and processing in all classes of engineering materials. Comprehensive coverage spanning physical, chemical, thermal, mechanical, electrical, magnetic, and optical responses. The course is intended for materials researchers from all backgrounds, as well as engineers working in product design, development and manufacturing who seek a deeper understanding of the full spectrum of engineering materials.

A. Justification for the Course

Justification of the need for the course

- Materials Engineering is an interdisciplinary field that attracts graduate students from a broad range of educational backgrounds including: chemistry, physics and other engineering disciplines.
- MSE 60000 is designed to provide a broad foundation in Materials Engineering fundamentals such that incoming students from a range of disciplines will possess a basic understanding of the field upon which they may build with further study.
- The foundation provided by MSE 60000 will benefit both the students and the Materials Engineering program by ensuring that the MSE graduate students possess the fundamental knowledge of the field needed to be an effective teaching assistant for MSE undergraduate courses.
- MSE 60000 will also serve as a distance education course offered through Engineering Professional Education.

Justification that course will be taught at a graduate level

- MSE 60000 is appropriate for a 600-level course because it introduces fundamental concepts that are subsequently explored in depth using past and current examples from the scientific literature. Further, course assessment through examination requires that students demonstrate the ability to build on knowledge acquired in class and apply them to new and unfamiliar situations.

Justification of the demand for the course

- Anticipated enrollment
    - Undergraduate 0
    - Graduate 35 on-campus students and 20 off-campus students

This course was offered as MSE 697 in Fall 2016 with an enrollment of 56 on-campus and 18 off-campus students and is being offered in Fall 2017 with a current enrollment of 38 on-campus and 14 off-campus students.

Justification for online delivery

MSE 60000 is also delivered at distance through the Engineering Professional Education (EPE) Program, to students primarily working in industry. It serves as an elective course in the Master's in Interdisciplinary Engineering Program, as well as a required course for the Materials Engineering concentration.

B. Learning Outcomes and Methods of Assessment

- 1. Perform calculations to quantify material properties and microstructural characteristics. Example: Calculate the interplanar spacing of a family of atomic planes given a x-ray diffraction pattern.

- 2. Recognize the effect of composition and microstructure on material properties. Example: The effect of dislocation density on yield strength and electrical conductivity.

- 3. Take information from a known situation and apply it to a new situation. Example: Effect of temperature and applied stress on the peak positions in a XRD pattern.

- 4. Predict property response or microstructural changes based on imposed conditions. Example: Effects of temperature and alloying on the resistivity of metals.

- 5. Assess the interplay of two or more material properties. Example: Assess the effect of atomic bond strength on Young's modulus, coefficient of thermal expansion and melting temperature.

- All assessment is performed through in class examinations. Questions involve both calculations and qualitative responses to assess understanding of the course material.

Final Grading Criteria

Describing the criteria that will be used to assess students and how the final grade will be determined. Add and delete rows as needed.

Assessment Methods (should match method types in the previous table)	**Weight Toward Final Course Grade**
Exams and Quizzes	100%

Methods of Instruction

Class Hrs/Week	**Method of Instruction**	**Contribution to Outcomes**
3	Lecture	[click here and explain contribution]

C. Prerequisite(s)

- There are no prerequisites for MSE 60000.

If no prerequisites, explain rationale:

- MSE 60000 is designed to provide a foundation in Materials Engineering fundamentals to graduate students whose undergraduate degrees encompass a broad range of disciplines.

D. Course Instructor(s)

Name	Rank	School, dept., or center	Graduate Faculty or expected date
Kevin Trumble	Professor	MSE	Yes
Elliott Slamovich	Professor	MSE	Yes

E. Course Schedule or Outline

Week	Topic(s)
1	• Introduction, bonding and crystal structure
2	• Non-crystalline and molecular structure
3	• Intrinsic properties
4	• Microstructure and microstructure-dependent properties
5	• Phase equilibrium and phase diagrams
6	• Kinetics and phase transformations
7	• Reactivity and chemical properties
8	• Thermal properties
9	• Mechanical properties (elastic)
10	• Mechanical properties (plastic and time-dependent)
11	• Electronic structure and properties
12	• Electronic transport properties

Week	Topic(s)
13	• Dielectric properties
14	• Magnetic properties
15	• Optical properties
16	Not applicable

F. Reading List (including course text)

Primary Reading List

- *The Principles of Engineering Materials*, C. R. Barrett, W. D. Nix, A. S. Tetelman, Prentice Hall (1973).
- R.P. Grosso, J.T. Fermann and W.J. Vining, "An In-Depth Look at the Madelung Constant for Cubic Crystal Systems, J. Chem. Ed., 78 [9] 1198-1202 (2001).
- A.V. Virkar, T.B. Jackson and R.A. Cutler, "Thermodynamic and Kinetic Effects of Oxygen Removal on the Thermal Conductivity of Aluminum Nitride," J. Am. Ceram. Soc., 72 [11] 2031-42 (1989).
- O.B.M. Hardouin Duparc, "The Preston of the Guinier-Preston Zones," Met. and Mat. Trans. A, 41A 1873-1883 (2010).

Secondary Reading List

G. Library Resources

No library sources are required because any required journal articles will be distributed to the students.

H. Course Syllabus (now required)

MSE 697 Materials Engineering Fundamentals Fall 2016

Lecture: MWF 1:30-2:20, WANG 2579. Lectures will be recorded in the classroom studio for students taking the course off campus through Purdue Engineering Professional Education (EPE). The recorded lectures will also be available to on-campus students.

Instructor: Prof. Elliott Slamovich, ARMS 2307, 765-494-6853, elliotts@purdue.edu.

Office Hours: Contact me by phone (765) 494-6853 or email elliotts@purdue.edu at any time. I will arrange office hour at specific times if needed.

Course Objectives

Understand the fundamental basis for materials phenomena in terms of the hierarchy of structures (e.g., atomic, molecular, crystal, grain) and their relations to properties responses and processing. Develop a foundation for advanced studies in materials engineering and related fields.

Description

Fundamental relationships between the internal structure, properties and processing in all classes of engineering materials. Comprehensive coverage spanning physical, chemical, thermal, mechanical, electrical, magnetic, and optical responses. The course is intended for materials researchers from all backgrounds, as well as engineers working in product design, development and manufacturing who seek a deeper understanding of the full spectrum of engineering materials.

Prerequisites

Graduate standing

Textbooks

The required text is: *The Principles of Engineering Materials*, C. R. Barrett, W. D. Nix, A. S. Tetelman, Prentice Hall (1973). Either the original (1st) edition or "REVISED PRINTING" are fine.

Also recommended is a copy of the popular introductory MSE book by W.D. Callister, Jr. There are two versions, which are essentially different arrangements of the same content. One is titled, *MSE: An Introduction* and the other, *Fundamentals of MSE: An Integrated Approach*. Either version is fine and the cost is low if you buy an older edition; even two or more editions back will be perfectly suitable.

Additional readings will be assigned from classic and recent papers in the literature and other sources.

Website: Course information, homework and other course resources will be posted on *Blackboard.*

Topic Outline by Week:

1. Introduction, bonding and crystal structure
2. Non-crystalline and molecular structure
3. Intrinsic properties
4. Microstructure and microstructure-dependent properties
5. Phase equilibrium and phase diagrams
6. Kinetics and phase transformations
7. Reactivity and chemical properties
8. Thermal properties
9. Mechanical properties (elastic)
10. Mechanical properties (plastic and time-dependent)
11. Electronic structure and properties
12. Electronic transport properties
13. Dielectric properties
14. Magnetic properties
15. Optical properties

Assessment and Grading

Grading will be based on written exams. There will be monthly in-class exams (3 x 20% = 60%) and a comprehensive final exam (40%). Homework will be assigned about weekly, but not graded. The class median will be used to determine the A-/B+ cutoff.

Emergency Policies and Procedures

Fire, weather, and civil emergency procedures specific to the WANG 2579 will be reviewed in class. Information on emergency preparedness at Purdue is available on the Purdue homepage and at http://www.purdue.edu/emergency_preparedness/. In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. These changes would be posted on Blackboard. In case of an extended disruption in which classes on campus are suspended the course will continue to the extent possible via *Blackboard*. If you do not have Internet access from your home, please send an e-mail message to Prof. Slamovich indicating this so that we can make an alternate plan for remote communication (e.g., telephone) if classes are suspended.

Academic Dishonesty Policy

Purdue University Regulations, Part 5, Section III-B-2-a describes the formal policies governing academic dishonesty. A guide providing specific examples, tips, and consequences is available at http://www.purdue.edu/odos/osrr/academicintegritybrochure.php