Supporting Documents
Engineering Faculty Document (EFD) No. 67-13
Date: April 19, 2013

TO: The Faculty of the College of Engineering

FROM: Faculty of the School of Nuclear Engineering

SUBJECT: New Undergraduate Course, NUCL 32500, Nuclear Materials Laboratory

The Faculty of the School of Nuclear Engineering has approved the new course and replacement of the MSE requirement. This action is now submitted to the Engineering Faculty with a recommendation for approval.

NUCL 32500, Nuclear Materials Laboratory

Sem. 1, Lab 2, Class 2, Cr. 3
Requisites, Restrictions, and Attributes: co-requisite with NUCL 32000 or consent of instructor

Course Description: Nuclear materials laboratory that evaluates various characterization techniques and technologies. Tensile properties, hardness, fracture toughness, microstructures, X-ray diffraction, electron microscopy, mechanical properties of thin-films, NDE techniques and data acquisition in materials characterization techniques.

Reason: Nuclear engineering students used to take MSE 23500 course for three credits from the School of Materials Engineering. Prior to Fall 2007 enrollments in both NE and MSE grew to the extent that MSE could no longer manage large number of both MSE and NE students in laboratories at MSE. MSE and NE agreed that a separate materials laboratory should be created in the NE department to manage the overload. NE department also decided to establish a materials laboratory with more emphasis on nuclear materials. In addition, the nuclear materials laboratory has been designed to include the enhanced technical writing experiences for the students in the form of short and formal reports.

The course has been taught five times (Spring 2009, Spring 2010, Fall 2010, Fall 2011, and Fall 2012) with an average rating of 4.2 managing an enrollment average of over 40 students. All students are from NE and the laboratory in the past two years has run concurrently with NUCL 32000 (Materials science course in NE) with much success.

A. Hassanein

Ahmed Hassanein, Department Head
Paul L. Wattelet Professor
School of Nuclear Engineering

APPROVED FOR THE FACULTY
OF THE SCHOOLS OF ENGINEERING
BY THE ENGINEERING
CURRICULUM COMMITTEE

ECC Minutes 10-4-13

Date 10-4-13

Chairman ECC

NUCL

EFD 67-13

Office of the Registrar
FORM 40 REV. 12/09

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

Print Form

DEPARTMENT Nuclear Engineering

EFFECTIVE SESSION Fall 2013 201420

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

- [X] 1. New course with supporting documents
- [ ] 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 (department head signature only)
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	NUCL	Subject Abbreviation	
Course Number	32500	Course Number	

Long Title: Nuclear Materials Laboratory

Short Title: NUCL MAT Lab

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 [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [X] W. Lafayette
[ ] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 3.00
2. Variable Credit Range:
Minimum Cr. Hrs
(Check One) To [ ] Or [ ]
Maximum Cr. Hrs.
3. Equivalent Credit: Yes [X] No [ ]

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [X] LMM
Maximum Repeatable Credit:
4. Credit by Examination [ ]
5. Special Fees [ ]
6. Registration Approval Type
Department [ ] Instructor [ ]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

ScheduleType	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3 2	16	
Recitation				
Presentation				
Laboratory	110	1	16	
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

RECEIVED
OCT 15 2013
OFFICE OF THE REGISTRAR

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):
Nuclear materials laboratory that evaluates various characterization techniques and technologies. tensile properties, hardness, fracture toughness, microstructures, X-ray diffraction, electron microscopy, mechanical properties of thin-films, NDE techniques and data acquisition in materials characterization techniques.

Co-Requisites: NUCL 32000 - Introduction to Materials for Nuclear Applications

*COURSE LEARNING OUTCOMES:
1. Understanding of what materials are, and how they perform and fail
2. Understand the conceptual tools dealing with materials phenomena
3. Be able to communicate with professionals about materials problems
4. Be able to address the limitations of materials in design, and improve them

	Date		Date
Calumet Department Head		Calumet School Dean	
Fort Wayne Department Head		Fort Wayne School Dean	
Indianapolis Department Head		Indianapolis School Dean	
North Central Faculty Senate Chair		Vice Chancellor for Academic Affairs	
West Lafayette Department Head	4/24/2013	West Lafayette College/School Dean	10/14/13
			West Lafayette Registrar 10/18/13

OFFICE OF THE REGISTRAR

NUCL 325 (NUCL 497M)
Nuclear Materials Laboratory
Fall 2011

Lab	M/T/W/TH	1:30-3:20 pm	*NUCL 111*
Lectures	M/W/F	8:30-9:20 am	*GRIS 166/EE 115*

General Course Description:

Nuclear materials laboratory that evaluates various characterization techniques and technologies. tensile properties, hardness, fracture toughness, microstructures, X-ray diffraction, electron microscopy, mechanical properties of thin-films, NDE techniques and data acquisition in materials characterization techniques.

Textbook

W.D. Callister, Jr., *Materials Science and Engineering – An Introduction,* 8th Edition, John Wiley & Sons, Inc. 2007, ISBN: 0-471-73696-1

Lab Handbook

NUCL 325 (NUCL 497M) *Nuclear Materials Laboratory, 3rd Edition*
Can be purchased in **Room 157** of the **Purdue Memorial Union** (Boiler Copy Maker)

Course Grading

Pre-Labs	12%	
Quizzes and Assignments	8%	
Short Lab Reports (5)	35%	
Formal Reports (3)	30%	
Final Exam	15%	(Cumulative of labs and reports)

A:	90 ~ 100	B:	70 ~ 79.9
A-:	85 ~ 89.9	C:	60 ~ 69.9
B+:	80 ~ 84.9	D:	50~59.9
F:	< 49.9		

Instructor Professor Jean Paul Allain, Email: allain@purdue.edu
NUCL/ Room 132C
Nuclear Engineering Building, (765) 496-9718

T.A. Brandon Holybee, email: bholybee@purdue.edu
Office Hours: Thursday 4:30-6:30 pm
Other days: TBA

Asst. T.A. Emily Gordon: ecgordon@purdue.edu; Kara Luitjohan: kluitjoh@purdue.edu

Graded Elements:

Pre-Labs (12%)

Due: Beginning of Recitation

Guidelines: Pre-Lab submission must be **typed** and submitted at the **beginning** of Recitation. Failure to submit a Pre-Lab will prevent you from participating in a Lab.

Short Lab Reports (35%)

Due: Beginning of Afternoon Lab.

Guidelines: Short Lab Report submissions must be **typed** and submitted at the **beginning** of afternoon lab session. Specific due dates for each Lab Submission are outlined in the schedule. Any changes to the schedule will be posted to blackboard. **Late reports will receive 0% credit. If you are not present at the beginning of lab when the TA collects the reports, your lab is considered late.**

Formal Lab Reports (30%)

Due: Beginning of Afternoon Lab.

Guidelines: Formal Labs must be typed and submitted at the **beginning** of afternoon lab session. Specific due dates for each Lab Submission are outlined in the schedule. Any changes to the schedule will be posted to blackboard. **Late reports will receive 0% credit. If you are not present at the beginning of lab when the TA collects the reports, your lab is considered late.**

Quizzes and Assignments (8%)

Quizzes will be conducted during the first few minutes of recitation and cannot be made up without prior approval. Assignments will be given throughout the semester and will be collected in lab, or in recitation, as outlined in the schedule or on blackboard.

Final Exam (15%)

The final exam will take place as scheduled during finals week. The exam will cover error analysis and elements from all labs conducted during the semester.

Schedule of Experimental Labs: († Formal Lab Reports)

1. X-ray Diffraction **Week of 08/29**
2. Introduction to Tensile Testing **Week of 09/12** †
3. Defects, Strengthening, and Fabrication of Metals **Week of 09/19**
4. Annealing and Hardness **Week of 09/26** †
5. Introduction to Ceramics **Week of 10/17**
6. Microstructures **Starts week of 10/24 –2 week lab**
7. Introduction to Vacuum Technology **Weeks of 11/07 and 11/14† - 2 week lab**
8. Radiation Modification of Surfaces and Interfaces **Week of 11/28**
9. Thin Film Growth **Week of 11/28**

Dead Week - No Labs or lectures **Week of 12/05**
Final Exam – Take Home **Week of 12/05**

Class Policy

Session Scheduling

Monday/Tuesday Session:	8:30-9:20 am	*Lecture 1A* (Mon)
	1:30-3:20 pm	*Lab* (Mon/Tues)
Wednesday Session	8:30-9:20 am	*Lecture 1B* (Wed)
	1:30-3:20 pm	*Lab* (Wed/Thurs)
Friday Combined Lecture	8:30-9:20 am	*Lecture 2* (Friday)

Each lab session will be split into smaller groups for experiments. Lab groups will change for each experiment and will be posted to blackboard. Labs are conducted over one or two weeks. In labs designated as "two weeks," *your report is due after the second week of class*. **Be sure you are aware of due dates for your Pre-Lab as you cannot participate in a lab session without turning in your Pre-Lab and attending Recitation.** Arrangements can be made with your TA and Dr. Allain if an emergency arises.

Lecture A & B

Any changes to procedure or lab write-ups will be given in any of the two lectures A or B. You will also receive instruction for using specialized equipment and will review the procedure for the afternoon lab session.

Completed Pre-Labs are to be submitted to the TA at the *beginning* of class. Pre-Labs submitted after the TA has collected them will be considered late and will not be counted for credit.

Quizzes will be conducted at the start of class and cannot be made up without prior instructor approval.

Lecture

Combined Lecture will be held once a week on Friday mornings. Lecture will cover theory, error analysis, equipment, etc. The first 15 minutes of class will have general Q&A about the lab conducted that week to aid in your analysis.

Attendance

All students must attend **ALL lectures** (8:30 am class), and **ALL labs** for credit.

If a situation arises which makes you unable to attend a Recitation and Lab, you must notify Dr. Allain 24 hours before that recitation-lab session; make-up to another lab section *within the same week* can be arranged. Arrangements can be made in the case of an emergency.

If you are unable to attend another recitation-lab session within the same week, keep in mind that make-up of the labs in ARMS or NE will likely not be possible.

NUCL 325 Course Schedule and Outline

Week	Date	*Lecture*	Due	Lab Topic
1	M - Th 08/22 - 08/25	Introduction to the course, technical writing, report format, and error analysis	--	No Lab
	F 08/26	*Error Analysis and X-Ray Diffraction*	--	--
2	M - Th 08/29 - 09/01	X-ray Diffractometer, Powder Diffraction, and Reading a PDF	***Error Analysis Homework*** and *XRD Pre-Lab*	XRD
	F 09/02	*X-ray Diffraction*	--	--
3	M - Th 09/05 - 09/08	Labor Day: No Formal Class	--	No Lab
	F 09/09	*Tensile Testing and Mechanical Properties of Materials*	--	--
4	M - Th 09/12 - 09/15	Tensile Testing, Strain-Gauges, Stress-Strain Curves, Deformation	***XRD Lab Report*** and *Tensile Pre-Lab*	Introduction to Tensile Testing
	F 09/16	*Defects, Strengthening, and Fabrication of Metals*	--	--
5	M – Th 09/19 - 09/22	Extrusion, Cold working, and Strain Hardening	***Introduction to Tensile Testing Lab Report*** and *Defects, Strengthening, and Fabrication of Metals Pre-Lab*	Defects, Strengthening, and Fabrication of Metals
	F 09/23	*Annealing and Hardness Measurement*	--	--
6	M - Th 09/26 - 09/29	Annealing and Rockwell Hardness Testing	***Defects, Strengthening, and Fabrication of Metals Lab Report*** and *Annealing and Hardness Measurement Pre-Lab*	Annealing and Hardness Measurement
	F 09/30	*No Lecture*	--	--
7	M - Th 10/03 - 10/06	No Formal Class		No Lab
	F 10/07	*No Lecture*	--	--
8	M - Th 10/10 - 10/13	Fall Break: No Formal Class		No Lab
	F 10/14	*Ceramics*	--	--
9	M - Th 10/17 - 10/20	Compression testing	***Annealing and Hardness Measurement Lab Report*** and *Ceramics Pre-Lab*	Properties of Ceramics
	F 10/21	*Microstructures I*	--	--
10	M - Th 10/24 - 10/27	Sample Prep, Grinding, and Polishing	***Properties of Ceramics Lab Report*** and *Microstructures Pre-Lab*	Microstructures I: Polishing
	F 10/28	*Microstructures II*	--	--
11	M - Th 10/31 - 11/03	Microscopy, Stereology, Hall-Petch Relationship		Microstructures II: Stereology
	F 11/04	*Vacuum Technology*		

12	M – Th 11/07 - 11/10	Vacuum Safety, Conductance, and Vacuum Regimes	***Microstructures Lab Report*** and *Introduction to Vacuum Technology Pre-Lab*	Introduction to Vacuum Technology
	F 11/11	*Residual Gas Analysis and Radiation Modification of Surfaces and Interfaces*	--	--
13	M - Th 11/14 - 11/17	*Vacuum Technology II: Mass spectrometry and analysis of residual gases*	*Vacuum Technology Part II Pre-Lab*	Vacuum Technology: Part II RGA
	F 11/18	*Thin Film Growth and Characterization*	--	--
14	M - Th 11/21 - 11/24	Thanksgiving Break: No Formal Class	--	No Lab
	F 11/25	*No Lecture*	--	--
15	M - Th 11/28 - 12/01	Ion guns, beam diameters, FWHM, Flux calculation, and XPS Magnetron Sputtering, and thin-film growth, and AFM techniques	***Vacuum Technology Lab Report*** **and** *Radiation Modification of Surfaces and Interfaces Pre-Lab*	*Radiation Modification and Growth of Thin-Film Surfaces and Interfaces*
	F 12/02	*Review*	--	--
16	M - Th 12/05 - 12/08	*Dead Week*	***Radiation Modification and Growth of Thin-Film Surfaces and Interfaces Lab Report Due: 12/14/11***	No Lab
	F 12/09	*Dead Week – No Lecture*	--	--

Additional Class Policy:

Emergency Provisions

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 beyond the instructor's control. Here are ways to get information about changes in this course:

Blackboard announcements
Instructor email (allain@purdue.edu)
Instructor phone # 765.496.9718

Academic Honesty

Be honest in your homework solutions and exams. Exams must be taken without the assistance of others. Cheating will result in a 0 for the exam and reports to your school and the Dean of Students, as required by the University policy.

Plagiarism

This course requires a lot of writing. Submitting plagiarized material will result in a zero. Plagiarism is defined by "Academic Integrity: A Guide for Students" (http://www.purdue.edu/odos/osrr/integrity.htm) as:

> *"...a special kind of academic dishonesty in which one person steals another person's ideas or words and falsely presents them as the plagiarist's own product. This is most likely to occur in the following ways:*
>
> - *using the exact language of someone else without the use of quotation marks and without giving proper credit to the author*
> - *presenting the sequence of ideas or arranging the material of someone else even though such is expressed in one's own words, without giving appropriate acknowledgment*
> - *submitting a document written by someone else but representing it as one's own"*