ARIZONA STATE UNIVERSITY

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GENERAL STUDIES PROGRAM COURSE PROPOSAL COVER FORM

Courses submitted to the GSC between 2/1 and 4/30 if approved, will be effective the following Spring.

Courses submitted between 5/1 and 1/31 if approved, will be effective the following Fall.

(SUBMISSION VIA ADOBE.PDF FILES IS PREFERRED)

DATE 1/7/2009

1. ACADEMIC UNIT: School of Materials

2. COURSE PROPOSED: MSE 315 Mathematical & Computer Methods in Materials 3
(prefix) (number) (title) (semester hours)

3. CONTACT PERSON: Name: Shahriar Anwar Phone: 480-965-5696

Mail Code: 8706 E-Mail: anwar@asu.edu

4. ELIGIBILITY: New courses must be approved by the Tempe Campus Curriculum Subcommittee and must have a regular course number. For the rules governing approval of omnibus courses, contact the General Studies Program Office at 965–0739.

5. AREA(S) PROPOSED COURSE WILL SERVE. A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study. (Please submit one designation per proposal)

Core Areas

Literacy and Critical Inquiry–L ☐
Mathematical Studies–MA ☐ CS ☒
Humanities, Fine Arts and Design–HU ☐
Social and Behavioral Sciences–SB ☐
Natural Sciences–SQ ☐ SG ☐

Awareness Areas

Global Awareness–G ☐
Historical Awareness–H ☐
Cultural Diversity in the United States–C ☐

6. DOCUMENTATION REQUIRED.
(1) Course Description
(2) Course Syllabus
(3) Criteria Checklist for the area
(4) Table of Contents from the textbook used, if available

7. ***In the space provided below (or on a separate sheet), please also provide a description of how the course meets the specific criteria in the area for which the course is being proposed.***

CROSS-LISTED COURSES: ☒ No ☐ Yes; Please identify courses: _____

Is this amultisection course?: ☒ No ☐ Yes; Is it governed by a common syllabus? _____

Subhash Mahajan
Chair/Director (Print or Type)

Chair/Director (Signature)

Date: January 9, 2009

Rev. 1/94, 4/95, 7/98, 4/00, 1/02, 10/08

Arizona State University Criteria Checklist for

MATHEMATICAL STUDIES [CS]

Rationale and Objectives

The **Mathematical Studies** requirement is intended to ensure that students have skill in basic mathematics, can use mathematical analysis in their chosen fields, and can understand how computers can make mathematical analysis more powerful and efficient. The **Mathematical Studies** requirement is completed by satisfying both the **Mathematics [MA]** requirement and the **Computer/Statistics/Quantitative Applications [CS]** requirement explained below.

The **Mathematics [MA]** requirement, which ensures the acquisition of essential skill in basic mathematics, requires the student to complete a course in College Mathematics, College Algebra, or Precalculus, or demonstrate a higher level of skill by completing a mathematics course for which any of the first three courses in a prerequisite.

The **Computer/Statistics/Quantitative Applications [CS]** requirement, which ensures skill in real world problem solving and analysis, requires the student to complete a course that uses some combination of computers, statistics, and mathematics.

Approved: Feb. 2000

Proposer: Please complete the following section and attach appropriate documentation.

ASU--[CS] CRITERIA			
A COMPUTER/STATISTICS/QUANTITATIVE APPLICATIONS [CS] COURSE MUST SATISFY ONE OF THE FOLLOWING CRITERIA: 1, 2, OR 3			
YES	**NO**		**Identify Documentation Submitted**
		1. Computer applications*: courses must satisfy both **a** and **b**:	
X	☐	**a.** Course involves the use of computer programming languages or software programs for quantitative analysis, modeling, simulation, animation, or statistics.	Syllabus and course catalog description.
		b. Course requires students to analyze and implement procedures that are applicable to at least one of the following problem domains **(check those applicable)**:	
☐	☐	**i.** Spreadsheet analysis, systems analysis and design, and decision support systems.	Syllabus
☐	☐	**ii.** Graphic/artistic design using computers.	
☐	☐	**iii.** Music design using computer software.	
X	☐	**iv.** Modeling, making extensive use of computer simulation.	Syllabus
X	☐	**v.** Statistics studies stressing the use of computer software.	Please see syllabus and page 5 of this document.
***The **computer applications** requirement **cannot** be satisfied by a course, the content of which is restricted primarily to word processing or report preparation skills; learning a computer language or a computer software package; or the study of the social impact of computers. Courses that emphasize the use of a computer software package or the learning of a computer programming language are acceptable, provided that students are required to understand, at an appropriate level, **the theoretical principles embodied in the operation of the software and are required to construct, test, and implement procedures that use the software to accomplish tasks in the applicable problem domains.**			
		2. Statistical applications: courses must satisfy both **a** and **b**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Precalculus**,** or a course already approved as satisfying the MA requirement.	
		b. The course must be focused principally on developing knowledge in statistical inference and include coverage of all of the following:	

ASU--[CS] CRITERIA			
YES	**NO**		**Identify Documentation Submitted**
☐	☐	**i.** Design of a statistical study.	
☐	☐	**ii.** Summarization and interpretation of data.	
☐	☐	**iii.** Methods of sampling.	
☐	☐	**iv.** Standard probability models.	
☐	☐	**v.** Statistical estimation	
☐	☐	**vi.** Hypothesis testing.	
☐	☐	**vii.** Regression or correlation analysis.	
		3. Quantitative applications: courses must satisfy both **a** and **b**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Precalculus**,** or a course already approved as satisfying the MA requirement.	
		b. The course must be focused principally on the use of mathematical models in quantitative analysis and design making. Examples of such models are:	
☐	☐	**i.** Linear programming.	
☐	☐	**ii.** Goal programming.	
☐	☐	**iii.** Integer programming.	

ASU--[CS] CRITERIA			
YES	**NO**		**Identify Documentation Submitted**
☐	☐	**iv.** Inventory models.	
☐	☐	**v.** Decision theory.	
☐	☐	**vi.** Simulation and Monte Carlo methods.	
☐	☐	**vii.** Other (explanation must be attached)	

Course Prefix	Number	Title	Designation
MSE	315	**Mathematical and Computer Methods in Materials**	**CS**

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
Course involves the use of computer programming languages or software programs for quantitative analysis, modeling, simulation, animation, or statistics.	The course requires students to write complex programs in MATLAB and LabView with applications in numerical analysis and engineering problems. DesignExpert is used for statistical and DOE analysis.	Program Outcome # 1, 3, and 4 (see below). Examples: a) Numerical solutions of differential equations. b) Structured programming. c) Numerical errors. Please see attached course syllabus.
Course requires students to analyze and implement procedures that are applicable to the following problem domain. **iv.** Modeling, making extensive use of computer simulation	This is a modeling course, and almost all of the methods are applied to engineering problems. For example, students design and simulate virtual machines in this course.	Program Outcome # 1, 3, and 4 (see below). Examples: a) Modeling inter-atomic forces and creating a movie of the atomic interactions. b) Design of a diffusion virtual machine. c) Acquisition of voltage and temperature from an experiment. Please see attached course syllabus.
Course requires students to analyze and implement procedures that are applicable to the following problem domain. **v.** Statistics studies stressing the use of computer	Students learn basic probability and statistical theory along with the design of experiments (DOE) with hands on applications.	Program Outcome # 1, 3, and 4 (see below). Examples: a) ANOVA analysis of 52 dice. b) DOE study using DesignExpert software. Please see attached course syllabus.

Contribution to Program Outcomes
Program Outcome #1 – an ability to apply knowledge of mathematics, science, and engineering principles to solve problems in materials science and engineering (ABET Criterion 3: a) (ABET Criterion 8: 1)
Program Outcome #3—ability to design and conduct experiments, and to collect, analyze, and interpret data on the behavior of materials in engineering applications, including the use of statistical and computational methods. (ABET Criterion 3:b) (ABET Criterion 8:4)
Program Outcome #4 – an ability to use modern techniques, skills, and tools required in the practice of materials science and engineering. (ABET Criterion 3: k)

MSE 315: Mathematical & Computer Methods in Materials

Shahriar Anwar

Catalog Description

Course description: Mathematical, computational, and statistical methods and computer programming used to model materials science phenomena and materials engineering applications.

Credits

3 (Three).

Enrollment Requirements

Pre-requisites: Engineering BS/BSE students OR Non-Engineering students with a minimum GPA of 3.00; MAT 274 or MAT 275 with D or better; MSE 250 or ECE 350 with D or better.

Syllabus

The basic objective of this course is to get the students up to speed in mathematical methods that they need to be an engineer and to introduce them to computing methods that will help them in their studies and future employment. Listed below are tentative topics that I plan to cover, but not necessarily in the order presented. We will use MATLAB, LabVIEW, and DesignExpert as our computational tools of choice to address problems in materials science & engineering.

1. Review of mathematical background for engineering.
2. Review of elementary analytic differential equations.
3. Introduction to MATLAB.
4. Matrix diagonalization.
5. Structured programming.
6. Numerical integration.
7. Numerical differentiation.
8. Numerical errors.
9. Solving system of equations.
10. Numerical methods in ordinary differential equations.
11. Numerical methods in partial differential equations.
12. Stochastic methods.
13. Fourier transforms.
14. LabVIEW graphical programming and data acquisition.
15. Basic statistical concepts and techniques.
16. Design of experiments.

MSE 315:
Mathematical and Computer Methods in Materials

Shahriar Anwar
School of Materials
Arizona State University
Tempe, AZ 85287-8706

August 26, 2008

Preliminaries

0.1 Instructor

Shahriar Anwar
Office: ECB 151
Phone: (480) 965-5696
E-mail: anwar@asu.edu
Office hours: Tuesdays & Thursdays 3:30–4:30 PM

0.2 Class Information for Fall 2008

MSE 315: Mathematical and Computer Methods in Materials.

Schedule line number: 76382.

Class meets in ECB 142 on Tuesdays and Thursdays, 1:30–2:45 PM.

Prerequisites: Engineering BS/BSE students or non-engineering students with a minimum GPA of 3.00; MAT 274 or MAT 275, or currently enrolled; MSE 250 or ECE 350.

0.3 Grading

Punctuality and attendance is *required* for all classes.

40% : Exams.

60% : Assignments (class work, homework, participation).

A portfolio of all your work is required at the end of the semester and will count towards the assignments grade.

Collaboration with your class mates in all assignments, *except exams*, is strongly encouraged, but you must submit your own work and not copy from another person. You may consult other books and the internet also. However, please cite and credit all collaborations and references. Collaboration is a great way to learn, however you should attempt to try out the problems yourself first for your own benefit.

This class is very intensive and will move very rapidly—you do not want to fall behind in any class, assignment or reading!

0.4 Textbooks and Softwares

1. *Applied Numerical Methods with MATLAB for Engineers and Scientists*, ISBN: 978–0–07–313290–7. Publisher: McGraw-Hill Higher Education, about $116. This is the main *required* textbook for this course.

2. *MATLAB & Simulink Student Version Release 2007a*, ISBN: 978–0–9792239–0–7. Publisher: The MathWorks, about $100. This one has the latest MATLAB software for Linux, Macintosh, and Windows in the same box. Although MATLAB is available on some campus computers, I strongly encourage you to purchase the item and install it on your own computers for convenience and for use in other courses. This is the full version of MATLAB (that retails for $1,900) except that the print out will say student version. The ASU Bookstore has enough copies since it is also required in two other electrical engineering courses. *Required.*

3. *Essential MATLAB for Engineers and Scientists*, 3nd edition, by Brian Hahn and Daniel Valentine. ISBN: 978-0-7506-8417-0. Publisher: Elsevier (Butterworth-Heinemann, $40. *Optional.*

4. *LabVIEW 8 Student Edition* by Robert Bishop & National Instruments. ISBN-13: 9780131999183. Publisher: Prentice Hall, $106.00 LabView is installed on the Lab computers. You may purchase the LabView book that includes the software at a ridiculously discounted price, but is not necessary. *Optional.*

5. Another software package that we will be using is a design of experiment program called *Stat-Ease*. Stat-Ease is a commercial program.

6. Notes and handouts by me.

7. Later in the semester I will require you to purchase (and bring to class) specified bags of *M&M* or *Skittles* candies. We do need to have some fun, don't you agree?

0.5 Main Topics

The basic objective of this course is to get you up to speed in mathematical methods that you need to be an engineer and to introduce you to computing methods that will help you in your studies and future employment. Listed below are tentative topics that I plan to cover, but not necessarily in the order presented. We will use MATLAB as our computational tool of choice to address problems in materials science & engineering.

1. Review of mathematical background for engineering.

2. Review of elementary analytic differential equations.

3. Introduction to MATLAB.

4. Numerical integration.

5. Numerical differentiation.

6. Numerical errors.

7. Solving system of equations.
8. Numerical methods in differential equations.
9. LabView graphical programming and data acquisition.
10. Design of experiments and statistical techniques.