UNDERGRADUATE CURRICULUM CHANGE MEMO

Date: 2/6/2020

From: Dr. Stella A. Quinones, Chair, Metallurgical, Materials and Biomedical Engineering (MMBME)

Through: Dr. Louis Everett, Chair of Curriculum Committee, College of Engineering

Through: Dr. Norman Love, Associate Dean for Academic Affairs and Undergraduate Studies, College of Engineering

Through: Dr. Theresa Maldonado, Dean, College of Engineering Theresa Maldonado 2/17/2020

To: Dr. Carla Ellis, Chair of University Curriculum Committee

Proposal Title: BS MME Degree Plan Changes

The MMBME faculty met in Fall 2018, Spring 2019 and Fall 2019 to review and improve the BS MME curriculum, and voted unanimously on the changes being proposed here. The major changes to the degree plan include the removal of 3 required courses in order to increase the number of electives from one to four and the replacement of the existing concentrations with updated concentrations that are relevant to industry. The proposed changes to the BS MME Degree Plan are described in this document and include:

1. Deletion of MME courses from BS MME Program
2. Removal of required courses from BS MME degree
3. Addition of new courses
4. Course name changes
5. Pre-requisite changes for existing courses
6. Removal of existing concentrations
7. Addition of new concentrations
8. Catalog Changes

1. Deletion of MME courses (a change of course is being implemented for these courses, and they are being added using the 'Course Add' forms, with catalog changes):
    - MME1301
    - MME1101
    - MME3312
    - MME3314
    - MME4195
    - MME4413
    - MME3321

2. Removal of required courses from BS MME degree: The following 3 courses were required in the BS MME degree plan, they will no longer be required based on the explanations listed below (Catalog change).
   - MECH2342 Electro Mechanical Systems: course will no longer be a required course in the BS MME degree plan; students will still be required to take the modified MME3309 Circuits, Electronic Materials and Devices course
   - MME3312 Biomaterials, Biomaterials Printing & Development: course name is being changed to MME4312 Biomaterials and Engineering. MME4312 will replace MME3312, and will be an elective course in the Biomaterials concentration
   - MME4304 Printable Materials: will now be an elective course in the Biomaterials concentration

3. Addition of new courses (w/Course Addition Form, Syllabi and Catalog Changes):
    - MME1401 Introduction to Metallurgical and Materials Engineering
    - MME3195 Junior Professional Orientation
    - MME3413 Materials Characterization
    - MME4190 Special Topics in MME
    - MME4290 Special Topics in MME
    - MME4390 Special Topics in MME
    - MME4312 Biomaterials Science and Engineering
    - MME4314 Composite Materials
    - MME4315 Metallography and Microstructure Interpretation
    - MME4321 Engineering Alloys
    - MME4330 Advanced Failure Analysis
    - MME 4331 Non-Destructive Examination
    - MME4332 Root Cause Analysis
    - MME4333 Fracture Mechanics
    - MME4334 Biomedical Product Performance Analysis
    - MME4335 Functional Failure Analysis
    - MME4340 Mineral Processing
    - MME4341 Recycling Processes
    - MME4342 Hydrometallurgy
    - MME4350 Materials Joining Technologies

4. Course name changes includes the MME3309 course. An introduction to circuit theory and hands on construction and analysis of simple passive and active circuits is being added to the MME3309 course, along with a change in schedule type from a 3 hour lecture to a 2 hour lecture and 3 hour lab (w/Course Change Form, Syllabus and Catalog Changes):
    - MME3309 Electronic Materials Science and Technology to MME3309 Circuits, Electronic Materials and Devices

5. The faculty approved the following pre-requisite changes for existing courses in order to better represent the background required for each course (w/ Course Change forms):
   - MME1205: From (CHEM1305 w/C or better) to (MATH1411 w/C or better)
   - MME2305: From CHEM1305 or CHEM1306 and MATH2313 to CHEM1305 or CHEM1306 and MATH1411
   - MME2434: From MATH1411 to MATH2313 and PHYS2421
   - MME4304: From PHYS2421 and CHEM1306 to CHEM1306 and MME2303
   - MME3407: From (MME2303 w/C or better) and (MME3406 w/C or better) to (MME2303 w/C or better) and (MME3406 W/D or better)
   - MME4303: From MME2303 w/C or better and MME3306 w/C or better and MME3308 w/C or better to MME3306 w/C or better and MME3308 w/C or better
   - MME4309: From MME2303 w/C or better to MME2303 w/C or better and MME3308 w/C or better
   - MME4310: From MME3407 w/C or better to MME2303 w/C or better
   - MME4404: From MME4303 w/C or better to (MME3306 w/C or better) and (MME3308 w/C or better)

6. Removal of existing concentrations: Three existing concentrations were removed since only the BS MME General Concentration has been implemented for the past 5 years. Four new concentrations are being added based on input from faculty and the MMBME industry advisory board (IAB) (w/Catalog changes):
    - Concentration 1: General Metallurgical and Materials Concentration
    - Concentration 2: Manufacturing
    - Concentration 3: Printed Nano Engineering

7. Addition of new concentrations: The general BS MME concentration is being modified to increase the number of electives from 1 to 4, the sequence of courses is being modified in order to improve the progression of student knowledge as they transition through the curriculum, and new concentrations and courses were added based on faculty and MMBME IAB input. The courses listed in red are courses that are being added as part of this proposal, all other courses have been taught previously (w/Catalog changes):

- Forensic Engineering and Materials Performance: Choice of 4 from the following (*required)
  MME4315 Metallography and Microstructure Interpretation*
  MME4330 Advanced Failure Analysis*
  MME4331 Non-Destructive Examination
  MME4332 Root Cause Analysis
  MME4333 Fracture Mechanics
  MME4334 Biomedical Product Performance Analysis
  MME4335 Functional Failure Analysis
  MME4390 Special Topics in MME

- Extractive and Process Metallurgy: Choice of 4 from the following (*required)
  MME4315 Metallography and Microstructure Interpretation*
  MME4320 Solidification Processes
  MME4340 Mineral Processing
  MME4341 Recycling Processes
  MME4342 Hydrometallurgy*
  MME4350 Materials Joining Technologies
  MME4390 Special Topics in MME
  GEOL4315 Topics in Geological Sciences

- Biomaterials: Choice of 4 from the following (*required)
  BME3303 Fundamentals of BME I
  BME3305 Fundamentals of BME II
  MME4304 Printable Materials
  MME4310 Polymer Engineering
  MME4312 Biomaterials Science and Engineering*
  MME4314 Composite Materials
  MME4334 Biomedical Product Performance Analysis
  MME4421 Engineering Alloys
  MME4390 Special Topics in MME

- General MME Concentration Choice of 3 from the following and 1 from any of the other concentrations
  (*required)
  MME4314 Composite Materials
  MME4310 Polymer Engineering
  MME4315 Metallography and Microstructure Interpretation*
  MME4321 Engineering Alloys

MME4331 Non-Destructive Examination
MME4350 Materials Joining Technologies
MME4390 Special Topics in MME

8. Catalog Changes: The catalog changes in the undergraduate catalog for BS MME http://catalog.utep.edu/undergrad/college-of-engineering/metallurgical-materials-engineering/metallurgical-materials-engineering-bs/ are included with track changes. The catalog changes include items 1-7 listed above.

The University of Texas at El Paso

Curriculum Change Proposal

Approval Page

Proposal Title: BS MME Degree Plan Changes

Department Chair **Dr. Stella A. Quinones**

I have read the enclosed proposal and approve this proposal on behalf of the department.

Signature

2/6/2020
Date

College Curriculum Committee Chairperson **Dr. Louis Everett**

I have read the enclosed documents and approve the proposal on behalf of the college curriculum committee.

Signature

2/7/20
Date

College Dean **Dr. Theresa Maldonado**

I have read the enclosed documents and approve the proposal on behalf of the college. I certify that the necessary funds will be allocated by the college in support of this proposal.

Theresa A Maldonado
Signature

2/17/2020
Date

Graduate Council/Undergraduate Curriculum Committee **Dr. Carla Ellis**

Council Action: ☐ Approved ☐ Returned to the College

Date of Action Report: _____

Signature, Chairman

Date

Mark A. Engle, Ph.D.
Professor
Department of Geological Sciences
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500 W. University Ave.
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Office: 915-747-5503
www.utep.edu/science/geology/index.html

From: Quinones, Stella <stellaq@utep.edu>
Sent: Friday, February 14, 2020 11:09 AM
To: Kubicki, James D
Cc: Kubicki, James D; Goodell, Philip C; Pingitore, Nicholas; Granda, Virginia D; Quinones, Stella; Arribas, Antonio; Engle, Mark A
Subject: Re: BS MME Curriculum Proposal

Hello Everyone,

We need to submit our curricular proposal today, and therefore, I would like to request to include the GEOL4315 Topics in Geological Sciences under the 'Extractive and Process Metallurgy' concentration. Do I have your formal approval. This email will be included in the proposal package. If you would like to send a separate email confirming this that would be fine.

Thank you all for your interest and engagement!
Stella

Stella A. Quinones
Chair and UTEP Distinguished Teaching Professor
Freeport-McMoRan Distinguished Chair in Metallurgical Engineering

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https://www.utep.edu/engineering/mmbme/

From: Engle, Mark A
Sent: Wednesday, February 12, 2020 1:53 PM
To: Quinones, Stella; Arribas, Antonio
Cc: Kubicki, James D; Goodell, Philip C; Pingitore, Nicholas; Granda, Virginia D
Subject: Re: BS MME Curriculum Proposal

Thanks Stella,

Granda, Virginia D

From: Kubicki, James D
Sent: Friday, February 14, 2020 11:19 AM
To: Quinones, Stella; Engle, Mark A
Cc: Goodell, Philip C; Pingitore, Nicholas; Granda, Virginia D; Arribas, Antonio
Subject: RE: BS MME Curriculum Proposal

Yes, I approve. Thanks.

From: Quinones, Stella <stellaq@utep.edu>
Sent: Friday, February 14, 2020 11:14 AM
To: Engle, Mark A <maengle@utep.edu>; Kubicki, James D <jdkubicki@utep.edu>
Cc: Goodell, Philip C <goodell@utep.edu>; Pingitore, Nicholas <npingitore@utep.edu>; Granda, Virginia D <granda@utep.edu>; Arribas, Antonio <aarribas@utep.edu>; Quinones, Stella <stellaq@utep.edu>
Subject: Re: BS MME Curriculum Proposal

Thank you Mark, that sounds great!

I think all I need at this time is an email confirming that we can include this course number in our curricular proposal.

Thanks again,
Stella

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From: Engle, Mark A
Sent: Friday, February 14, 2020 11:13 AM
To: Quinones, Stella; Kubicki, James D
Cc: Kubicki, James D; Goodell, Philip C; Pingitore, Nicholas; Granda, Virginia D; Quinones, Stella; Arribas, Antonio
Subject: Re: BS MME Curriculum Proposal

Hi Stella,
Obviously it's up to Jim to approve anything but Antonio and I have talked offline and are happy to put a course together under the GEOL4315 title. I am working on a rough outline but am busy in the lab today.
-Mark

That's excellent! It would be a great continuation of building synergies between the two Departments.
-Mark

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Associate Editor, Applied Computing and Geosciences

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From: "Quinones, Stella" <stellaq@utep.edu>
Date: Wednesday, February 12, 2020 at 9:06 AM
To: "Engle, Mark A" <maengle@utep.edu>, "Arribas, Antonio" <aarribas@utep.edu>
Cc: "Kubicki, James D" <jdkubicki@utep.edu>, "Goodell, Philip C" <goodell@utep.edu>, "Pingitore, Nicholas" <npingitore@utep.edu>, "Granda, Virginia D" <granda@utep.edu>, "Quinones, Stella" <stellaq@utep.edu>
Subject: Re: BS MME Curriculum Proposal

We have about 110 ug student enrollment at this time. We hope to increase that amount to 200 over the next 5 years. The enrollment in elective courses varies from 15 - 25, depending on the course.

We can also work together to develop the course material, and maybe team teach some of them. At this time, the effort would be limited to PhD student involvement, but we hope to grow our extractive metallurgy/process metallurgy department representation.

I hope this helps!
Stella

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From: Engle, Mark A
Sent: Wednesday, February 12, 2020 7:18 AM
To: Arribas, Antonio; Quinones, Stella
Cc: Kubicki, James D; Goodell, Philip C; Pingitore, Nicholas; Granda, Virginia D
Subject: Re: BS MME Curriculum Proposal

Hi All,

Or of curiosity, approximately him many undergrad students are enrolled in the mettallurgy program? If it's more than 20, it could virtually guarantee that the classes will get enough students that it can make consistently. Obviously, we hope to entice geology and environmental science students to take it as well.
-Mark

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From: Arribas, Antonio <aarribas@utep.edu>
Sent: Tuesday, February 11, 2020 1:27 PM
To: Quinones, Stella
Cc: Kubicki, James D; Engle, Mark A; Goodell, Philip C; Pingitore, Nicholas; Granda, Virginia D
Subject: Re: BS MME Curriculum Proposal

That looks better...
Antonio

On Feb 11, 2020, at 12:48, Quinones, Stella <stellaq@utep.edu> wrote:

Every other year would be fine.

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From: Kubicki, James D
Sent: Tuesday, February 11, 2020 12:23 PM
To: Quinones, Stella; Arribas, Antonio
Cc: Engle, Mark A; Goodell, Philip C; Pingitore, Nicholas; Granda, Virginia D
Subject: RE: BS MME Curriculum Proposal

The Chair approves, but this is contingent upon the schedule of those teaching the course. Is this a course you would want to see once a year or every other year?

From: Quinones, Stella <stellaq@utep.edu>
Sent: Tuesday, February 11, 2020 9:54 AM
To: Arribas, Antonio <aarribas@utep.edu>; Kubicki, James D <jdkubicki@utep.edu>
Cc: Engle, Mark A <maengle@utep.edu>; Goodell, Philip C <goodell@utep.edu>; Pingitore, Nicholas <npingitore@utep.edu>; Granda, Virginia D <granda@utep.edu>; Quinones, Stella <stellaq@utep.edu>
Subject: Re: BS MME Curriculum Proposal

For the purpose of our curriculum proposal, the GEOL4315 course is listed as an option under the 'Extractive and Process Metallurgy' concentration. I am happy to see the interest in creating an appropriate list of topics that could be taken by both Geology and Metallurgy and Materials Science students! Given the interest on both sides, would you be willing to approve the inclusion of this course as an option under this concentration?

My understanding is that your approval in response to this email would be included in the curriculum proposal.

Thank you,
Stella

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From: Arribas, Antonio
Sent: Tuesday, February 11, 2020 9:05 AM
To: Kubicki, James D
Cc: Quinones, Stella; Engle, Mark A; Goodell, Philip C; Pingitore, Nicholas
Subject: Re: BS MME Curriculum Proposal

I agree that providing the background on geological processes/mineralogy/geochemistry needed for the class topic within the class itself is preferable to requiring an 'intro geology' class.

Antonio

On Feb 11, 2020, at 8:40, Kubicki, James D <jdkubicki@utep.edu> wrote:

Yes, I hope we can create a Special Topics with a sub-title and content that matches your needs. It would be great if our students and Metallurgy students could both take this course and learn from one another.

From: Quinones, Stella <stellaq@utep.edu>
Sent: Monday, February 10, 2020 4:03 PM

To: Kubicki, James D <jdkubicki@utep.edu>; Arribas, Antonio <aarribas@utep.edu>; Engle, Mark A <maengle@utep.edu>
Cc: Goodell, Philip C <goodell@utep.edu>; Pingitore, Nicholas <npingitore@utep.edu>; Quinones, Stella <stellaq@utep.edu>
Subject: Re: BS MME Curriculum Proposal

Yes, I agree that we need to try to avoid adding additional pre-requisites. I like the topics suggested by all, including:

minerals and rock-forming processes
metals
critical minerals
geological principles and processes
energy resources

We have a Special Topics course in Engineering, that can be used for various topics. At any given time, we have several sections of Special Topics being taught around various topics by several faculty.

If you have a similar course, then our students could enroll in the course when it focuses on any of the above topics.

Thank you for all these ideas!
Stella

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From: Kubicki, James D
Sent: Sunday, February 9, 2020 8:16 AM
To: Arribas, Antonio; Engle, Mark A
Cc: Goodell, Philip C; Pingitore, Nicholas; Quinones, Stella
Subject: Re: BS MME Curriculum Proposal

A specifically-designed course is a good idea, but we have to remember that adding in prerequisites is always an issue when you start crossing disciplinary boundaries. This is especially true for Engineering students who have little leeway in the course selection.
Are Civil Engineering students at UTEP required to take Intro to Physical Geology?
I can imagine a Geology course for Metallurgists that has a quick primer on minerals and rock-forming processes that covers the relevant topics in Intro to Physical Geology without covering many of the chapters.

From: Arribas, Antonio
Sent: Saturday, February 8, 2020 10:13 AM
To: Engle, Mark A
Cc: Kubicki, James D; Goodell, Philip C; Pingitore, Nicholas; Quinones, Stella
Subject: Re: BS MME Curriculum Proposal

I think the title of the course should be changed, if that's not too difficult, from 'Topics in Geological Sciences', which lacks specifics, to something more specific and relevant-sounding to the students.

Also, if the course had as a requirement GEOL 1313 'Intro to Physical Geology', then it could concentrate on resources (energy, water, metals, critical minerals...) and their economic and environmental issues. Someone (Nick?) could want to say something on the economics/environment and critical minerals...

May be topic this is topic for a meeting?
Antonio

On Feb 8, 2020, at 9:45, Arribas, Antonio <aarribas@utep.edu> wrote:

Absolutely!! My apologies, I forgot that we have the expertise - and the need (in that part of Japan water is not an issue, they get one of the highest snowfall in the world). Water would make the perfect 4th component, eg: a) Geology background, b) Energy, c) Water, d) Metals/Minerals.

Antonio

On Feb 8, 2020, at 9:27, Engle, Mark A <maengle@utep.edu> wrote:

Hi All,
I agree with Antonio's concept of a geologic resources class, though we might also consider water resources, too. In concept, I'd be willing to teach energy geology and/or water resources.
-Mark

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From: Arribas, Antonio <aarribas@utep.edu>
Sent: Saturday, February 8, 2020 9:20 AM
To: Kubicki, James D
Cc: Engle, Mark A; Goodell, Philip C; Pingitore, Nicholas; Quinones, Stella
Subject: Re: BS MME Curriculum Proposal

Hi Jim:

At Akita University we had a course on 'Introduction to Earth Resources' for first year students on Resource Science (geology, engineering, economics/policy). Half of it was on Hydrocarbons (oil, gas and coal) and the other on Metals, which I taught. This was an excellent course for all the students, but especially for the engineers and policy/economics students because it was directly relevant to them and provided a good reason for them be exposed to some geology science (another short class) prior to this course.

I m not sure I understand well how setting up a course works at UTEP, but I would propose one that would consists of 3 parts: 1) start with basic geological principles and processes, just enough to provide the basis for, 2) energy resources, and 3) metals and minerals.

I would be happy to do nos. 1 and 3. Would welcome someone to teach no. 2.

Cheers,
Antonio

On Feb 8, 2020, at 7:28, Kubicki, James D <jdkubicki@utep.edu> wrote:

All:
Engineering is proposing to include
GEOL4315 Topics in Geological Sciences

in their 'Extractive and Process Metallurgy' concentration. I agree with this in principle.

Do we have specific courses under this heading you think will be best or is it better to keep it more general?

Jim

From: Quinones, Stella
Sent: Friday, February 7, 2020 5:27 PM
To: Kubicki, James D
Cc: Quinones, Stella; Everett, Louis; Granda, Virginia D
Subject: BS MME Curriculum Proposal

Hello Jim,

The MMBME department is proposing a curricular change to its BS MME Program. One of those changes is to incorporate the following concentrations:

1. Forensic Engineering and Materials Performance
2. Extractive and Process Metallurgy
3. Biomaterials
4. General BS MME

Within the Extractive and Process Metallurgy concentration, we are proposing that students take 4 out of the following courses:

MME4315 Metallography and Microstructure Interpretation*
MME4320 Solidification Processes

MME4340 Mineral Processing
MME4341 Recycling Processes
MME4342 Hydrometallurgy*
MME4350 Materials Joining Technologies
MME4390 Special Topics in MME
GEOL4315 Topics in Geological Sciences

Since one of the listed courses is from Geology (GEOL 4315), we would like to request that your department consider this proposal and provide a recommendation. Please let us know if you approve the inclusion of GEOL4315 in the 'Extractive and Process Metallurgy' concentration.

Best regards,
Stella

Stella A. Quinones
Chair and UTEP Distinguished Teaching Professor
Freeport-McMoRan Distinguished Chair in Metallurgical Engineering

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DELETION OF MME COURSES

COURSE DELETE FORM

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for deleting the courses:
(1) A separate lecture and lab course is being eliminated in order to combine the lecture and lab into a 4 credit hour course, (2) Junior level courses that are used as senior electives are being deleted and created with a MME4XXX designation; and (3) Senior level courses that are being moved down to the junior level are being eliminated and created with a MME3XXX designation.

Courses to be deleted: (You may list several on the same sheet)

Course Prefix and Number	Course Title
Ex. POLS 2310	**Introduction to Politics**
MME1301	Intro to Metal Mat Engr Design
MME1101	Intro to MME Design Lab
MME3312	Biomat, Biomat Prntng & Dev
MME3314	Composite Materials
MME3321	Engineering Alloys
MME4195	Senior Professional Orientation
MME4413	Structural Characterization

ADDITION OF NEW MME COURSES

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
ALIGNMENT OF LECTURE AND LAB AND COMBINATION OF LECTURE AND LAB TO AVOID STUDENTS TAKING ONE WITHOUT THE OTHER

All fields below are required

Subject Prefix and # MME1401

Title (29 characters or fewer): Intro to Metal and Matls Eng

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction to Metallurgical and Materials Engineering (3-3) This course will introduce the student to effective procedures for solving simple metallurgical and materials engineering and design problems using mathematics, computers, basic measuring systems and devices, computational tools, and statistical concepts. The course will also introduce the student to the metallurgical and materials engineering profession, including the role and responsibilities of the engineer in today's society. The laboratory portion will provide some hands-on, practice-oriented experiences.

Contact Hours (per week): 3 Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☒ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MATH1411	C	Y
RWS1301	C	Y

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	LD MME, LDEL, EL , MME

1. MME 1401: Introduction to Metallurgical and Materials Engineering

2. 4 credit hours: 3 lecture contact hours and 3 lab contact hours per week

3. Instructor: Dr. Christopher M. Bradley

4. Textbook
    a. Fundamentals of Materials Science for Technologists: Properties, Testing and Laboratory Practices, 3rd Ed, Larry Horath

5. Specific course information
    a. Course Description: Introduction to Metallurgical and Materials Engineering (3-3) This course will introduce the student to effective procedures for solving simple metallurgical and materials engineering and design problems using mathematics, computers, basic measuring systems and devices, computational tools, and statistical concepts. The course will also introduce the student to the metallurgical and materials engineering profession, including the role and responsibilities of the engineer in today's society. The laboratory portion will provide some hands-on, practice-oriented experiences.
    b. Pre-Requisites: MATH 1411 and RWS 1301 (may be taken concurrently)
    c. Required course

6. Specific goals for the course
    a. Learning Outcomes:
        - Identify, formulate and solve engineering problems by applying the principles of engineering, science and mathematics while using proper units and conversions (Exam 1-3)
        - Identify atomic bonding to structure, properties, processing and performance of engineering materials. (Exam 1)
        - Recognize crystalline structures to calculate atomic packing factor and density (Exam 1)
        - Describe the importance and use for non-destructive testing (Exam 2)
        - Observe tensile testing first-hand as a visual aid in order to identify the importance of mechanical properties of materials. (Exam 2)
        - Label and calculate results from tabulated and graphical stress-strain data (Exam 2)
        - Understand the mechanics of the various failure modes (fracture, fatigue and creep). (Exam 3)
        - Differentiate and properly label graphical data for fatigue, creep and CVN tests. (Exam 3)
        - Understand how processing techniques (solidification, plastic deformation and heat treatment) affect material properties. (Exam 3)
        - Observe metallographic procedures and calculate ASTM grain size (Exam 3)
        - Interpret isomorphous binary phase diagrams concepts (Exam 3)

- Develop written and verbal communication skills through lab reports and presentations (Lab)
- Practice working as a team on an engineering firm project (Engineering Firm Project)
- Conduct hands on experiments related to chemical and mechanical properties (Lab)

b. Student Outcomes
- Outcome 3: An ability to communicate effectively with a range of audiences.
- Outcome 4: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- Outcome 6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.

7. Brief list of topics to be covered
- Developing the problem-solving and design skills of engineering
  - The role of analysis in engineering
  - Dimensions and units
  - Analysis methodology
  - Problem solving using common engineering concepts
  - Using spreadsheet software to analyze data and create professional graphics
- Engineering ethics, including honesty and "data ethics"
- Statistical analysis of data and drawing conclusions from experiments
- Writing concise and professional scientific and engineering reports
- Developing and delivering powerful presentations
- Planning your career path in metallurgy and materials engineering
- Enforcing laboratory/workplace/chemical safety principles to ensure safe work environments and establish fun hands-on activities

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
THIS COURSE WILL BE MOVED FROM THE 7TH SEMESTER TO THE 5TH SEMESTER

All fields below are required

Subject Prefix and # MME3195

Title (29 characters or fewer): Junior Professional Orientati

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction to the engineering profession with emphasis on job placement, professional ethics & the engineering field exam.

Contact Hours (per week): 1 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 4 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N
Junior Standing		

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior**
Major	**MME Major**

1. MME 3195: Junior Professional Orientation

2. 1 credit hour: 1 contact hour per week

3. Instructor: Dr. Stephen W. Stafford

4. No textbook required

5. Specific course information
   a. Course Description: Junior Professional Orientation (1-0) Introduction to the engineering profession with emphasis on job placement, professional ethics & the engineering field exam.
   b. Pre-requisites: Junior standing and MME2303 (w/C or better)
   c. Required course

6. Specific goals for the course
   a. Learning outcomes
      - Write an effective cover letter & resume
      - Write professional correspondence
      - Understand how to acquire employment via Career Services, career fairs, internet & networking
      - Understand the requirements & opportunities in continuing and post-graduate education
      - Understand the issues associated with transitioning from college to the professional world
      - Understand the process & requirements of professional engineering licensing
      - Understand some of the various engineering ethic issues presented in case studies in the class & be able to discuss them in an open forum
      - Understand the fundamental financial planning strategies to achieve financial security
      - Write a critique of the MMBME Department based on your educational experiences

   b. Student outcomes addressed by the course
      - an ability to communicate effectively with a range of audiences
      - an ability to recognize ethical & professional responsibilities in engineering situations & make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental & societal contexts
      - an ability to function effectively on a team whose members together provide leadership, create a collaborative & inclusive environment, establish goals, plan tasks & meet objectives

7. Brief list of topics to be covered
   - Cover letters & professional correspondence, resumes, & portfolios
   - Career opportunities & how to obtain employment
   - Graduate & continuing education
   - Professional licensing

- Survival in the "real world"
- Engineering ethics case studies
- Financial planning & security
- Program review & department critique

COURSE ADD

All fields below are required

College : College of Engineering Department : MMBME

Rationale for adding the course:
MOVE THE CHARACTERIZATION COURSE TO EARLIER IN THE CURRICULUM (FROM 7TH SEMESTER TO 6TH SEMESTER SO THAT STUDENTS TAKE THE COURSE PRIOR TO SENIOR ELECTIVES.

All fields below are required

Subject Prefix and # MME3413

Title (29 characters or fewer): Materials Characterization

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
The application of modern instrumentation and techniques to structural characterization problems. Both theory and operation will be stressed. X-Ray analysis, electron microscopy (TEM-SEM), and electron probe analysis will be included.

Contact Hours (per week): 3 Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☒ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N
PHYS2421	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	MME, EL

1. MME 3413: Materials Characterization

2. 4 credit hours: 3 lecture contact hours and 3 lab contact hours per week

3. Instructor: Dr. David A. Roberson

4. Textbook, title, author, and year.
Microstructural Characterization of Materials Second Edition by David Brandon and Wayne D. Kaplan, 2008.
Contemporary scientific journal articles pertaining to microscopy.

5. Specific course information
   a. Course Description: Materials Characterization (3-3) The application of modern instrumentation and techniques to structural characterization problems. Both theory and operation will be stressed. X-Ray analysis, electron microscopy (TEM-SEM), and electron probe analysis will be included.
   b. Pre-Requisite: MME 2303 and PHYS2421 (both w/C or better)
   c. Required course

6. Specific goals for the course
   a. Learning Outcomes:
      - Explain the theory associated with digital imaging, surface energy analysis, and light optical microscopy. (Test 1)
      - Interpret the signals generated by electron/material interactions (EDS, backscatter electrons and secondary electrons. (Test II)
      - Explain how different types of electron emitters affect instrument performance and how to solve the problem of electron charging. (Test II)
      - Understand the basic principles associated with an X-ray diffraction including the derivation of Bragg's Law. (Test III)
      - Interpret and analyze data associated with transmission electron microscopy (TEM) imaging techniques (Ex. Ewald sphere, sources of contrast, combining information from real and reciprocal space, and basic diffraction pattern indexing). (TEST IV)
      - Collaborate as a team to combine and interpret the data from a minimum of three characterization instruments to identify a solution. (Final Project)
      - Examine unknown specimens to by applying new characterization knowledge to conclude the material composition. (Lab Assignments)
   b. Student Outcomes Addressed by the Course
      - Outcome 5, Teamwork/Project Management: Final project where a minimum of three characterization instruments must be used to solve a mystery. Presentation is given.
      - Outcome 7, Acquire-Apply New Knowledge: Lab projects where lab groups are to characterize an item anonymously chosen at random. Written report and presentation are graded.

7. Brief list of topics to be covered
   - Optical Microscopy

- Electron Microscopy
- X-Ray Analysis
- Technical Aspects of Analytical Equipment

COURSE ADD

All fields below are required

College : College of Engineering Department : MMBME

Rationale for adding the course:
Creation of laboratory to be used for new courses prior to them being adopted by the program.

All fields below are required

Subject Prefix and # MME4190

Title (29 characters or fewer): Special Topics in MME Lab

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 5

Should the course be exempt from the "Three Repeat Rule?" ☒Yes ☐No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Lab for MME 4190. May be repeated for credit when topic varies.

Contact Hours (per week): 0 Lecture Hours 3 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): 2 week Wintermester, 2 week Maymester, 4 week summer, 8 week summer

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
Junior or senior standing in MME or EL		
MME2303	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior or Senior
Major	MME or EL MT ~~[illegible]~~ EL ~~[illegible]~~

1. MME 4190 Special Topics in Metallurgical and Materials Science

2. 1 Credit Hour: 3 lab contact hours or 1 lecture contact hour per week

3. Instructor: based on course/topic being taught

4. Text book: based on course/topic being taught

5. Specific course information
    a. Description: Lab for MME 4190. May be repeated for credit when topic varies.
    b. Pre-requisite: MME2303 and Junior or Senior Standing in MME or EL
    c. Elective

6. Course Outcomes
    a. Learning Outcomes – based on course being taught
    b. Student Outcomes – based on course being taught

7. Brief list of topics to be covered – based on course being taught

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMMBME

Rationale for adding the course:
Creation of 2 hour course to consist of a 1 hour lecture and a 3 hour laboratory.

All fields below are required

Subject Prefix and # MME4290

Title (29 characters or fewer): Special Topics in MME

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 5

Should the course be exempt from the "Three Repeat Rule?" ☒Yes ☐No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Special topics in Metallurgical and Materials Engineering. May be repeated for credit when topic varies.

Contact Hours (per week): 1 Lecture Hours 3 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☒ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): 2 week Wintermester, 2 week Maymester, 4 week summer, 8 week summer

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
Junior or Senior Standing in MME or EL		
MME2303	**C**	**N**

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4290 Special Topics in Metallurgical and Materials Science

2. 2 Credit Hours: 1 hour lecture and 3 hour lab per week

3. Instructor: based on course/topic being taught

4. Text book: based on course/topic being taught

5. Specific course information
    a. Description: Special topics in Metallurgical and Materials Engineering. May be repeated for credit when topic varies.
    b. Pre-requisite: MME2303 and junior or senior standing in MME or EL
    c. Elective

6. Course Outcomes
    a. Learning Outcomes – based on course being taught
    b. Student Outcomes – based on course being taught

7. Brief list of topics to be covered – based on course being taught

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
Creation of course to be used for new courses prior to them being adopted by the program.

All fields below are required

Subject Prefix and # MME4390

Title (29 characters or fewer): Special Topics in MME

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 5

Should the course be exempt from the "Three Repeat Rule?" ☒Yes ☐No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Selected topics in Metallurgical and Materials Engineering. May be repeated for credit when topic varies.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): 2 week Wintermester, 2 week Maymester, 4 week summer, 8 week summer

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
Junior or Senior Standing in MME or EL		
MME2303	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior or Senior
Major	MME or EL

1. MME 4390 Special Topics in Metallurgical and Materials Science

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: based on course/topic being taught

4. Text book: based on course/topic being taught

5. Specific course information
    a. Description: Special topics in Metallurgical and Materials Engineering. May be repeated for credit when topic varies
    b. Pre-requisite: MME2303 and junior and senior standing in MME or EL
    c. Elective

6. Course Outcomes
    a. Learning Outcomes – based on course being taught
    b. Student Outcomes – based on course being taught

7. Brief list of topics to be covered – based on course being taught

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME3312 was made a senior elective so MME3312 was deleted and MME4312 will take its place.

All fields below are required

Subject Prefix and # MME4312

Title (29 characters or fewer): Biomaterials Science and Eng

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
This course provides an overview of digital and non-impact printing for biomedical applications in non traditional disciplines such as MEMS or bioengineering. By exploiting non-impact printing approaches and new materials, it has become possible to pattern and two- and three-dimensional structures that are biologically active. This course is intended to provide an introduction to this area. It covers established and new digital fabrication methods, new materials and processes that enable fabrication, and manufacture a broad range of biologically active devices, systems and structures.

Contact Hours (per week): 3 Lecture Hours 0 Lab Hours 0 Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): 8 week summer

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	**Engineering Majors, BME Minor**

1. MME 4312 Biomaterials Science and Engineering

2. 3 credit hours: 3 lecture contact hours per week

3. Instructor: Dr. Binata Joddar

4. An Introduction to Materials in Medicine, B.D. Ratner, A.S. Hoffman, F.S. Schoen, and J.E. Lemmons (Eds), Second or Third Edition Academic Press, San Diego, CA, 2004

5. Specific course information
   a. Course Description: Biomaterials Science and Engineering (3-0) This course provides an overview of digital and non-impact printing for biomedical applications in non traditional disciplines such as MEMS or bioengineering. By exploiting non-impact printing approaches and new materials, it has become possible to pattern and two- and three-dimensional structures that are biologically active. This course is intended to provide an introduction to this area. It covers established and new digital fabrication methods, new materials and processes that enable fabrication, and manufacture a broad range of biologically active devices, systems and structures.
   b. Pre-Requisites: MME2303 or BME minor (w/C or better). Restricted to engineering majors.
   c. Elective course

6. Specific goals for the course
   a. Learning Outcomes:
      - Understand fundamental concepts associated with biomaterials and their classification (Exam I)
      - Understand materials properties based on molecular structure (Exam I).
      - Apply materials selection criteria and stress distribution for hip implants and artificial blood vessel grafts (Exam I).
      - Understand biocompatibility between materials and the body (Exam II).
      - Understand various animal models for biomaterial implant testing (Exam II).
      - Collaborate on a biomaterial research project (Term Paper and Presentation).
   b. Student Outcomes:
      - Outcome 1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics
      - Outcome 3: An ability to communicate effectively with a range of audiences
      - Outcome 4: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
      - Outcome 6: An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions
      - Outcome 7: An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
    - Introduction to Biomaterials, Structure and Function Relationships
    - Classification: Metals, Ceramics, Polymers, Composites & surface design
    - Metallic Biomaterials and effect of biological environment on metals
    - Ceramics & effect of biological environment on metals
    - Introduction to Polymers & polymers chemistry. Polymers: Effect of biological environment, case study, Hydrogels; Biomedical Polymers
    - Biomedical Composites & Functional Materials
    - Microscopy for Biomaterials Science
    - Additive Manufacturing, Bio printing/ 3D organ printing
    - Host Reactions to Biomaterials and their evaluation
    - Applications of Materials in Medicine, Biology, and artificial organs
    - Nano-biomaterials
    - Practical aspects of Biomaterials

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
Course is a senior elective so course number is being changed from MME3314 to MME4314

All fields below are required

Subject Prefix and # MME4314

Title (29 characters or fewer): Composite Materials

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction to fiber-reinforced materials. Manufacturing technology for strong fibers and whiskers. Mechanical performance, design, and manufacturing of composite products. Adhesion, interfacial shear, and critical fiber length. Anisotropic plane-stress elasticity; multiaxial strength of anisotropic materials. Classical theory of laminates. Delamination and other performance problems.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N
MME2434	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4314 Composite Materials

2. 3 credit hours: 3 lecture contact hours per week

3. Instructor: Darren Cone

4. Composite Materials: Science and Engineering, 3rd edition, Krishna Chawla, Springer (2013) ISBN: 978-0-387-74364-6

5. Specific course information
    a. Course Description: (3-0) Introduction to fiber-reinforced materials. Manufacturing technology for strong fibers and whiskers. Mechanical performance, design, and manufacturing of composite products. Adhesion, interfacial shear, and critical fiber length. Anisotropic plane-stress elasticity; multiaxial strength of anisotropic materials. Classical theory of laminates. Delamination and other performance problems.
    b. Pre-requisites: MME2303 and MME2434 (both w/C or better) and junior or senior standing.
    c. Elective course

6. Specific goals for the course
    a. Learning Outcomes
        - Identify the advantages and disadvantages of composites for particular applications
        - Define the interfacial properties between the reinforcement and matrix components based on the bonding type
        - Calculate the bulk mechanical properties of composites based on shear and bending modes of loading
        - Distinguish between the different fiber material types based on the relationship between fabrication techniques, microstructures and properties
        - Describe the relationships between composite mechanical properties, volume fraction, and geometric arrangement of the constituent materials in isotropic, anisotropic and orthotropic composites
        - Calculate theoretical composite properties using the rule of mixtures and Halpin-Tsai relationships
        - Describe the composite materials selection and design processes.
        - Identify possible composite failure modes and how they influence the factors of safety applied to composite systems
    b. Student Outcomes
        - Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - Outcome 3: an ability to communicate effectively with a range of audiences
        - Outcome 4: an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the

impact of engineering solutions in global, economic, environmental, and societal contexts
- Outcome 6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- Outcome 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
   - Introduction to families of composites, properties and applications
   - Physical characteristics of composites: volume fraction, density, heat capacity, etc
   - Elastic micromechanics of continuous-fiber composites
   - Laminates: mechanics, design and performance
   - Reinforcing fibers: manufacturing and properties
   - Strength prediction and failure modes
   - Polymer-matrix composites (PMC): properties and limitations
   - Manufacturing of polymer-matrix composites
   - Discontinuous reinforcement: critical length and properties
   - Metal-matrix composites (MMC)
   - Ceramic-matrix composites (CMC)

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4315 will be a required course in the Forensic Engineering and Materials Performance concentration and in the Extractive Metallurgy concentration.

All fields below are required

Subject Prefix and # MME4315

Title (29 characters or fewer): Metallogrphy and Micro Inter

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Metallographic sample preparation and microstructural characterization for various metals, alloys and/or material systems. Use of the tools necessary for analysis including sectioning, mounting, polishing and etching using standard metallographic procedures. Metallographic samples prepared in class will be evaluated using stereomicroscopy, optical and scanning electron microscopy to aid with proper microstructural interpretation. Introduction to chemical analysis using optical emission spectroscopy and X-ray fluorescence for positive material identification.

Contact Hours (per week): 2 Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☒ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME3406	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4315 Metallography and Microstructure Interpretation

2. 3 Credit Hours: 2 lecture contact hours and 3 lab contact hours per week

3. Instructor: Dr. Chris Bradley

4. Text book: None

5. Specific course information
    a. Description: Metallography and Microstructure Interpretation (2-3) Metallographic sample preparation and microstructural characterization for various metals, alloys and/or material systems. Use of the tools necessary for analysis including sectioning, mounting, polishing and etching using standard metallographic procedures. Metallographic samples prepared in class will be evaluated using stereomicroscopy, optical and scanning electron microscopy to aid with proper microstructural interpretation. Introduction to chemical analysis using optical emission spectroscopy and X-ray fluorescence for positive material identification.
    b. Pre-requisite: MME3406 (w/C or better) and junior or senior standing
    c. Elective

6. Course Outcomes
    a. Learning Outcomes
        •
    b. Student Outcomes
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
        - An ability to communicate effectively with a range of audiences
        - An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
        - An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
        - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
        - An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
    - Familiarize students with the lab and its functions

MME 4315

- Chemical analysis (OES and XRF), sample selection and orientation for various industrial-related systems involving routine work, failure analysis and/or research
- Equipment training (Use of abrasive cut-off wheel, presicion saw and mounting equipment to include vacuum impregnation and TeraPress) for proper specimen sizes and sectioning techniques for various metals, alloys and/or material systems. Implementation of sample cleaning for optimal mounting results.
- Metallographic preparation focused on manual polishing techniques with discussions of semi-automated systems.
- Chemical etching and safety for various metals and alloy systems.
- Imaging techniques for light optical microscopy (LOM) and scanning electron microscopy (SEM)
- Analyze various metals and alloys
- Engineering ethics, including honesty and "data ethics".
- Statistical analysis of data and drawing conclusions from lab work.
- Write concise and professional engineering reports.
- Enforce laboratory, workplace, and chemical safety principles to ensure safe work environments and establish well-developed hands-on experience

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
Engineering Alloys is a senior elective and course number is being changed from MME3321 to MME4321.

All fields below are required

Subject Prefix and # MME4321

Title (29 characters or fewer): Engineering Alloys

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
The study of the selection and specification of engineering alloys for use in industrial applications. Topics related to ferrous and nonferrous metals in the cast, wrought, powder and particulate state will be covered. Mill test reports (MTR) and how to interpret them as well as interpreting compliance with various specification entities to include ASTM. API, ABS, etc. are inherent to the course.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME3406	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4321, Engineering Alloys

2. 3 credit hours: 3 lecture contact hours per week

3. Instructor: Stephen W. Stafford

4. Elements of Metallurgy and Engineering Alloys, ed. F. Campbell, ASM International, 2008.

5. Specific course information
    a. Course Description: Engineering Alloys (3-0) The study of the selection and specification of engineering alloys for use in industrial applications. Topics related to ferrous and nonferrous metals in the cast, wrought, powder and particulate state will be covered. Mill test reports (MTR) and how to interpret them as well as interpreting compliance with various specification entities to include ASTM. API, ABS, etc. are inherent to the course.
    b. Pre-requisite: MME 3406 (w/C or better) and junior or senior standing
    c. Elective course

6. Specific goals for the course
    a. Learning Outcomes
        - Students will have the fundamental knowledge of alloy design principles used to optimize strength, fracture toughness and pertinent physical properties (Homework, exams and course project)
        - Students will be able to explain alloy strengthening mechanisms applied to low and high alloy steels; tool steels, cast irons; aluminum alloys; nickel alloys, copper alloys, titanium alloys; beryllium alloys; and various metal matrix composites (Homework, in-class projects, exams, course project)
        - For any given alloy category, the students will be familiar with the chemical and structural states; processing and fabrication; properties and performance abilities with emphasis on alloy selection and applications (Homework, exams and course project)
        - Students will have a fundamental knowledge in reading specifications (ASTM, API and SAE), interpreting mill test reports and production records (Homework, exams and course project)
        - Students will hone their microstructural interpretation skills with various ferrous and non-ferrous alloys (Homework, exams and course project)

    b. Student Outcomes addressed by the course
        - Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science & mathematics
        - Outcome 2: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety & welfare, as well as global, cultural, social, environmental, and economic factors
        - Outcome 3: an ability to communicate effectively with a range of audiences

MME 4321

- Outcome 5: an ability to function effectively on a team whose members together provide leadership, create a collaborative & inclusive environment, establish goals, plan tasks & meet objectives
- Outcome 6: an ability to develop & conduct appropriate experimentation, analyze & interpret data, and use engineering judgment to draw inclusions
- Outcome 7: an ability to acquire & apply new knowledge as needed, using appropriate learning strategies.

7. A brief list of topics to be covered: Fundamentals of metallic alloy design; the Fe/Fe_3C system and the heat treatment of ferrous alloys; carbon, alloy, HSLA, micro-alloyed, stainless steels; cast irons; tool steels; aluminum and aluminum alloys; titanium and titanium alloys; copper and copper alloys; nickel and nickel alloys; cobalt and cobalt alloys and miscellaneous alloy systems, which will include metal matrix composites (MMCs).

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
Course is currently taken by undergraduates as an individual studies course and course will be an option under the new Forensic Engineering and Material Performance concentration.

All fields below are required

Subject Prefix and # MME4330

Title (29 characters or fewer): Advanced Failure Analysis

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
An advanced study of structural failure processes to include topics in failure analysis, fracture mechanics, nondestructive evaluation (NDE), fatigue, and environmental assisted cracking. Analysis of failures using metallographic, electron microscopy, and microanalytic techniques will be covered. Fracture of specific materials: steels, nonferrous alloys, composites, and nonmetallics will be included. A moderate knowledge of mechanical behavior of materials will be assumed.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME4316	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4330 Advanced Failure Analysis

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: Dr. Steve Stafford

4. Text book: List of books & references in the Library (Reserve Section) In Library use only-three hours max.
   - Case Studies in Failure Analysis
   - Analysis of Metallurgical Failures
   - Avoidance of Failure
   - Why Metals Fail
   - Failure Analysis: The British Engine Technical Reports
   - Source Book in Failure Analysis
   - Understanding How Components Fail
   - Metals Handbook Vol. 11 Failure Analysis and Prevention-9th Edition
   - Failure Analysis-Case Histories & Methodology
   - Metallurgy of Failure Analysis

5. Specific course information
   a. Description: Advanced Failure Analysis (3-0) An advanced study of structural failure processes to include topics in failure analysis, fracture mechanics, nondestructive evaluation (NDE), fatigue, and environmental assisted cracking. Analysis of failures using metallographic, electron microscopy, and microanalytic techniques will be covered. Fracture of specific materials: steels, nonferrous alloys, composites, and nonmetallics will be included. A moderate knowledge of mechanical behavior of materials will be assumed.
   b. Pre-requisite: MME4316 and junior or senior standing
   c. Elective

6. Course Outcomes
   a. Learning Outcomes
   b. Student Outcomes

7. Brief list of topics to be covered
   - Introduction
   - Field Failure Investigations
   - Fracture Modes and Mechanisms (A Review)
   - Fracture Mechanics
   - Fracture Properties of Selected Materials Systems
   - Embrittlement (Beyond the conventional)
   - Elevated Temperature Service & Failure
   - Fabrication Defects (welds, castings, forgings, etc.)
   - Interpretative and Quantitative Fractography
   - Applications of NDE

- Fracture of Non-Metallic Materials
- Failure of Non-Load Bearing Components
- Litigation & serving as an expert witness

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4331 will be a course option under the Forensic Engineering and Material Performance concentration.

All fields below are required

Subject Prefix and # MME4331

Title (29 characters or fewer): Non-Destructive Examination

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction and theory of ultrasonic testing, such as phased array and shear wave techniques, dye penetrate inspection, interpretation of radiographs, wet/dry magnetic particle inspection, chemical analysis using X-Ray fluorescence and in-situ metallography techniques (replication).

Contact Hours (per week): 2 Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☒ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4331 Non-Destructive Examination

2. 3 Credit Hours: 2 lecture contact hours and 3 lab contact hours per week

3. Instructor(s): Dr. Smith/Dr. Bradley, Cone or visiting professor

4. Text book: ASM Handbook (digital version available at UTEP)

5. Specific course information
    a. Description: Non-Destructive Examination (2-3) Introduction and theory of ultrasonic testing, such as phased array and shear wave techniques, dye penetrate inspection, interpretation of radiographs, wet/dry magnetic particle inspection, chemical analysis using X-Ray fluorescence and in-situ metallography techniques (replication).
    b. Pre-requisite: MME2303 (w/C or better) and Junior or Senior standing
    c. Elective

6. Course Outcomes
    a. Learning Outcomes
        - Understanding of fundamental NDE theory
        - Implementation of NDE techniques
        - Interpretation of NDE results
    b. Student Outcomes
        - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
        - An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
    - NDE Theory
    - Ultrasonic Testing
        - Phased Array
        - Shear Wave
    - Dye Penetrant
    - Wet or Dry Magnetic Particle Inspection
    - Radiography
    - Chemical Analysis using X-Ray Fluorescence
    - In-situ metallography

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4332 will be an option course in the Forensic Engineering and Materials Performance concentration.

All fields below are required

Subject Prefix and # MME4332

Title (29 characters or fewer): Root Cause Analysis

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Root Cause Analysis (3-0) Using analytical techniques to determine underlying causes and causal factors related to materials, component and systemic problems. Analytical tools and techniques will be used to identify problems and track data used to determine the root and proximate cause and to implement corrective actions.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME1205	C	N
MME2303	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4332 Root Cause Analysis

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: Dr. Smith/Dr. Bradley, Cone or visiting professor

4. Text book: TBD

5. Specific course information
    a. Description: Root Cause Analysis (3-0) Using analytical techniques to determine underlying causes and causal factors related to materials, component and systemic problems. Analytical tools and techniques will be used to identify problems and track data used to determine the root and proximate cause and to implement corrective actions.
    b. Pre-requisite: MME1205 and MME2303 (both w/C or better), and junior or senior standing.
    c. Elective

6. Course Outcomes
    a. Learning Outcomes
        - Understand the methodologies applied to root cause analysis
        - Apply root cause methodologies using analytical tools to real world scenarios
        - Demonstrate effective teamwork approaches to complex problems
        - Analyzing and interpreting ethically challenging scenarios in the context of determining the cause of failures
    b. Student Outcomes
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
        - An ability to communicate effectively with a range of audiences
        - An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
        - An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
        - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
        - An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered

- Analytical methodologies (fault tree and fish bone analysis)
- Design of experiments
- Engineering ethics
- Technical interview skills
- Presentation of complex data
- Interdisciplinary project management and teamwork

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4333 will be an option course in the Forensic Engineering and Materials Performance Option

All fields below are required

Subject Prefix and # MME4333

Title (29 characters or fewer): Fracture Mechanics

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Mechanisms of fracture for brittle and ductile materials using linear elastic and elastic-plastic fracture mechanics. ASTM standard fracture testing, numerical methods, and creep, fatigue, and dynamic fractures of metallic and non-metallic materials.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

MME 4333

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N
MME2434	C	N
MATH2326	C	N
Junior or Senior Standing		

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4333 Fracture Mechanics

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: Darren Cone and Steve Stafford

4. Text book: TBD

5. Specific course information
    a. Description: Fracture Mechanics (3-0) Mechanisms of fracture for brittle and ductile materials using linear elastic and elastic-plastic fracture mechanics. ASTM standard fracture testing, numerical methods, and creep, fatigue, and dynamic fractures of metallic and non-metallic materials.
    b. Pre-requisite: MME2303, MME2434 and MATH2326 (all w/C or better), and junior or senior standing.
    c. Elective

6. Course Outcomes
    a. Learning Outcomes
        - Apply the mathematical approaches to determine the stress states in solid matter
        - Model the stress intensity due to defects
        - Interpret experimental fracture test data and relate to underlying theory
        - Describe methodologies to enhance material fracture resistance
        - Evaluate the effect of the service environment on the various fracture mechanism
    b. Student Outcomes
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
        - An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered – based on course being taught
    - Griffith energy criterion
    - Basic stress analysis and modeling
    - Stress intensity factor calculations
    - Crack growth resistance
    - Environmentally assisted fracture
    - Experimental methods

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4334 will be an option course in the Forensic Engineering and Materials Performance concentration.

All fields below are required

Subject Prefix and # MME4334

Title (29 characters or fewer): Biomed Product Performance

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Students will learn through case-based studies of product development for biomedical devices with emphasis on factors that contribute to the success or failure of new biomedical products. Additionally, students will learn about the special challenges presented by emerging biomedical technologies.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N
MME4312	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4334 Biomedical Product Performance Analysis

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: Binata Joddar and Steve Stafford

4. Text book:

5. Specific course information
    a. Description: Biomedical Product Performance Analysis (3-0) Students will learn through case-based studies of product development for biomedical devices with emphasis on factors that contribute to the success or failure of new biomedical products. Additionally, students will learn about the special challenges presented by emerging biomedical technologies.
    b. Pre-requisite: MME2303 and MME4312 (both w/C or better), and junior or senior standing.
    c. Elective

6. Course Outcomes
    a. Learning Outcomes
        - Students will learn the product development process for various biomedical products.
        - Students will learn the regulatory approval process and key regulatory agencies for biomedical products.
        - Students will understand the roles of preclinical and clinical product development and the manufacturing processes required for new products.
        - Students will appreciate the technical factors that are necessary for successful product development in the biomedical product sector.
        - Students will appreciate ethical, social, cultural and legal considerations for biomedical failure mode and effects analysis of these various products.
        - Students will learn to analyze and critique contemporary real-world cases of biomedical product development to include failures in their various forms.
        - By the end of the course, students will experience the laboratory skills essential to the performance analysis of biomedical products
    b. Student Outcomes
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
        - An ability to communicate effectively with a range of audiences
        - An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered: Each student will complete a project to
   - Perform a lab-based performance analysis of a biomedical product which constitutes a failure to function. Example: Revision of a orthopedic joint replacement.
   - Make recommendations to correct and minimize future failures of the medical product.
   - Present their work in a PowerPoint format and write a technical paper for journal submission.

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4335 will be an option course in the Forensic Engineering and Materials Performance concentration.

All fields below are required

Subject Prefix and # MME4335

Title (29 characters or fewer): Functional Failure Analysis

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
A structural approach to identifying potential failures that may exist with a design or process. Failure modes are the means by which a process or product can fail. Failures in this context are the ways failures can lead to waste, defects and harmful outcomes which may lead to litigation and manufacturing liability claims. The intent is to use this information to make improvements to the process and/or the product design.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME2303	C	N
MME2434	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**MME or EL**

1. MME 4335 Functional Failure Analysis

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: Darren Cone, Shalayna Smith and Chris Bradley

4. Text book: TBD

5. Specific course information
    a. Description: Functional Failure Analysis (3-0) A structural approach to identifying potential failures that may exist with a design or process. Failure modes are the means by which a process or product can fail. Failures in this context are the ways failures can lead to waste, defects and harmful outcomes which may lead to litigation and manufacturing liability claims. The intent is to use this information to make improvements to the process and/or the product design.
    b. Pre-requisite: MME2303 and MME2434 (both w/C or better) and junior or senior standing
    c. Elective

6. Course Outcomes
    a. Learning Outcomes
        - Students will be familiar with ISO 14971 and FMEA (Failure Modes and Effects Analysis)
        - Students will learn what FMEA is, what it can do, what it means, how it is conducted and how it compares to other methods
        - Students will learn methodologies to identify, analyze and mitigate risk
        - Students will learn the risks and the requirements
        - Students will learn to achieve end-to-end traceability and
        - specify the path to compliance.
        - Student Outcomes – based on course being taught
    b. Student Outcomes
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
        - An ability to communicate effectively with a range of audiences
        - An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
        - An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
   - Application of failure modes and effects analysis methodologies to components and complex systems to identify risk
   - Probablisitic risk assessment and management processes
   - Strategies for risk mitigation
   - Verification and validation during engineering design to minimize risk
   - Concepts of redundancy

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4340 will be option course under the Extractive Metallurgy concentration.

All fields below are required

Subject Prefix and # MME4340

Title (29 characters or fewer): Mineral Processing

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
The study of mineral concentrate production from ores.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME4303	C	N
Junior or Senior Standing		

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior or Senior
Major	MME, EL

1. MME 4340 Mineral Processing

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: TBD

4. Text book: TBD

5. Specific course information
   a. Description: Mineral Processing (3-0) The study of mineral concentrate production from ores.
   b. Pre-requisite: MME4303 (w/C or better) and Junior or Senior Standing
   c. Elective

6. Course Outcomes
   a. Learning Outcomes – based on course being taught
      - Understand the mineralogy of the ores and size reduction
      - Analyze the size and size distribution of the grains
      - Understand particle selection, screening and particulate separation
      - Understand the industrial practice of mineral processing for concentration production

   b. Student Outcomes – based on course being taught
      - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
      - An ability to communicate effectively with a range of audiences
      - An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
      - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
      - An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered – based on course being taught
   - Phase present and their chemical composition
   - Size reduction including crushing and grinding
   - Size distribution and liberation
   - Surface properties and flotation process for various minerals
   - Liquid-solid separation and tailings
   - Process flowsheet and their control

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4341 will be option course under the Extractive Metallurgy concentration.

All fields below are required

Subject Prefix and # MME4341

Title (29 characters or fewer): Recycling Processes

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
The study of the metal recycling from industrial wastes.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME4303	C	N
Junior or Senior Standing		

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior or Senior
Major	MME, EL

1. MME 4341 Recycling Processes

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: TBD

4. Text book: TBD

5. Specific course information
    a. Description: Recycling Processes (3-0) The study of the metal recycling from industrial wastes
    b. Pre-requisite: MME4303 (w/C or better), and junior or senior standing
    c. Elective

6. Course Outcomes
    a. Learning Outcomes – based on course being taught
        - Understand the collection and processing of metal-containing wastes
        - Analyze the physical, hydrometallurgical, and pyrometallurgical processing of metals such as copper, zinc, aluminium, precious metals, etc.
        - Understand the industrial practice for metals recycling

    b. Student Outcomes – based on course being taught
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to communicate effectively with a range of audiences
        - An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
        - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
        - An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered – based on course being taught
    - Materials cycle and secondary resources such as scraps and industrial wastes
    - Industrial wastes processing and beneficiation
    - Characteristics of secondary metal recourses such as E-waste, spent catalyst and battery and sorting
    - Recycling technology and economics
    - Process, equipment, materials and markets

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4342 will be option course under the Extractive Metallurgy concentration.

All fields below are required

Subject Prefix and # MME4342

Title (29 characters or fewer): Hydrometallurgy

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
The study of metal extraction process in aqueous solutions from ore or concentrates.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME4303	C	N
Junior or Senior Standing		

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior or Senior
Major	MNE, EL

1. MME 4342 Hydrometallurgy

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: Dr. Yue

4. Text book: TBD

5. Specific course information
    a. Description: Hydrometallurgy (3-0) The study of metal extraction process in aqueous solutions from ore or concentrates.
    b. Pre-requisite: MME4303 (w/C or better), and junior or senior standing
    c. Elective

6. Course Outcomes
    a. Learning Outcomes
        - Understand the ore preparation, leaching, separation and purification
        - Analyze the kinetics and thermodynamics of leaching, separation and electrowinning
        - Understand the industrial practice of hydrometallurgical extraction of metals
    b. Student Outcomes
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to communicate effectively with a range of audiences
        - An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
        - An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
        - An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
    - Mineral processing including crushing, grinding and flotation
    - Leaching model and kinetics for different reaction systems
    - Separation including precipitation, cementation, solvent extraction and ion exchange
    - Electrowinning and electrorefining to produce high purity metals

COURSE ADD

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for adding the course:
MME4350 will be option course under the Forensic Engineering and Materials Performance concentration.

All fields below are required

Subject Prefix and # MME4350

Title (29 characters or fewer): Material Joining Technologies

Dept. Administrative Code : 1984

CIP Code 14.2001.0006

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Fundamentals of materials joining theory and application. A variety of technologies will be covered, to include: welding, brazing, soldering, adhesives, etc. for metals, ceramics, polymers, composites and electronic materials. Emphasis will be on both the theoretical principles of each process and practical aspects of the technique and/or equipment.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks): Summer: 8 weeks

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MME3406	C	N
Junior or Senior Standing		

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior or Senior
Major	MME, EL

1. MME 4350 Materials Joining Technologies

2. 3 Credit Hours: 3 lecture contact hours per week

3. Instructor: Dr. Stephen Stafford

4. Text book: TBD

5. Specific course information
   a. Description: Fundamentals of materials joining theory and application. A variety of technologies will be covered, to include: welding, brazing, soldering, adhesives, etc. for metals, ceramics, polymers, composites and electronic materials. Emphasis will be on both the theoretical principles of each process and practical aspects of the technique and/or equipment.
   b. Pre-requisite: MME2303 (w/C or better) and junior or senior standing
   c. Elective

6. Course Outcomes
   a. Learning Outcomes
      - Understanding of fundamentals of various joining processes
      - Evaluate the effect of joining on structure, properties and performance
      - Demonstrate knowledge of the metallurgy of welding techniques
      - Describe joining techniques of various nonmetallic systems
   b. Student Outcomes
      - an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
      - an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

7. Brief list of topics to be covered
   - Mechanical bonding
   - Welding
   - Soldering and Brazing
   - Diffusion Bonding
   - Adhesives
   - Applications

MME COURSE NAME CHANGES

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : MMBME**

Rationale for changing the course:
Will add theory and hands on construction and analysis of simple passive and active circuits to the existing course. Fundamental quantum mechanics concepts will be emphasized with theory, simulations and wave-particle models. This will help students understand the functionality of devices and simple circuit construction and behavior. This will eliminate the need for students to take MECH2324 Electromechanical Systems, and will free up 3 credit hours in order to offer more electives. There is currently only 1 elective in BS MME program.

All fields below are required

Subject Prefix and number MME3309

Course Title Electronic Materials Science and Technology

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Course Name	Electronic Materials Science and Technology	Circuits, Electronic Materials and Devices
Pre-requisite(s)	PHYS2421 w/C or better	(PHYS2420 w/C or better) AND (PHYS2421 w/C or better) &AND (MATH2326 w/C or better)
Semester in Degree Plan	6th semester	5th semester
Type of Instruction/Schedule Type	3 hour lecture	2 hour lecture and 3 hour lab; lecture/lab combined
Major Restriction	MME	MME or EL

1. MME 3309: Circuits, Electronic Materials and Devices

2. 3 credit hours: 2 lecture contact hours and 3 lab contact hours per week

3. Instructor: Dr. Stella A Quinones

4. Textbook
    a. Course Notes will be provided

5. Specific course information
    a. Course Description: Circuits, Electronic Materials and Devices (2-3) Circuit theory, applied hands-on circuit construction, introduction to quantum mechanics concepts, applied quantum mechanics to nanosystems, electronic materials, device physics and modeling of electronic devices using quantum mechanical simulations.
    b. Pre-Requisites: MME2303, PHYS2420, PHYS2421 and MATH2326 (all w/C or better)
    c. Required course

6. Specific goals for the course
    a. Learning Outcomes:
        - Become familiar with the Analog Discovery device (oscilloscope and waveform functions).
        - Use MATLAB to model experimental data.
        - Analyze Simple Circuits using Ohm's Law, Equivalent Circuits, KVL, KCL and voltage divider methods.
        - Build and analyze circuits using passive and active components.
        - Build and analyze signals through circuits with low pass, high pass and band pass filters.
        - Use Bode Plots to characterize filters and predict signal response.
        - Build circuits using sensor inputs to create a measureable output.
        - Understand basic fundamental concepts associated with quantum mechanics
        - Understand the wave nature of quantum mechanics as it applies to electromagnetic waves and electrons
        - Understand the probabilistic nature of electrons
        - Be able to solve quantum mechanical problems associated with photon-electron interactions
        - Be able to use boundary conditions and the time-independent Schrödinger equation to solve quantum mechanical problems
        - Be able to design and simulate electronic devices using simulation tools
    b. Student Outcomes:
        - An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
        - An ability to communicate effectively with a range of audiences
        - An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
   - Circuits:
     - Introduction to Circuits and Ohm's Law
     - Energy of Charged Particles (Electrons)
     - MATLAB data modeling
     - Series and Parallel Circuits
     - Voltage Divider
     - Filters
     - Simple Applied Op-Amp Circuits
   - Quantum Mechanics
     - Semiconductor Bonding, Doping and Energy Band Models
     - Wave Theory
     - Electromagnetic Waves and Photons
     - Potential, Potential Energy and Kinetic Energy
     - Electron Energy and Relativistic Calculations
     - Schrodinger's Equation and its Applications
   - Devices
     - Absorption
     - PN Junctions
     - Quantum Wells
     - Tunneling

- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

7. Brief list of topics to be covered
   - Circuits:
     - Introduction to Circuits and Ohm's Law
     - Energy of Charged Particles (Electrons)
     - MATLAB data modeling
     - Series and Parallel Circuits
     - Voltage Divider
     - Filters
     - Simple Applied Op-Amp Circuits
   - Quantum Mechanics
     - Semiconductor Bonding, Doping and Energy Band Models
     - Wave Theory
     - Electromagnetic Waves and Photons
     - Potential, Potential Energy and Kinetic Energy
     - Electron Energy and Relativistic Calculations
     - Schrodinger's Equation and its Applications
   - Devices
     - Absorption
     - PN Junctions
     - Quantum Wells
     - Tunneling

MME COURSE PRE-REQUISITE CHANGES

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : MMBME**

Rationale for changing the course:
CHEM1305 is not an appropriate pre-requisite for MME1205 and is not required to teach/learn the course material in MME1205

All fields below are required

Subject Prefix and number MME1205

Course Title Computation_Graphics in Material Science

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisites	(CHEM1305 w/C or better)	(MATH1411 w/C or better)
Major Restrictions	Restricted to majors of CE,CHEM,CS,EE,EL,IE,LDCE,LDCS,LDEE,LDME,LDMT,ME,MT,PHYS,PREE	Restricted to majors of MME and LEEL

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for changing the course:
MME2305 does not require MATH2313; MATH1411 is sufficient math preparation for this course.

All fields below are required

Subject Prefix and number MME2305

Course Title Material and Energy Balance

Change	From	To
Ex. Prerequisite	Ex. POLS 2310	Ex. POLS 2312
Pre-requisite	(CHEM1305 w/C or better) or (CHEM1306 w/C or better) and (MATH2313 w/C or better)	(CHEM1305 w/C or better) or (CHEM1306 w/C or better) and (MATH1411 w/C or better)

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : MMBME**

Rationale for changing the course:
The vector mechanics and vector-valued functions covered in PHYS2420 and MATH2313, respectively, will help prepare students for the vector based approach covered in MME2434.

All fields below are required

Subject Prefix and number MME2434

Course Title Mechanics of Materials

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisites	(MATH1411 w/C or better)	(MATH2313 w/C or better) and (PHYS2420 w/C or better)

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : MMBME**

Rationale for changing the course:
MME4304 does not require PHYS2421, and this course is being replaced with the fundamental materials course MME2303. CHEM1306 and MME2303 include sufficient background in types of materials, chemistry and materials properties for MME4304.

All fields below are required

Subject Prefix and number MME4304

Course Title Printable Materials

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisites	(PHYS2421 w/C or better) and (CHEM1306 w/C or better)	(CHEM1306 w/C or better) and (MME2303 w/C or better)

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department :** MMBME

Rationale for changing the course:
MME3406 and MME3407 are only taught once a semester and earning a D in MME3406, a very challenging course, is sufficient to ernoll in MME3407. Students will still be required to earn a grade of C in MME3406 and MME3407 in order to graduate.

All fields below are required

Subject Prefix and number MME3407

Course Title Mechanical Behavior of Materials

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisite	(MME2303 w/C or better) and (MME3406 w/C or better)	(MME2303 w/C or better) and (MME3406 W/D or better)

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : MMBME**

Rationale for changing the course:
MME3306 and MME3308 include the majority of background required for MME4303, thermodynamics and kinetics, required to support the understanding of the processing technologies covered in this course.

All fields below are required

Subject Prefix and number MME4303

Course Title Metals Processing

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisite	(MME2303 w/C or better) and (MME3306 w/C or better) and (MME3308 w/C or bette)r	MME3306 w/C or better and MME3308 w/C or better

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : MMBME**

Rationale for changing the course:
MME4309 Corrosion is heavily based on thermodynamic calculations, and requiring MME3308 (Applied Chemical Thermodynamics) will help students understand complex calculations.

All fields below are required

Subject Prefix and number MME4309

Course Title Corrosion

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisite	(MME2303 w/C or better)	(MME2303 w/C or better) and (MME3308 w/C or bette)r

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : MMBME**

Rationale for changing the course:
Materials structure dependence on temperature and processing is covered in both MME2303 and MME3407, with a more in depth and higher level view in MME3407. The introductory material in MME2303 is sufficient to understand the material in MME4310 Polymer Engineering.

All fields below are required

Subject Prefix and number MME4310

Course Title Polymer Engineering

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisites	(MME3407 w/C or better)	(MME2303 w/C or better)

These changes will be reflected in Banner, Goldmine, and the catalog

COURSE CHANGE FORM

COPY OF CATALOG PAGE NOT REQUIRED

All fields below are required

College : College of Engineering **Department : Metallurgical, Materials and Biomedical Engineering**

Rationale for changing the course:
Both MME4303 and MME4404 require thermodynamics, fluid flow and kinetics that are covered in MME3308 and MME3306, in an applied manner. Requiring MME4303 does not add background material required to understand the chemical based processes covered in MME4303.

All fields below are required

Subject Prefix and number MME4404

Course Title Materials Processing

Change	From	To
Ex. Prerequisite	**Ex. POLS 2310**	**Ex. POLS 2312**
Pre-requisite	(MME4303 w/C or better)	(MME3306 w/C or better) and (MME3308 w/C or better)

These changes will be reflected in Banner, Goldmine, and the catalog

BS MME CATALOG CHANGES

BS in Metallurgical and Materials Engineering

Return to: Degree Programs

~~The Metallurgical and Materials Engineering curriculum is a broad-based program designed to provide a basic education in metallurgical and materials engineering. The student can specialize in one or more areas in the junior and senior year by taking appropriate elective courses. The program is well suited for a career in industry or as a basis for graduate study. Courses related to advanced materials topics are also available.~~The Metallurgical and Materials Engineering undergraduate curriculum focuses on a strong materials science and engineering foundation, a deep understanding of how materials are processed, and how to tailor materials structure and properties to satisfy industrial needs and performance requirements. Students may choose a concentration in forensic engineering and materials performance, extractive metallurgy or biomaterials.

Vision

Our vision is to provide a modern Metallurgical and Materials Engineering Program of the highest quality.

Mission

~~We will emphasize learning and applying metallurgical and materials engineering fundamentals, spanning all major classes of materials. We will offer students opportunities to explore the whole gamut of applications, from advanced microelectronic technology to the basic infrastructure on which we all depend.~~ The BS degree program in Metallurgical and Materials Engineering (MME) will serve two broad purposes: (1) to provide sufficient theory and ~~sufficient~~ hands-on experiences in metallurgical and materials engineering ~~grounding~~ for a graduate to perform effectively~~y~~, in industry or other employment; and (2) to provide opportunities~~y~~ for all types of students~~,~~ while maintaining a high level of excellence as students progress through the curriculum in all graduates. ~~It will sharpen communication skills, both oral and written.~~ The MME program ~~It~~ will also provide basic engineering skills for problem-solving and lifelong learning, along with ~~It will sharpen~~good communication skills, both oral and written. ~~We~~MME faculty will maintain a balance between the applied and theoretical aspects, and will strive to provide pre-professional employment opportunities (either research experiences or internships) by continuously engaging industry in program activities with students.

Educational Objectives

1. Graduates will secure employment and/or admission to a graduate program in metallurgical and materials engineering or related professions

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2. Graduates will advance in their career by continuing lifelong learning and personal/professional development
3. Graduates work effectively as contributors and leaders on diverse, interdisciplinary teams enabling innovation at the leading edge of technology in an ever-changing global community.
4. Graduates will be more competitive as practicing professionals with broad understanding of material systems, associated manufacturing processes and engineering solutions.

Concentrations

The Metallurgical and Materials Engineering (MME) program offers a Bachelor of Science MME degree with an option to develop an expertise in one of the four concentrations ~~Each list of courses permits the student to develop a focus or pursue a particular career objective. In following a particular list, students complete an in-depth~~listed below~~, program of current interest in Metallurgical and Materials Engineering~~. ~~Most concentration courses are offered only once each academic year. The student must complete all the requirements for either Concentration 1, Concentration 2, or Concentration 3.~~

- ~~Concentration 1:~~ Forensic Engineering and Materials Performance~~General Metallurgical and Materials Engineering~~
~~This concentration provides students a program of study that emphasizes the major areas of metallurgical and materials engineering. This concentration is intended for students with a broad interest in metallurgical and materials engineering. Students choosing this concentration follow the curriculum outlined above.~~
- ~~Concentration 2:~~ Extractive Metallurgy ~~Manufacturing~~
~~This concentration utilizes electives in the traditional metallurgical and materials engineering program along with other appropriate program modifications to allow a graduate to perform a variety of professional duties in manufacturing arenas especially involved with materials selection and design, materials processing, environmental concerns, production failures and materials degradation, and a range of materials and processes quality control. This concentration prepares a student for advanced study in manufacturing engineering, materials science and engineering, or other related engineering areas. In addition to the requirements shown in the degree plan, the student must work on a manufacturing related project during Senior Design (MME 4419).~~

Concentration 3: Biomaterials

- Concentration 4: General Metallurgical and Materials Engineering ~~Printed Nano Engineering~~
~~Nanotechnology involves reactions on the surfaces of nano materials and is widely used in electronics. Its application, especially in the field of electronics is already of importance worldwide. Materials research here will be a contributor both in research and global business. The program itself will supply students of multilingual background, with printing and nanotechnology backgrounds in engineering.~~

Joint-Degree BS-MBA Program

Students with at least 90 hours accumulated toward their BSMME degree, a cumulative GPA of at least 3.30, and admission to the full-time MBA program can pursue a joint-degree BS-MBA program. Students admitted to this program (a) will apply credit for ECON 5360 Managerial Economics, BLAW 5306 Business Law and Ethics, and ACCT 5301 Financial Accounting toward the requirements of MME 4320 Nanomaterials & Nanostructures, MME 4303 Metals Processing, and one upper-division

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elective course in Metallurgical and Materials Engineering and (b) will apply graduate credit for (a) MME 4419 MME Design & Practice, (b) MME 4404 Materials Processing and (c) MME 4195 Senior Professional Orientation toward the electives requirements of the MBA program.

~~BS in Metallurgical and Materials Engineering~~Degree Plans

~~Degree Plan~~

BS in Metallurgical and Materials Engineering~~ with Concentration~~

Required Credits: 128

~~**Code**~~	~~**Title**~~	~~**Hours**~~
~~**University Core Curriculum**~~		
~~Complete the University Core Curriculum requirements.~~		~~42~~
~~**Metal & Materials Engineering Prerequisites (All courses listed require a grade of C or better.)**~~		
~~Required Courses:~~		
~~CHEM 1105~~	~~Laboratory for CHEM 1305~~	~~1~~
~~CHEM 1305~~	~~General Chemistry~~	~~3~~
~~CHEM 1306~~	~~General Chemistry~~	~~4~~
~~MATH 1411~~	~~Calculus I~~	~~4~~

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Code	Title	Hours
PHYS 2420	Introductory Mechanics	4
PHYS 2421	Introductory Electromagnetism	4
BSMME (Lower Division) (All courses require a grade of C or better.)		
Required Courses:		
CE 2326	Econ for Engrs & Scientists	3
MATH 1312	Calculus II	3
MATH 1411	Calculus I	4
MATH 2313	Calculus III	3
MATH 2326	Differential Equations	3
MECH 2342	Electro Mechanical Systems	3
MME 1101	Intro to MME Design Lab	1
MME 1205	Computation/Graph in Mater Sci	2
MME 1301	Intro to Metal Mat Engr Design	3

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Code	Title	Hours
MME 2303	Intro to Materials Sci & Engrg	3
MME 2305	Material & Energy Balance	3
MME 2434	Mechanics of Materials	4
Concentration		
Complete one of the following concentrations		42-46
Total Hours		**128**

Course List

[1] PHYS 2420 Introductory Mechanics may be substituted.

[C] Courses require a grade of C or better.

Concentration in General MME

Code	Title	Hours
BSMME (General MME)		
Required Courses:		
MME 3306	Rate Processes [C]	3
MME 3308	Appl Chemical Thermodynamics [C]	3

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Code	Title	Hours
MME 3309	Electronic Mat Sci & Tech [C]	3
MME 3312	Biomat, Biomat Prntng & Dev	3
MME 3314	Composite Materials	3
or MME 3321	Engineering Alloys	
or MME 4310	Polymer Engineering	
MME 3406	Nanofuctnl Physical Metallurgy [C]	4
MME 3407	Mechanical Behavior of Matls [C]	4
MME 4195	Senior Professional Orient.	1
MME 4303	Metals Processing	3
MME 4304	Printable Materials	3
MME 4309	Corrosion	3
MME 4316	Failure Analysis	3
MME 4404	Mat. Synthesis & Manufacturing	4
MME 4413	Structural Characterization	4
MME 4419	Metal Materials Design & Pract	4

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Code	Title	Hours
Total Hours		**48**

Course List

C Courses require a grade of C or better.

Concentration in Manufacturing

Code	Title	Hours
BSMME (Manufacturing)		
IE 3331	Systems Engineering [C]	3
IE 3373	Engr Probability & Stat Models [C]	3
IE 4385	Statist Quality Cntrl/Reliabil	3
IE 4391	Production & Inventory Control	3
MME 3314	Composite Materials [C]	3
MME 3321	Engineering Alloys [C]	3
MME 3406	Nanofuctnl Physical Metallurgy [C]	4
MME 3407	Mechanical Behavior of Matls [C]	4
MME 4195	Senior Professional Orient.	1

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Code	Title	Hours
MME 4304	Printable Materials	3
MME 4309	Corrosion	3
MME 4316	Failure Analysis	3
MME 4330	Solidification Processes	3
MME 4413	Structural Characterization	4
MME 4419	Metal Materials Design & Pract	4
Total Hours		**47**

Course List

C Courses require a grade of C or better.

Concentration in Printed Nano Engineering

Code	Title	Hours
BSMME (Printed Nano)		
Required Courses:		
MME 3303	Nano Organic Materials	3

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Code	Title	Hours
MME 3308	Appl Chemical Thermodynamics [c]	3
MME 3309	Electronic Mat Sci & Tech	3
MME 3406	Nanofuctnl Physical Metallurgy [c]	4
MME 3407	Mechanical Behavior of Matls [c]	4
MME 4195	Senior Professional Orient.	1
MME 4303	Metals Processing	3
MME 4304	Printable Materials	3
MME 4309	Corrosion	3
MME 4316	Failure Analysis	3
MME 4371	Engineering Problems	3
MME 4404	Mat. Synthesis & Manufacturing	4
MME 4407	3D Additive Manufacturing	4
MME 4413	Structural Characterization	4
MME 4419	Metal Materials Design & Pract	4
Total Hours		**49**

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BS in Metallurgical and Materials Engineering

Return to: Degree Programs

The Metallurgical and Materials Engineering curriculum ~~is a broad-based program designed to provide a basic education in metallurgical and materials engineering. The student can specialize in one or more areas in the junior and senior year by taking appropriate elective courses. The program is well suited for a career in industry or as a basis for graduate study. Courses related to advanced materials topics are also available~~focuses on a strong materials science and engineering foundation, a deep understanding of how materials are processed, and microstructure engineering to industrial needs and performance requirements. Students may choose a concentration in (1) forensic engineering and materials performance, (2) extractive and process metallurgy, (3) biomaterials or (4) general metallurgical and materials engineering.

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Vision

Our vision is to provide a modern Metallurgical and Materials Engineering Program of the highest quality.

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Mission

~~We will emphasize learning and applying metallurgical and materials engineering fundamentals, spanning all major classes of materials. We will offer students opportunities to explore the whole gamut of applications, from advanced microelectronic technology to the basic infrastructure on which we all depend.~~ The BS degree program in Metallurgical and Materials Engineering will serve two broad purposes: (1) to provide sufficient ~~grounding~~ theory and hands-on experiences in metallurgical and materials engineering for a graduate to perform effectively, in industry or other employment; and (2) to provide opportunities~~y~~ for all types of students, while maintaining a high level of excellence ~~in all graduates~~as students progress through the curriculum. The MME program will also provide ~~It will sharpen communication skills, both oral and written. It will also provide~~ basic engineering skills for problem-solving and lifelong learning, along with the communication skills, both oral and written, sought after by industry. ~~We~~The MME program will maintain a balance between the applied and theoretical aspects, and will strive to provide pre-professional employment opportunities (either research experiences or internships) by continuously engaging industry in program activities and interactions with students.

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Educational Objectives

1. Graduates will secure employment and/or admission to a graduate program in metallurgical and materials engineering or related professions

2. Graduates will advance in their career by continuing lifelong learning and personal/professional development
3. Graduates work effectively as contributors and leaders on diverse, interdisciplinary teams enabling innovation at the leading edge of technology in an ever-changing global community.
4. Graduates will be more competitive as practicing professionals with broad understanding of material systems, associated manufacturing processes and engineering solutions.

Concentrations

~~Each list of courses permits the student to develop a focus or pursue a particular career objective. In following a particular list, students complete an in-depth program of current interest in Metallurgical and Materials Engineering. Most concentration courses are offered only once each academic year. The student must complete all the requirements for either Concentration 1, Concentration 2, or Concentration 3~~The Metallurgical and Materials Engineering (MME) program offers a Bachelor of Science degree in MME with an option to develop expertise in one of the four concentrations listed below:~~.~~

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~~• Concentration 1: General Metallurgical and Materials Engineering~~

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~~This concentration provides students a program of study that emphasizes the major areas of metallurgical and materials engineering. This concentration is intended for students with a broad interest in metallurgical and materials engineering. Students choosing this concentration follow the curriculum outlined above.~~

~~• Concentration 2: Manufacturing~~

~~This concentration utilizes electives in the traditional metallurgical and materials engineering program along with other appropriate program modifications to allow a graduate to perform a variety of professional duties in manufacturing arenas especially involved with materials selection and design, materials processing, environmental concerns, production failures and materials degradation, and a range of materials and processes quality control. This concentration prepares a student for advanced study in manufacturing engineering, materials science and engineering, or other related engineering areas. In addition to the requirements shown in the degree plan, the student must work on a manufacturing-related project during Senior Design (MME 4419).~~

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~~Concentration 3: Printed Nano Engineering~~

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~~Nanotechnology involves reactions on the surfaces of nano-materials and is widely used in electronics. Its application, especially in the field of electronics is already of importance worldwide. Materials research here will be a contributor both in research and global business. The program itself will supply students of multilingual background, with printing and nanotechnology backgrounds in engineering~~

- Concentration 1: Forensic Engineering and Materials Performance
- Concentration 2: Extractive Metallurgy
- Concentration 3: Biomaterials
- Concentration 4: General Metallurgical and Materials Engineering~~.~~

Joint-Degree BS-MBA Program

Students with at least 90 hours accumulated toward their BSMME degree, a cumulative GPA of at least 3.30, and admission to the full-time MBA program can pursue a joint-degree BS-MBA program.

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Students admitted to this program (a) will apply credit for ECON 5360 Managerial Economics, BLAW 5306 Business Law and Ethics, and ACCT 5301 Financial Accounting toward the requirements of MME 4320 Nanomaterials & Nanostructures, MME 4303 Metals Processing, and one upper-division elective course in Metallurgical and Materials Engineering and (b) will apply graduate credit for (a) MME 4419 MME Design & Practice, (b) MME 4404 Materials Processing and (c) MME 4195 Senior Professional Orientation toward the electives requirements of the MBA program.

BS in Metallurgical and Materials Engineering

~~BS in Metallurgical and Materials Engineering~~

Degree Plan

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BS in Metallurgical and Materials Engineering with concentrations in -(1) Forensic Engineering and Materials Performance, (2) Extractive and Processing Metallurgy, (3) Biomaterials and (4) General Metallurgical and Materials Engineering ~~Concentration~~

Required Credits: 128

Code	Title	Hours
1. University Core Curriculum		
~~Complete the~~ University Core Curriculum requirements (some of which are listed below) – Total Hours:		42

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Code	Title	Hours
2. Metallurgical & Materials Engineering Prerequisites (All courses listed require a grade of C or better.)		
Required Courses as part of the University Core:		
MATH 1312~~CHEM 1105~~	Calculus II~~Laboratory for CHEM 1305~~	3~~1~~
CHEM 1305	General Chemistry	3
CHEM 1306	General Chemistry	34
CE 2326	Econ for Engrs & Scientists	3
Additional Required Courses:~~MATH 1411 Calculus I~~		4
CHEM 1105	Laboratory for CHEM 1305	1
MATH 1411	Calculus I	4
MATH 2313	Calculus III	3
MATH 2326	Differential Equations	3
PHYS 2420	Introductory Mechanics	4
PHYS 2421	Introductory Electromagnetism	4
Total Hours		19
3. BSMME (Lower Division) (All courses require a grade of C or better.)		
Required Courses:		
~~CE 2326~~	~~Econ for Engrs & Scientists~~	~~3~~
~~MATH 1312~~	~~Calculus II~~	~~3~~
~~MATH 1411~~	~~Calculus I~~	~~4~~
~~MATH 2313~~	~~Calculus III~~	~~3~~
~~MATH 2326~~	~~Differential Equations~~	~~3~~

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Code	Title	Hours
~~MECH 2342~~	~~Electro-Mechanical Systems~~	~~3~~
~~MME 1101~~	~~Intro to MME Design Lab~~	~~1~~
MME 1205	Computation/Graph in Mater Sci	2
MME ~~1301~~1401	Intro to Metal Mat Engr ~~Design~~	~~3~~4
MME 2303	Intro to Materials Sci & Engrg	3
MME 2305	Material & Energy Balance	3
MME 2434	Mechanics of Materials	4
Total Hours		16

4. BSMME (Upper Division and Concentrations)

Upper division and concentration courses – Total Hours~~Complete one of the following concentrations~~	~~42~~ 4651
Total BS MME Degree Hours	**128**

~~Course List~~

~~† PHYS 2420 Introductory Mechanics may be substituted.~~

~~C Courses require a grade of C or better.~~

~~Concentration in General~~ Metallurgical and Materials Engineering (Upper Division and Concentration Courses)

Code	Title	Hours
~~**BSMME (General MME)**~~		
Required Courses:		
MME 3195	Junior Professional Orient.[C]	1

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Code	Title	Hours
MME 3306	Rate Processes [c]	3
MME 3308	Appl Chemical Thermodynamics [c]	3
MME 3309	~~Electronic Mat Sci &~~Cir ~~Tech~~cuits, Electronic Materials and Devices [c]	3
~~MME 3312~~	~~Biomat, Biomat Prntng & Dev~~	~~3~~
~~MME 3314~~	~~Composite Materials~~	~~3~~
~~or MME 3321~~	~~Engineering Alloys~~	
~~or MME 4310~~	~~Polymer Engineering~~	
MME 3406	Nanofuctnl Physical Metallurgy [c]	4
MME 3407	Mechanical Behavior of Matls [c]	4
MME 3413	Materials Characterization [c]	4
~~MME 4195~~	~~Senior Professional Orient.~~	~~1~~
MME 4303	Metals Processing	3
~~MME 4304~~	~~Printable Materials~~	~~3~~
MME 4309	Corrosion	3
MME 4316	Failure Analysis	3
MME 4404	Mat. Synthesis & Manufacturing	4
~~MME 4413~~	~~Structural Characterization~~	~~4~~
MME 4419	Metal Materials Design & Pract	4
	Concentration Elective Course I [c]	3
	Concentration Elective Course II [c]	3
	Concentration Elective Course III [c]	3
	Concentration Elective Course IV [c]	3
Total Hours		5~~148~~

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Code	Title	Hours

Course List

C - Courses require a grade of C or better.
C

Concentration in ManufacturingForensic Engineering and Materials Performance

Code	Title	Hours
BSMME - (Forensic Engineering and Materials Performance Manufacturing)		
Choice of 4 courses from the following:		
MME4315IE 3331	Metallography and Microstructure Interpretation* c Systems Engineering c	3
MME4330IE 3373	Advanced Failure Analysis* c Engr Probability & Stat Models c	3
MME4331IE 4385	Non-Destructive Examination c Statist Quality Cntrl/Reliabil	3
MME4332IE 4391	Root Cause Analysis c Production & Inventory Control	3
MME4333MME 3314	Fracture Mechanics c Composite Materials c	3
MME4334MME 3321	Biomedical Product Performance Analysis c Engineering Alloys c	3
MME4335MME 3406	Functional Failure Analysis c Nanofuctnl Physical Metallurgy c	34
MME 3407MME4390	Mechanical Behavior of MatlsSpecial Topics in MME c	34
MME 4195	Senior Professional Orient.	1
MME 4304	Printable Materials	3

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Code	Title	Hours
MME 4309	Corrosion	3
MME 4316	Failure Analysis	3
MME 4330	Solidification Processes	3
MME 4413	Structural Characterization	4
MME 4419	Metal Materials Design & Pract	4
Total Hours		17

Course List

* - Required Courses

C - Courses require a grade of C or better.

Concentration in Printed Nano EngineeringExtractive and Process Metallurgy

Code	Title	Hours
BSMME – Extractive and Process Metallurgy (Printed Nano)		
Choice of 4 courses from the following:Required Courses:		
MME4315MME 3303	Metallography and Microstructure Interpretation*C Nano Organic Materials	3
MME4320MME 3308	Solidification ProcessesC Appl Chemical Thermodynamics C	3
MME4340MME 3309	Mineral ProcessingC Electronic Mat Sci & Tech	3
MME4341	Recycling ProcessesC	3
MME4342MME 3406	HydrometallurgyC Nanofuctnl Physical Metallurgy C	34
MME4350	Materials Joining TechnologiesC	3

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Code	Title	Hours
MME4390~~MME 3407~~	Special Topics in MM[C] ~~Mechanical Behavior of Matls~~[C]	34
GEOL 4315~~MME 4195~~	Topics in Geological Sciences[C] ~~Senior Professional Orient.~~	31
~~MME 4303~~	~~Metals Processing~~	~~3~~
~~MME 4304~~	~~Printable Materials~~	~~3~~
~~MME 4309~~	~~Corrosion~~	~~3~~
~~MME 4316~~	~~Failure Analysis~~	~~3~~
~~MME 4371~~	~~Engineering Problems~~	~~3~~
~~MME 4404~~	~~Mat. Synthesis & Manufacturing~~	4
~~MME 4407~~	~~3D Additive Manufacturing~~	4
~~MME 4413~~	~~Structural Characterization~~	4
~~MME 4419~~	~~Metal Materials Design & Pract~~	4
~~**Total Hours**~~		~~49~~

~~Course List~~

~~C~~ * - Required Courses
C - Courses require a grade of C or better.

C - Cour

Concentration in Biomaterials

Code	Title	Hours
BSMME – Biomaterials		
Choice of 4 courses from the following:		
BME 3303	Fundamentals of BME I[C]	3
BME 3305	Fundamentals of BME II[C]	3
MME4304	Printable Materials[C]	3

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Code	Title	Hours
MME4310	Polymer Engineering[C]	3
MME4312	Biomaterials Science and Engineering*[C]	3
MME4314	Composite Materials[C]	3
MME4334	Biomedical Product Performance Analysis[C]	3
MME4421	Engineering Alloys[C]	3
MME4390	Special Topics in MME[C]	3

* - Required Courses
C - Courses require a grade of C or better.

C - Cour

General MME Concentration

Code	Title	Hours
BSMME – General		
Choice of 3 courses from the following and 1 course from another MME concentration:		
MME4310	Polymer Engineering[C]	3
MME4314	Composite Materials[C]	3
MME4315	Metallography and Microstructure Interpretation*[C]	3
MME4321	Engineering Alloys[C]	3
MME4331	Non-Destructive Examination[C]	3
MME4350	Materials Joining Technologies[C]	3
MME4390	Special Topics in MME[C]	3

* - Required Courses
C - Courses require a grade of C or better.

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University Core Curriculum

NOTE: The department may make specific suggestions for courses which are most applicable towards your major.

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Psychology and Criminal Justice majors and minors are required to take MATH 1320 Math for Social Sciences I or a higher level Calculus course.
Business majors are required to take MATH 1320 Math for Social Sciences I or a higher level Calculus course.
NOTE: All courses require a C or better

also need to have taken in Semester two

~~Code~~ ~~Title~~ ~~Hours~~

~~Course List~~

~~C Courses require a grade of C or better.~~

Freshman 1ST Semester (15 credits)

- RWS 1301. Rhetoric & Composition I[C]
- MATH 1411. Calculus 1[C]
- CHEM 1305. General Chemistry[C]
- CHEM 1105. Laboratory for CHEM 1305[C]
- MME 1401. Intro to Metal Mat Engr and Lab[C]

2ST Semester (17 credits)

- RWS 1302. Rhetoric & Composition 2[C]
- CHEM 1306. General Chemistry[C]
- MATH 1312. Calculus II[C]
- MME 1205. Computational Graphics in Matls Sci[C]
- HIST 1301. History of U.S. to 1865[C]
- Component Elective[C]

Component Elective (3 C/H)

Select one

- UNIV 1301. Seminar/Critical Inquiry[C]

  Or

- COMM 1302. Business/Profession Comm[C]

Sophomore 3RD Semester (16 credits)

- MME 2303. Intro to Materials Sci & Engrg.[C]
- POLS 2310. Introduction to Politics[C]
- CE 2326. Econ for Engrs & Scientists[C]

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- MATH 2313. Calculus III[C]
- PHYS 2420. Introductory Mechanics[C]

4TH Semester (17 credits)

- MATH 2326. Differential Equations[C]
- MME 2434. Mechanics of Materials[C]
- PHYS 2421. Introductory Electromagnetism[C]
- MME 2305. Material & Energy Balance[C]
- Creative Arts Elective[C]

Creative Arts Elective (3 C/H)

Select one

- ART 1300. Art Appreciation[C]

Or

- ARTH 1305. History of Art I[C]
- ARTH 1306. History of Art II[C]
- DANC 1304. Dance Appreciation[C]
- FILM 1390. Intro-Art of Motion Pict.[C]
- MUSL 2321. Intro to Music History[C]
- MUSL 1324. Music Appreciation[C]
- MUSL 1327. Jazz to Rock[C]
- THEA 1313. Introduction to Theatre[C]

Junior Year 5TH Semester (14 credits)

- MME 3309. Circuits, Electronic Materials and Devices[C]
- MME 3195. Junior Professional Orient[C]
- MME 3308. Appl. Chemical Thermodynamics[C]
- MME 3406. Nanofuctional Physical Metallurgy[C]
- HIST 1302. History of U.S. Since 1865[C]

6TH Semester (17 credits)

- MME 3306. Rate Processes[C]
- MME 3407. Mechanical Behavior of Matls[C]
- MME 3413. Materials Characterization[C]
- POLS 2311. American Gover & Politics[C]
- Component Elective[C]

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Component Elective (3 C/H)

Select one

- UNIV 1301. Seminar/Critical Inquiry [C]
- COMM 1302. Business/Profession Comm [C]

Senior 7TH Semester (15 credits)

- MME 4303. Metals Processing [C]
- MME 4316. Failure Analysis [C]
- Concentration Elective Course I (3 credits) [C]
- Concentration Elective Course II (3 credits) [C]
- Language Philosophy & Culture Elective [C]

Language Philosophy & Culture Elective [3 C/H]

Select one

- ENGL 2311. English Literature [C]
- ENGL 2312. English Literature [C]
- ENGL 2313. Intro to American Fiction [C]
- ENGL 2314. Intro to American Drama [C]
- ENGL 2318. Intro to American Poetry [C]
- HIST 2301. World History to 1500 [C]
- FREN 2322. Making of the "Other" Americas [C]
- HIST 2302. World History Since 1500 [C]
- PHIL 1301. Introduction to Philosophy [C]
- PHIL 2306. Ethics [C]
- RS 1301. Introduction to Religious Studies [C]
- SPAN 2340. Seeing & Naming: Conversations [C]
- WS 2300. Introduction to Women's Studies [C]
- WS 2350. Global Feminisms [C]

8th semester (17 credits)

- MME 4309. Corrosion [C]
- MME 4404. Mat. Synthesis & Manufacturing [C]
- MME 4419. Metal Materials Design & Pract [C]
- Concentration Elective Course III (3 credits) [C]
- Concentration Elective Course IV (3 credits) [C]

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CONCENTRATION I - Forensic Engineering and Materials Performance

(Choice of 4 from the following - *required)

- MME4315 Metallography and Microstructure Interpretation[C]*
- MME4330 Advanced Failure Analysis[C]*
- MME 4331 Non-Destructive Examination[C]
- MME4332 Root Cause Analysis[C]
- MME4333 Fracture Mechanics[C]
- MME4334 Biomedical Product Performance Analysis[C]
- MME4335 Functional Failure Analysis[C]

CONCENTRATION II - Extractive Metallurgy

(Choice of 4 from the following - *required)

- MME4415 Metallography and Microstructure Interpretation[C]*
- MME1320 Solidification Processes[C]
- MME4340 Mineral Processing[C]
- MME4341 Recycling Processes[C]
- MME4342 Hydrometallurgy[C]*
- MME4350 Materials Joining Technologies[C]
- GEOL4315 Topics in Geological Sciences[C]

CONCENTRATION III - Biomaterials

(Choice of 4 from the following - *required)

- BME3303 Fundamentals of BME I[C]
- BME3305 Fundamentals of BME II[C]
- MME4304 Printable Materials[C]
- MME4310 Polymer Engineering[C]
- MME4312 Biomaterials Science and Engineering[C]*
- MME4314 Composite Materials[C]
- MME4334 Biomedical Product Performance Analysis[C]
- MME4421 Engineering Alloys[C]

CONCENTRATION IV - General MME

(Choice of 3 from the following and 1 from any of the other concentrations - *required)

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- MME4314 Composite Materials[C]
- MME4310 Polymer Engineering[C]
- MME4315 Metallography and Microstructure Interpretation[C]*
- MME4321 Engineering Alloys[C]
- MME4331 Non-Destructive Examination[C]
- MME4350 Materials Joining Technologies[C]

~~University Core Curriculum~~

~~NOTE: The department may make specific suggestions for courses which are most applicable towards your major.~~

~~**Psychology and Criminal Justice majors and minors** are required to take MATH 1320 Math for Social Sciences I or a higher level Calculus course.~~

~~**Business majors** are required to take MATH 1320 Math for Social Sciences I or a higher level Calculus course.~~

~~NOTE: All courses require a C or better~~

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BS in Metallurgical and Materials Engineering

Return to: Degree Programs

The Metallurgical and Materials Engineering undergraduate curriculum focuses on a strong materials science and engineering foundation, a deep understanding of how materials are processed, and how to tailor materials structure and properties to satisfy industrial needs and performance requirements. Students may choose a concentration in forensic engineering and materials performance, extractive metallurgy or biomaterials.

Vision

Our vision is to provide a modern Metallurgical and Materials Engineering Program of the highest quality.

Mission

The BS degree program in Metallurgical and Materials Engineering (MME) will serve two broad purposes: (1) to provide sufficient theory and hands-on experiences in metallurgical and materials engineering for a graduate to perform effectively in industry or other employment; and (2) to provide opportunities for all types of students while maintaining a high level of excellence as students progress through the curriculum. The MME program will also provide basic engineering skills for problem-solving and lifelong learning, along with good communication skills, both oral and written. MME faculty will maintain a balance between the applied and theoretical aspects, and will strive to provide pre-professional employment opportunities (either research experiences or internships) by continuously engaging industry in program activities with students.

Educational Objectives

1. Graduates will secure employment and/or admission to a graduate program in metallurgical and materials engineering or related professions
2. Graduates will advance in their career by continuing lifelong learning and personal/professional development
3. Graduates work effectively as contributors and leaders on diverse, interdisciplinary teams enabling innovation at the leading edge of technology in an ever-changing global community.
4. Graduates will be more competitive as practicing professionals with broad understanding of material systems, associated manufacturing processes and engineering solutions.

Concentrations

The Metallurgical and Materials Engineering (MME) program offers a Bachelor of Science MME degree with an option to develop an expertise in one of the four concentrations listed below.

Concentration 1: Forensic Engineering and Materials Performance
Concentration 2: Extractive Metallurgy
Concentration 3: Biomaterials
Concentration 4: General Metallurgical and Materials Engineering

Joint-Degree BS-MBA Program

Students with at least 90 hours accumulated toward their BSMME degree, a cumulative GPA of at least 3.30, and admission to the full-time MBA program can pursue a joint-degree BS-MBA program. Students admitted to this program (a) will apply credit for ECON 5360 Managerial Economics, BLAW 5306 Business Law and Ethics, and ACCT 5301 Financial Accounting toward the requirements of MME 4320 Nanomaterials & Nanostructures, MME 4303 Metals Processing, and one upper-division elective course in Metallurgical and Materials Engineering and (b) will apply graduate credit for (a) MME 4419 MME Design & Practice, (b) MME 4404 Materials Processing and (c) MME 4195 Senior Professional Orientation toward the electives requirements of the MBA program.

Degree Plans

BS in Metallurgical and Materials Engineering

Required Credits: 128

Freshman 1ST Semester (15 credits)

- RWS 1301. Rhetoric & Composition I[C]
- MATH 1411. Calculus 1[C]
- CHEM 1305. General Chemistry[C]
- CHEM 1105. Laboratory for CHEM 1305[C]
- MME 1401. Intro to Metal Mat Engr and Lab[C]

2ST Semester (17 credits)

- RWS 1302. Rhetoric & Composition 2[C]
- CHEM 1306. General Chemistry[C]

- MATH 1312. Calculus II[C]
- MME 1205. Computational Graphics in Matls Sci[C]
- HIST 1301. History of U.S. to 1865[C]
- Component Elective[C]

Component Elective (3 C/H)

Select one

- UNIV 1301. Seminar/Critical Inquiry[C]

  Or

- COMM 1302. Business/Profession Comm[C]

Sophomore 3RD Semester (16 credits)

- MME 2303. Intro to Materials Sci & Engrg. [C]
- POLS 2310. Introduction to Politics[C]
- CE 2326. Econ for Engrs & Scientists[C]
- MATH 2313. Calculus III[C]
- PHYS 2420. Introductory Mechanics[C]

4TH Semester (17 credits)

- MATH 2326. Differential Equations[C]
- MME 2434. Mechanics of Materials[C]
- PHYS 2421. Introductory Electromagnetism[C]
- MME 2305. Material & Energy Balance[C]
- Creative Arts Elective[C]

Creative Arts Elective (3 C/H)

Select one

- ART 1300. Art Appreciation[C]

  Or

- ARTH 1305. History of Art I[C]
- ARTH 1306. History of Art II[C]
- DANC 1304. Dance Appreciation[C]
- FILM 1390. Intro-Art of Motion Pict. [C]
- MUSL 2321. Intro to Music History[C]

- MUSL 1324. Music Appreciation[C]
- MUSL 1327. Jazz to Rock[C]
- THEA 1313. Introduction to Theatre[C]

Junior Year 5TH Semester (14 credits)

- MME 3309. Circuits, Electronic Materials and Devices[C]
- MME 3195. Junior Professional Orient [C]
- MME 3308. Appl. Chemical Thermodynamics [C]
- MME 3406. Nanofuctional Physical Metallurgy[C]
- HIST 1302. History of U.S. Since 1865[C]

6TH Semester (17 credits)

- MME 3306. Rate Processes[C]
- MME 3407. Mechanical Behavior of Matls [C]
- MME 3413. Materials Characterization [C]
- POLS 2311. American Gover & Politics [C]
- Component Elective[C]

Component Elective (3 C/H)

Select one

- UNIV 1301. Seminar/Critical Inquiry [C]
- COMM 1302. Business/Profession Comm [C]

Senior 7TH Semester (15 credits)

- MME 4303. Metals Processing [C]
- MME 4316. Failure Analysis [C]
- Concentration Elective Course I (3 credits) [C]
- Concentration Elective Course II (3 credits) [C]
- Language Philosophy & Culture Elective[C]

Language Philosophy & Culture Elective [3 C/H]

Select one

- ENGL 2311. English Literature [C]
- ENGL 2312. English Literature [C]
- ENGL 2313. Intro to American Fiction [C]
- ENGL 2314. Intro to American Drama [C]

- ENGL 2318. Intro to American Poetry [C]
- HIST 2301. World History to 1500 [C]
- FREN 2322. Making of the "Other" Americas [C]
- HIST 2302. World History Since 1500 [C]
- PHIL 1301. Introduction to Philosophy [C]
- PHIL 2306. Ethics [C]
- RS 1301. Introduction to Religious Studies [C]
- SPAN 2340. Seeing & Naming: Conversations [C]
- WS 2300. Introduction to Women's Studies [C]
- WS 2350. Global Feminisms [C]

8th semester (17 credits)

- MME 4309. Corrosion [C]
- MME 4404. Mat. Synthesis & Manufacturing [C]
- MME 4419. Metal Materials Design & Pract [C]
- Concentration Elective Course III (3 credits) [C]
- Concentration Elective Course IV (3 credits) [C]

CONCENTRATION I - Forensic Engineering and Materials Performance

(Choice of 4 from the following - *required)

- MME4315 Metallography and Microstructure Interpretation[C]*
- MME4330 Advanced Failure Analysis[C]*
- MME 4331 Non-Destructive Examination[C]
- MME4332 Root Cause Analysis[C]
- MME4333 Fracture Mechanics[C]
- MME4334 Biomedical Product Performance Analysis[C]
- MME4335 Functional Failure Analysis[C]

CONCENTRATION II - Extractive Metallurgy

(Choice of 4 from the following - *required)

- MME4415 Metallography and Microstructure Interpretation[C]*
- MME4320 Solidification Processes[C]
- MME4340 Mineral Processing[C]
- MME4341 Recycling Processes[C]
- MME4342 Hydrometallurgy[C]*

- MME4350 Materials Joining Technologies[C]
- GEOL4315 Topics in Geological Sciences[C]

CONCENTRATION III - Biomaterials

(Choice of 4 from the following - *required)

- BME3303 Fundamentals of BME I[C]
- BME3305 Fundamentals of BME II[C]
- MME4304 Printable Materials[C]
- MME4310 Polymer Engineering[C]
- MME4312 Biomaterials Science and Engineering[C]*
- MME4314 Composite Materials[C]
- MME4334 Biomedical Product Performance Analysis[C]
- MME4421 Engineering Alloys[C]

CONCENTRATION IV - General MME

(Choice of 3 from the following and 1 from any of the other concentrations - *required)

- MME4314 Composite Materials[C]
- MME4310 Polymer Engineering[C]
- MME4315 Metallography and Microstructure Interpretation[C]*
- MME4321 Engineering Alloys[C]
- MME4331 Non-Destructive Examination[C]
- MME4350 Materials Joining Technologies[C]