5. Special Consideration

**Dwight Look College of Engineering**
Department of Materials Science and Engineering
BS in Materials Science and Engineering
Request for a new degree program
SPECIAL CONSIDERATION
SPECIAL CONSIDERATION

Dwight Look College of Engineering
Department of Materials Science and Engineering
BS in Materials Science and Engineering
Request for a New Degree Program
Dear Dr. Karaman:

I would like to strongly support the adoption of the proposed new Bachelor of Science (B.S.) degree program in Materials Science and Engineering at Texas A&M University. This degree would greatly advance the University’s efforts towards increasing research, undergraduate and graduate education in the field of materials science and engineering to the benefit of students, the University, the State of Texas, the nation, and society in general. It is envisioned that the program will be a key problem-solving education entity that produces highly competent workforce and leaders for the industry, research institutions, and in academia.

To further the development and advancement of new materials discovery and innovations, traditional science and engineering fields alone are inadequate. Materials Science and Engineering is inherently interdisciplinary; therefore, this B.S. degree was designed jointly by faculty in the College of Engineering and the College of Science. The new degree program will benefit from a network of quality experimental facilities and internationally recognized researchers and educators in two colleges, the Dwight Look College of Engineering and the College of Science.

The U.S. Bureau of Labor Statistics’ (BLS) 2012 to 2022 Employment Projections Report indicates a 16.4 percent growth for material scientists and engineers in the State of Texas. Although many Texas industries are “materials-intensive,” there is no undergraduate materials science and engineering program in either of the flagship public universities. Again, according to the BLS report, about 10% of the projected new jobs in materials science and engineering will be located in Texas, however, the current undergraduate programs in Texas only educate 2% of the national B.S. graduates in materials science and engineering. Planning for the future necessitates providing a workforce educated in the research, development, and fabrication of sophisticated materials to serve the “materials-intensive” industry, which promise to be responsible for a large share of the future growth of the Texas economy.

In Texas, only three universities, the University of Texas at El Paso, University of North Texas, and Rice University offer ABET-accredited materials science and engineering undergraduate curriculum. In contrast, there are seven ABET-accredited materials programs in California, six in Pennsylvania, and six in Ohio. Without established departments focusing on MSEN, Texas is short-changing its talented prospective scientists and engineers, by not addressing the future workforce needs of the state and failing to attract good students from both inside and outside the state in this critical area.
The B. S. degree program has been purposely designed by faculty in the College of Science and faculty in the College of Engineering to encompass both traditional materials areas and new emerging fields. The education and training of a B.S. materials science and engineering graduate requires a curriculum with solid foundations in mathematics, chemistry and physics. Furthermore, developing MSEN B.S. graduates for the future requires flexibility in academic preparation to keep pace with emerging sciences and industries such as energy materials, nano and bio materials, and nanotechnologies to meet the challenges of many industries present in Texas such as: aerospace, petrochemical, biomedical, computer, electronics, and telecommunications. Upon establishment, this program will produce Bachelor of Science graduates who will provide these industrial employers with leading-edge expertise in materials.

Summarizing, the College of Science is committed to the establishment of this new undergraduate degree program in Materials Science and Engineering and to providing the support to implement the new program. If I can provide any additional help with this effort, please feel free to contact me.

Sincerely,

Meigan Aronson, Ph.D.
Dean
College of Science

Email: maronson@physics.tamu.edu
Office Tel: 1-979-845-2629
Texas A&M University
New Certificate, Bachelors, Masters, or Doctoral Program
Undergraduate • Graduate • Professional
• Proposal Checklist •

Program request type: ☑ Undergraduate ☐ Graduate ☐ First Professional (e.g., DVM, JD, MD, etc.)
Requested by the Department or Unit of: Department of Materials Science and Engineering

Program Type, Level, Designation, Title, Description, Hours
Program Type: ☐ Certificate Program ☑ Degree Program
Program Level: ☐ UG Certificate ☐ Grad Certificate ☑ Bachelor ☐ Master ☐ Doctoral ☐ Professional
Degree Designation (i.e., BS, BA, MA, MS, MEng, MEd, PhD, EdD, etc.) B.S.
Title of proposed program: Materials Science and Engineering
Proposed CIP Code (if known): 14.1801

Brief program description (provide a catalog description for undergraduate and graduate certificates):

Materials science and engineering is an interdisciplinary field that centers on understanding the physical properties of matter, and producing materials with specific characteristics to serve a desired function.

Materials scientists study the connections between material synthesis/processing, matter’s underlying structure, and the properties and performance provided by the structure.

Materials engineers develop materials and manufacturing techniques and integrate these materials into commercial products.

Practicing materials scientists and engineers utilize different processing, characterization, modeling, and simulation techniques to solve fundamental materials challenges and enable new materials, devices, and technologies.

Materials Science and Engineering is inherently interdisciplinary; therefore, this degree was designed jointly by faculty in the College of Engineering and the College of Science. The proposed program also complements the existing M.S., M.Eng. and Ph.D. degrees in Materials Science and Engineering at Texas A&M University.

Materials scientists and engineers play crucial roles in nearly all industry sectors, including energy, defense and homeland security, biomedicine, electronics, transportation, infrastructure, and personal care products. The proposed B.S. degree will allow students to obtain a customized learning experience including computational materials science, polymers and soft materials, corrosion engineering, materials design / processing / characterization / simulation, and advanced structural materials. Students may have opportunities to participate in study abroad programs, industrial internships, and undergraduate research or entrepreneurship opportunities.

MSEN B.S. graduates will be prepared to pursue careers as materials engineers and scientists, pursue advanced graduate study, or to apply their knowledge in other areas such as law, medicine or business. Graduates from our department will have the following skills:

• Bridge the gap between fundamental research (science) and technology (engineering),
• Apply fundamental materials processing, structure, properties, and performance relationships to identify and solve materials-related challenges,
Texas A&M University
New Certificate, Bachelors, Masters, or Doctoral Program
Undergraduate • Graduate • Professional
• Proposal Checklist •

- Master a broad suite of synthesis, characterization, and simulation techniques,
- Thrive in multidisciplinary engineering environments,
- Advance as future leaders in specific materials science and engineering areas.

The MSEN B.S. degree program will seek accreditation from ABET at the appropriate time. Guidance and academic advising will be provided through the Department of Materials Science and Engineering.

Minimum program semester credit hours (SCH)

<table>
<thead>
<tr>
<th>Proposed program hours:</th>
<th>Certificates - 12 hours*</th>
<th>Bachelors - 120 hours</th>
<th>Masters - 30 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>*12 hours minimum to appear on transcript</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Certificate Programs
- [] Embedded
- [] Standalone

Students take coursework that will result in a degree and certificate being earned at the same time.
Non-degree seeking students take coursework to earn a certificate only (no degrees are awarded).

Off-Campus or Distance Delivery

<table>
<thead>
<tr>
<th>% of Program a student can take off-campus or through Distance Education</th>
<th>Program Start Date</th>
<th>SACSCOC Approval**</th>
<th>When Provost needs to inform SACSCOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] 25%</td>
<td></td>
<td>Notification Only</td>
<td></td>
</tr>
<tr>
<td>[ ] 50%</td>
<td></td>
<td>Approval Required</td>
<td>6 months before first day of program</td>
</tr>
<tr>
<td>[ ] 80%</td>
<td></td>
<td>Approval Required</td>
<td>6 months before first day of program</td>
</tr>
<tr>
<td>[ ] 100%</td>
<td></td>
<td>Approval Required</td>
<td>6 months before first day of program</td>
</tr>
</tbody>
</table>

**Notification letter arranged through the Vice Provost for Academic Affairs and sent by TAMU President.

Program Delivery Mode

[ ] On-campus
[ ] Broadcast / TTVN
[ ] Specific off-campus location**
[ ] Distance Education / Internet
[ ] In-State
[ ] Out-of-State

[ ] Out-of-Country

Location
College Station/Main Campus

Will this program be offered with another institution?
[ ] Yes
[ ] No
If yes, contact the Vice Provost for Academic Affairs for additional reporting requirements.

***Is this an approved SACSCOC location?
[ ] Yes
[ ] No
If no, a program prospectus must be sent to SACSCOC.
Approved locations as of March 2012: TAMU-Galveston, TAMU-Qatar, University Center-The Woodlands, CityCentre-Houston, Dubai and Saudi Arabia.

Program Funding

Has program funding been finalized at the department or college level?
[ ] Yes
[ ] No
If no, explain or attach budget: _______

Will new costs for the first five years of the program be under $2 million?
[ ] Yes
[ ] No
If new costs exceed $2 million, coordinating board approval is required.
Submitted by (Contact Person):
Dr. Ibrahim Karaman ikaraman@tamu.edu
Name
Professor and Head, Department Materials Science and
Engineering
Title

Certification Statement
By signing below, the Dean of the College certifies the proposed program complies with coordinating board standards. If the program is delivered through Distance Education, the Dean of the College certifies that they are following the Principles of Good Practice for Academic Degree and Certificate Programs and Credit Courses Offered Electronically.

<table>
<thead>
<tr>
<th>Signature, Department Head or Interdisciplinary Program Chair</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Ibrahim Karaman, Head, Department of Materials Science and Engineering Texas A&amp;M University</td>
<td></td>
</tr>
<tr>
<td>Chair, College Review Committee Date</td>
<td>Chair, College Review Committee Date</td>
</tr>
<tr>
<td>Dr. Valerie Taylor Senior Associate Dean for Academic Affairs Dwight Look College of Engineering Texas A&amp;M University</td>
<td></td>
</tr>
<tr>
<td>Dr. Katherine Banks Vice Chancellor and Dean of Engineering Texas A&amp;M University Director, Texas A&amp;M Engineering Experiment Station</td>
<td></td>
</tr>
<tr>
<td>Dr. Timothy P. Scott Chair, University Curriculum Committee Texas A&amp;M University</td>
<td></td>
</tr>
</tbody>
</table>

Additional Approvals Required. Faculty Senate and President.
Agenda Item No.________

AGENDA ITEM BRIEFING

Submitted by: Michael K. Young, President/CEO
Texas A&M University

Subject: Approval of a New Bachelor of Science Degree Program with a Major in Field of Study in Materials Science and Engineering and Authorization to Request Approval from the Texas Higher Education Coordinating Board

Proposed Board Action:

Approve the establishment of a new degree program at Texas A&M University leading to a Bachelor of Science in Materials Science and Engineering (MSEN), authorize the submission of this degree program to the Texas Higher Education Coordinating Board (THECB) for approval and certify that all applicable THECB criteria have been met.

Background Information:

Industry demand and student interest in Materials Science and Engineering (MSEN) undergraduate program across Texas and the nation are growing. The U.S. Bureau of Labor Statistics’ (BLS) 2012 to 2022 Employment Projections Report indicates a 16.4 percent growth for material scientists and engineers in the State of Texas. Again, according to the BLS report, about 10% of the projected new jobs in materials science and engineering will be located in Texas; however, the current undergraduate programs in Texas only educate 2% of the national B.S. graduates in materials science and engineering. Therefore, the Department of Materials Science and Engineering at Texas A&M University (TAMU) is proposing a Bachelor of Science (B.S.) degree program in MSEN to launch in Fall 2017. TAMU is well positioned for this undertaking in that it will impart a significant benefit to the students and faculty of the University as well as the citizens of the state of Texas at large.

The establishment of this degree program is warranted by several factors:

- being responsive to and serving the existing and future economic needs in Texas and across the nation;
- offering a well-rounded education to Texas science and engineering students;
- responding to the encouraging survey results showing industry employer’s future need for B.S. degrees in MSEN;
- contributing to the improvement of the national rankings in the TAMU College of Engineering and Science and thus, attracting better students;
- providing well prepared undergraduate students who can pursue graduate degrees in materials science and engineering and related fields to address the increasing demand for MSEN advanced degrees in the nation.

The present situation in Texas regarding the production of B.S. graduates to meet industry needs is serious because there are only three (3) undergraduate MSEN programs in the state and no Texas flagship institution offers a Bachelor of Science in materials science and engineering.

There is also an increasing demand for B.S. materials science and engineering graduates to obtain advanced degrees. The current graduation rate from institutions across the country does not produce enough B.S. graduates to provide a sufficient domestic student pool to recruit both new hires for industry and students for graduate programs in Texas.
Therefore, at the current graduation rate for the Bachelors of Science in Materials Science and Engineering, Texas will fail to provide enough professionals to meet the industrial, research and scientific needs of our state and nation. As the pre-eminent engineering land-grant institution in Texas, it is our responsibility to anticipate these needs and to prepare future scientists, professionals and engineers who are competitive and flexible enough to keep pace with the increasing rate of technological advancement in our state, nation and worldwide.

A&M System Funding or Other Financial Implications:

The five-year costs associated with the MSEN undergraduate program start-up are estimated to be $2,982,868. This estimate includes $2,003,200 for new personnel including an undergraduate program coordinator, three additional faculty members and two professors of practice or senior lecturers, graduate assistants, and clerical staff. Facilities and equipment to support existing and the new laboratories should be around $927,668, and supplies and materials are estimated to be $26,500. Other costs, which include accreditation and travel costs, are estimated to be $25,500.

Approximately fifty percent (50%) of the new B.S. MSEN curriculum will leverage current MSEN courses and Dwight Look College of Engineering laboratories for materials are already in place. Most of the costs associated with the five-year startup plan for the MSEN program will be for the development and delivery of new (or highly modified) courses to support the new curriculum, including faculty salary, staff salary for student recruiting and enrollment advising, improved facilities and additional equipment.

Faculty required to deliver the B.S. MSEN curriculum will grow from today's 14 Full-Time-Equivalent (FTE) in the existing MSEN department to 19 FTE (which includes three new full time tenure track faculty and two new non-tenure track professor of practice / lecturer) faculty over the five-year startup period to support program advising and new course development and delivery. Graduate Assistant Teaching (GAT) support will grow to ten (10) in the first five years to accommodate additional lab sections of current and new lab courses.

The five-year funding plan includes use of reallocated funds derived from the hiring of new faculty members who will focus on MSEN undergraduate courses. In addition to the estimated $945,000 of anticipated reallocated funds for faculty hiring, $2,037,868 will come from additional Differential Tuition (DT) funding that will be generated and used for non-tenure track professor of practice / lecturer salaries, full time program coordinator staff salary, GAT support, establishment of an undergraduate laboratory, procurement of new laboratory equipment, and lab supplies.
Agenda Item No.

TEXAS A&M UNIVERSITY
Office of the President
Date of Submission

Members, Board of Regents
The Texas A&M University System

Subject: Approval of a New Bachelor of Science Degree Program with a Major in Field of Study in Materials Science and Engineering and Authorization to Request Approval from the Texas Higher Education Coordinating Board

I recommend adoption of the following minute order:

"The Board of Regents of The Texas A&M University System approves the establishment of a new degree program at Texas A&M University- College Station, leading to a Bachelor of Science Degree Program with a Major in Field of Study in Materials Science and Engineering.

The Board also authorizes submission of Texas A&M University's new degree program request to the Texas Higher Education Coordinating Board for approval and hereby certifies that all applicable criteria of the Coordinating Board have been met."

Respectfully submitted,

Michael K. Young
President

Approval Recommended:

Approved for Legal Sufficiency:

John Sharp
Chancellor

Ray Donilla
General Counsel

Billy Hamilton
Executive Vice Chancellor and Chief Financial Officer

James R. Hallmark, Ph.D.
Vice Chancellor for Academic Affairs
TEXAS A&M UNIVERSITY
Bachelor of Science
With a major in Materials Science and Engineering
(CIPs: 14.1801.00)

PROGRAM REVIEW OUTLINE

BACKGROUND & PROGRAM DESCRIPTION

ADMINISTRATIVE UNIT: Dwight Look College of Engineering, Department of Materials Science and Engineering.

The Department of Materials Science and Engineering at Texas A&M University (TAMU) is proposing a Bachelor of Science (B.S.) degree program in Materials Science and Engineering (MSEN) for Fall 2017.

RATIONALE:

The establishment of this degree program is warranted by several factors:

- being responsive to and serving the existing and future economic needs in Texas and across the nation;
- offering a well-rounded education to Texas science and engineering students;
- responding to the encouraging survey results showing industry employer’s future need for B.S. degrees in MSEN;
- providing well prepared undergraduate students who can pursue graduate degrees in MSEN that address the increasing demand for MSEN advanced degrees in the nation.

According to the Texas Workforce Commission (TWC) projections, industry jobs in Texas for B.S. graduates in materials science and engineering are projected to increase 16.4% between 2012 and 2022, which is considerably higher than the national average for all industry clusters. According to the Occupational Outlook Handbook by the Bureau of Labor Statistics (BLS), about 10% of the projected new jobs in materials science and engineering in the nation will be located in Texas in the next decade, however, the current undergraduate programs in Texas only educate 2% of the national B.S. graduates in materials science and engineering.

The present situation in Texas is serious because there are only three (3) undergraduate MSEN programs in the state and no Texas flagship institution offers a Bachelor of Science in materials science and engineering. On the other hand, California has seven (7) undergraduate programs in materials science and engineering, Ohio has six (6), and Pennsylvania has six (6) undergraduate programs. The enrollment and the number of B.S. graduates from those programs have increased 5% annually over the last five years while the existing number of graduates from Texas remained nearly constant over that period.

Program Outline: Page 1
There is also a demand for more B.S. materials science and engineering graduates to obtain advanced degrees. The current graduation rate from institutions across the country does not produce enough B.S. graduates to provide a sufficient domestic student pool to recruit both new hires for industry and students for graduate programs in Texas.

Therefore, at the current graduation rate for the Bachelors of Science in Materials Science and Engineering, Texas will fail to provide enough professionals to meet the industrial, research and scientific needs of our state and nation. As the pre-eminent engineering land-grant institution in Texas, it is our responsibility to anticipate these needs and to prepare future scientists, professionals and engineers who are competitive and flexible enough to keep pace with the increasing rate of technological advancement in our state, nation and worldwide.

CONTINGENCIES:

Texas A&M University, Dwight Look College of Engineering and the Department of Materials Science and Engineering is committed to seek accreditation for the Bachelor of Science degree program from the Accreditation Board for Engineering and Technology (ABET) upon graduation of its first class of students.

PROPOSED PROGRAM:

The Bachelor of Science (B.S.) degree awarded from the Department of Materials Science and Engineering (MSEN) at Texas A&M University will require 128 semester credit hours (SCHs). This curriculum builds on the common first-year sequence in engineering (27 SCHs), and the University Core Curriculum electives (24 SCHs) required of all TAMU undergraduates. The MSEN undergraduate major includes core MSEN undergraduate courses (59 SCHs) that provide a strong, common, foundation in materials science and engineering, MSEN electives (9 SCHs) that provide depth in a focus topic, and specialty technical electives (9 SCHs) to add breadth in interdisciplinary technical fields.

<table>
<thead>
<tr>
<th>Category</th>
<th>Semester Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education Core Curriculum (bachelor’s degree only)</td>
<td>51</td>
</tr>
<tr>
<td>MSEN Core Courses</td>
<td>59</td>
</tr>
<tr>
<td>MSEN Technical Electives</td>
<td>9</td>
</tr>
<tr>
<td>Specialty Technical Electives</td>
<td>9</td>
</tr>
<tr>
<td>Other (Specify, e.g., internships, clinical work)</td>
<td>(if not included above)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>128</td>
</tr>
</tbody>
</table>
Bachelor of Science in Materials Science and Engineering

- **Flexibility** to engage in one or more of several defined emphasis areas, or with guidance from a faculty mentor, create a custom emphasis degree plan.
- **Opportunities** to participate in internships with industry partners, and research in academic and government laboratories.
- **Integration** of laboratory experience with computational simulation.
- **Preparation** for employment as a professional engineer across a range of industries, including energy, biomedical, semiconductor, and defense.

Educational Objectives

MSEN graduates will be prepared to pursue careers as materials scientists and engineers, pursue advanced graduate study, or to apply their knowledge in other fields such as law, medicine or business. Graduates from our department will have the following skills:

- Apply fundamental materials processing, structure, properties, and performance relationships to identify and solve materials-related challenges,
- Master a broad suite of synthesis, characterization, and simulation techniques,
- Thrive in multidisciplinary engineering environments,
- Bridge the gap between fundamental research (science) and technology (engineering),
- Communicate effectively, both orally and in writing,
- Advance as future leaders in specific materials emphasis areas,
- Demonstrate an increased level of leadership and responsibility,
- Exhibit a commitment to professional ethics in their professional career.

Student Outcomes:

- An appropriate mastery of the knowledge, techniques, skills and modern tools of complex systems that span multiple engineering technology disciplines.
- An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology.
- An ability to conduct standard tests and measurements; to conduct, analyze and interpret experiments, and to apply experimental results to improve processes.
- An ability to apply creativity in the design of complex systems that span multiple engineering technology disciplines.
- An ability to function effectively on teams.
- An ability to identify, analyze and solve technical problems.
- An ability to apply written, oral, and graphical communication skills in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.
- An understanding of the need for and an ability to engage in self-directed continuing education and professional development.
- An ability to understand professional, ethical and social responsibilities.
- A respect for diversity and knowledge of contemporary professional, societal and global issues.
- A commitment to quality, timeliness, and continuous improvement.
EVIDENCE OF WORKFORCE NEED, STUDENT DEMAND, LACK OF DUPLICATION:

Workforce Need

Nationally, ten percent (10%) of all new materials science and engineering jobs will be located in Texas over the next decade. However, universities in Texas only produce two percent (2%) of the national B.S. degrees awarded in materials science and engineering.

More importantly, according to BLS, job prospects for materials scientists and engineers are favorable as they will be needed to fill positions as more experienced materials scientists and engineers are promoted or retire. Every year between 2012 and 2022, three percent (3%) of all-existing positions will be replaced with new B.S. graduates in materials science and engineering, indicating that thirty percent (30%) of the entire workforce will need to be replaced in the next 10 years.

State and National Trends in Employment for Materials Science and Engineering between 2012 and 2022

<table>
<thead>
<tr>
<th>United States</th>
<th>Employment</th>
<th>Percent Change</th>
<th>Average Annual Jobs Due to Growth*</th>
<th>Average Annual Jobs Due to Replacements*</th>
<th>Projected Annual Job Openings</th>
<th>Total Job Openings Over the Next Decade</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>31,500</td>
<td>2.20%</td>
<td>70</td>
<td>940</td>
<td>1,010</td>
<td>10,100</td>
</tr>
<tr>
<td>2022</td>
<td>32,200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>Employment</td>
<td>Percent Change</td>
<td>Average Annual Jobs Due to Growth</td>
<td>Average Annual Jobs Due to Replacements</td>
<td>Projected Annual Job Openings</td>
<td>Total Job Openings Over the Next Decade</td>
</tr>
<tr>
<td>2012</td>
<td>2,320</td>
<td>16.40%</td>
<td>40</td>
<td>70</td>
<td>110</td>
<td>1,100</td>
</tr>
<tr>
<td>2022</td>
<td>2,700</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Projected Annual Job Openings refers to the average annual job openings due to growth and net replacement.
4Texas Workforce Commission, Labor Market & Career Information Department

Student Demand

The MSEN Department initiated a survey of undergraduate students enrolled in a series of selected lower level science and engineering classes to gauge interest in a B.S. degree in materials science and engineering. Almost twenty-nine percent (29%) of more than 1,000 undergraduate students surveyed reported they would have considered a major in MSEN as one of their top 3 or first choice as a major. Over sixty percent (60%) of the students surveyed would have explored or considered a major in materials science and engineering. Fifty percent (50%) of the students surveyed reported they were interested in materials science and engineering and almost twenty percent (20%) reported being very interested.

More strikingly, the State of Texas significantly lags behind other large economy states in producing adequate B.S. graduates in materials science and engineering. As mentioned above, Texas only has three
(3) undergraduate programs while California has seven (7) undergraduate programs in materials science and engineering, Ohio has six (6), and Pennsylvania has six (6) programs. The enrollment and the number of B.S. graduates from those programs have increased 5% annually over the last five years while the existing number of graduates from Texas remained nearly constant over that period (24 degrees in 2010, 18 in 2011, 36 in 2012, 22 in 2013, and 33 in 2014, See Table 6). Therefore, there is a need for an undergraduate program in a flagship Texas school to produce enough B.S. graduates to serve the Texas economy and satisfy demand.

**Lack of Duplication of Program**
- Number of B.S. degree programs in the state with the same 6-digit CIP: 3
- Number of B.S. degree programs within a 60-minute drive with same 6-digit CIP: 0

**ENROLLMENT PROJECTIONS:**

We expect the process of establishing a full program with complete course offerings would occur over a five-year period. A comprehensive recruitment program in years 1 and 2 will focus on attracting domestic students from Texas, and in particular, among the underrepresented student groups and first-generation college students. As it matures, the MSEN undergraduate program will accept 100 undergraduate students per year. The table below illustrates the target number of 300 undergraduate students with an eighty-five percent (85%) retention rate and an average graduation time of less than 4.5 years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Change of Major/Transfers</th>
<th>New Students</th>
<th>Attrition</th>
<th>Graduation</th>
<th>Cumulative Headcount</th>
<th>Cumulative* FTES (new only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>60</td>
<td>3</td>
<td>0</td>
<td>122</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>80</td>
<td>7</td>
<td>0</td>
<td>215</td>
<td>138</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>80</td>
<td>11</td>
<td>42</td>
<td>262</td>
<td>213</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>80</td>
<td>13</td>
<td>64</td>
<td>285</td>
<td>231</td>
</tr>
</tbody>
</table>

**COSTS:**

Approximately fifty percent (50%) of the new MSEN curriculum will leverage current MSEN courses and Look College laboratories already in place. Most of the costs associated with the five-year startup plan for the MSEN program will be for the development and delivery of new (or highly modified) courses to support the new curriculum, including faculty salary, staff salary for student recruiting and enrollment advising, improved facilities and additional equipment.

The Faculty required to deliver the MSEN curriculum will grow from today’s 14 Full-Time-Equivalent (FTE) to 19 FTE (which includes three new full time tenure track faculty and two new non-tenure track professor of practice / lecturer) faculty over the five-year startup period to support program advising and new course development and delivery. From year three (3) to five (5), the need for lecturers will grow from one (1) to three (3) FTEs to support growth requirements for new sections of current and new

Program Outline: Page 5
MSEN courses. Graduate Assistant Teaching (GAT) support will grow to ten (10) in the first five years to accommodate additional lab sections of current and new lab courses. Administrative costs will include a full-time program coordinator beginning in year one (1). The five-year funding plan includes use of reallocated funds derived from the hiring of new faculty members who will focus on MSEN undergraduate courses. In addition to the estimated $945,000 of anticipated reallocated funds for faculty hiring, $2,037,868 will come from additional Differential Tuition (DT) funding that will be generated and used for non-tenure track professor of practice / lecturer salaries, full time program coordinator staff salary, GAT support, establishment of an undergraduate laboratory, procurement of new laboratory equipment, and lab supplies.

### Five-Year Costs and Funding Sources

<table>
<thead>
<tr>
<th></th>
<th>Five-Year Costs</th>
<th>Five-Year Funding</th>
</tr>
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<tr>
<td>Personnel(^1)</td>
<td>$2,003,200</td>
<td>Reallocated Funds $945,000</td>
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<td>Facilities and Equipment</td>
<td>$927,668</td>
<td>Anticipated New Formula Funding(^3) $0</td>
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<tr>
<td>Library, Supplies, and Materials</td>
<td>$26,500</td>
<td>Special Item Funding $0</td>
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<tr>
<td>Other(^2)</td>
<td>$25,500</td>
<td>Other(^4) (includes DT funds) $2,037,868</td>
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<tr>
<td><strong>Total Costs</strong></td>
<td><strong>$2,982,868</strong></td>
<td><strong>Total Funding</strong> $2,982,868</td>
</tr>
</tbody>
</table>

The Chief Executive Officer of the institution has certified that the institution will have funds sufficient to support the proposed program.
New Bachelor's and Master's Degree
Cover Page/Signature Page

Directions: An institution shall use this form to propose a new bachelor's or master's degree program. In completing the form, the institution should refer to the document Standards for Bachelor's and Master's Programs, which prescribes specific requirements for new degree programs. Note: This form requires signatures of (1) the Chief Executive Officer, certifying adequacy of funding for the new program, (2) a member of the Board of Regents (or designee), certifying Board approval, and (3) if applicable, a member of the Board of Regents or (designee), certifying that criteria have been met for staff-level approval. NCTE: Preliminary authority is required for all engineering programs. An institution that does not have preliminary authority for a proposed engineering program shall submit a separate request for preliminary authority prior to submitting the degree program request form. That request shall address criteria set in Coordinating Board rules Section 5.24 (a).

Information: Contact the Division of Academic Affairs and Research at 512/427-6200 for more information.

Administrative Information

1. Institution: Texas A&M University

2. Program Name – Show how the program would appear on the Coordinating Board’s program inventory (e.g., Bachelor of Business Administration degree with a major in Accounting):

Bachelor of Science degree with a major in Materials Science and Engineering

<table>
<thead>
<tr>
<th>CIP Code Description</th>
<th>CIP Code</th>
<th>Degree Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Assoc</td>
</tr>
<tr>
<td>ENGINEERING</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>MATERIALS SCIENCE AND ENGINEERING</td>
<td>14.1801.00</td>
<td>MS (32 SCH)</td>
</tr>
</tbody>
</table>

THECB Proposed Program Inventory for Texas A&M University - 003632

<table>
<thead>
<tr>
<th>CIP Code Description</th>
<th>CIP Code</th>
<th>Degree Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Assoc</td>
</tr>
<tr>
<td>ENGINEERING</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>MATERIALS SCIENCE AND ENGINEERING</td>
<td>14.1801.00</td>
<td>B.S. (128 SCH)</td>
</tr>
</tbody>
</table>


4. Number of Required Semester Credit Hours (SCHs) (If the number of SCHs exceeds 120 for a Bachelor's program, the institution must request a waiver documenting the compelling academic reason for requiring more SCHs): 128
The Bachelor of Science (B.S.) degree awarded from the Department of Materials Science and Engineering (MSEN) at Texas A&M University requires 128 semester credit hours (SCHs). This curriculum builds on the common first-year sequence in engineering (27 SCHs), and the University Core Curriculum electives (24 SCHs) required of all TAMU undergraduates. The MSEN undergraduate major includes core MSEN undergraduate courses (59 SCHs) that provide a strong, common, foundation in materials science and engineering, MSEN electives (9 SCHs) that provide depth in a focus topic and specialty technical electives (9 SCHs) to add breadth in interdisciplinary technical fields.

*We request a waiver to exceed the required 120 SCH maximum for a Bachelor’s program so that this program is on par with existing engineering programs in the Dwight Look College of Engineering. The 128 SCH requirement for our existing engineering programs will satisfy ABET requirements for depth and breadth in the engineering discipline, math and science, and satisfy the core curriculum requirements. The 128 SCH requirement has helped position seven current BS degree programs offered by the Dwight Look College of Engineering to be ranked among the top 10 programs offered by public institutions in the nation. The proposed B.S. in MSEN will require similar depth and breadth to satisfy ABET accreditation and core curriculum requirements.*

5. Brief Program Description – Describe the program and the educational objectives:

Materials science and engineering is an interdisciplinary field that centers on understanding the physical properties of matter, and producing materials with specific characteristics to serve a desired function.

Materials scientists *study* the connections between material synthesis/processing, matter’s underlying structure, and the properties and performance provided by the structure.

Materials engineers *develop* materials and manufacturing techniques and integrate these materials into commercial products.

Practicing materials scientists and engineers *utilize* different processing, characterization, modeling, and simulation techniques to solve fundamental materials challenges and enable new materials, devices, and technologies.

Materials Science and Engineering is inherently interdisciplinary; therefore, this degree was designed jointly by faculty in the College of Engineering and the College of Science. The proposed program also complements the existing M.S., M.Eng. and Ph.D. degrees in Materials Science and Engineering at Texas A&M University.

Materials scientists and engineers play crucial roles in nearly all industry sectors, including energy, defense and homeland security, biomedicine, electronics, transportation, infrastructure, and personal care products. The proposed B.S. degree will allow students to obtain a customized learning experience including computational materials science, polymers and soft materials, corrosion engineering, materials design/processing/characterization/simulation, and advanced structural materials. Students may have opportunities to participate in study abroad programs, industrial internships, and undergraduate research or entrepreneurship opportunities.
MSEN B.S. graduates will be prepared to pursue careers as materials engineers and scientists, pursue advanced graduate study, or to apply their knowledge in other areas such as law, medicine or business. Graduates from our department will have the following skills:

- Bridge the gap between fundamental research (science) and technology (engineering),
- Apply fundamental materials processing, structure, properties, and performance relationships to identify and solve materials-related challenges,
- Master a broad suite of synthesis, characterization, and simulation techniques,
- Thrive in multidisciplinary engineering environments,
- Advance as future leaders in specific materials science and engineering areas.

The MSEN B.S. degree program will seek accreditation from ABET at the appropriate time. Guidance and academic advising will be provided through the Department of Materials Science and Engineering.

6. Administrative Unit – Identify where the program would fit within the organizational structure of the university (e.g., The Department of Electrical Engineering within the College of Engineering):

The Department of Materials Science and Engineering within the Dwight Look College of Engineering

7. Proposed Implementation Date – Report the date that students would enter the program (MM/DD/YY): 08/21/2017

8. Contact Person – Provide contact information for the person who can answer specific questions about the program:

Name: Dr. Ibrahim Karaman  
Title: Professor and Department Head  
E-mail: ikaraman@tamu.edu  
Phone: 979-862-3923
# New Program Request Form for Bachelor's and Master's Degrees

**Directions:** An institution shall use this form to propose a new bachelor's or master's degree program that is in the field of engineering or has costs exceeding $2 million for the first five years of operation. In completing the form, the institution should refer to the document Standards for Bachelor's and Master's Programs, which prescribes specific requirements for new degree programs. Note: This form requires signatures of (1) the Chief Executive Officer or Chief Academic Officer, certifying adequacy of funding for the new program and the notification of other institutions; (2) a member of the Board of Regents (or designee), certifying Board approval. **NOTE:** Preliminary notification is required for all engineering programs. Prior to submission of an engineering program proposal, the institution should notify the Division of Workforce, Academic Affairs and Research of its intent to request such a program.

For more information: Contact the Division of Workforce, Academic Affairs and Research at 512/427-6200.

---

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<td>C. Faculty</td>
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<td>E. Library</td>
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<td>A. Five-Year Costs and Funding Sources</td>
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<td>Appendix G. Course Syllabi</td>
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</tr>
</tbody>
</table>
Administrative Information

1. **Institution:** Texas A&M University

2. **Program Name** – Show how the program would appear on the Coordinating Board’s program inventory (e.g., Bachelor of Business Administration degree with a major in Accounting):

**Bachelor of Science degree with a major in Materials Science and Engineering**

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<tr>
<th>CIP Code Description</th>
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<td>Assoc</td>
</tr>
<tr>
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<td>14</td>
<td></td>
</tr>
<tr>
<td>MATERIALS SCIENCE AND ENGINEERING</td>
<td>14.1801.00</td>
<td></td>
</tr>
</tbody>
</table>

**THECB Proposed Program Inventory for Texas A&M University—003632**

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<tr>
<th>CIP Code Description</th>
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<tr>
<td>MATERIALS SCIENCE AND ENGINEERING</td>
<td>14.1801.00</td>
<td></td>
</tr>
</tbody>
</table>

3. **Proposed THECB CIP Code:** 14.1801 Title: Materials Science and Engineering.

4. **Number of Required Semester Credit Hours (SCHs)** (If the number of SCHs exceeds 120 for a Bachelor’s program, the institution must request a waiver documenting the compelling academic reason for requiring more SCHs): **128**

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physical properties of matter, and producing materials with specific characteristics to serve a
desired function.

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underlying structure, and the properties and performance given the structure.

Materials engineers *develop* materials and manufacturing techniques and integrate these
materials into commercial products.

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opportunities.

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<table>
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</tr>
</thead>
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</tbody>
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<table>
<thead>
<tr>
<th>7. Proposed Implementation Date – Report the date that students would enter the program (MM/DD/YY):</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/21/2017</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>8. Contact Person – Provide contact information for the person who can answer specific questions about the program:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Dr. Ibrahim Karaman</td>
</tr>
<tr>
<td>Title: Professor and Department Head</td>
</tr>
<tr>
<td>E-mail: <a href="mailto:ikaraman@tamu.edu">ikaraman@tamu.edu</a></td>
</tr>
<tr>
<td>Phone: 979-862-3923</td>
</tr>
</tbody>
</table>
PROGRAM INFORMATION

Executive Summary

The Department of Materials Science and Engineering at Texas A&M University (TAMU) is proposing a Bachelor of Science (B.S.) degree program in Materials Science and Engineering (MSEN) beginning Fall 2017.

The establishment of this degree program is warranted by several factors:

- being responsive to and serving the existing and future economic needs in Texas and across the nation;
- offering a well-rounded education to Texas science and engineering students;
- responding to the encouraging survey results showing industry employer's future need for B.S. degrees in MSEN;
- providing well prepared undergraduate students who can pursue graduate degrees in MSEN that address the increasing demand for MSEN advanced degrees in the nation.

The present situation in Texas is serious because there are only three (3) undergraduate MSEN programs in the state and no Texas flagship institution offers a Bachelor of Science in materials science and engineering.

Industry jobs in Texas for B.S. graduates in materials science and engineering are projected to increase 16.4% between 2012 and 2022, which is considerably higher than the national average for all industry clusters.

Nationally, ten percent (10%) of all new materials science and engineering jobs will be located in Texas over the next decade. However, universities in Texas only produce two percent (2%) of the national B.S. degrees awarded in materials science and engineering.

There is also a demand for more B.S. materials science and engineering graduates to obtain advanced degrees. The current graduation rate from institutions across the country does not produce enough B.S. graduates to provide a sufficient domestic student pool to recruit both new hires for industry and students for graduate programs in Texas.

Therefore, at the current graduation rate for the Bachelors of Science in Materials Science and Engineering, Texas will fail to provide enough professionals to meet the industry, research and scientific needs of our state and nation.

As the pre-eminent engineering land-grant institution in Texas, it is our responsibility to anticipate these needs and to prepare future scientists, professionals and engineers who are competitive and flexible enough to keep pace with the increasing rate of technological advancement in our state, nation and worldwide.
1. **Need**

   A. **Job Market Need** - Provide short- and long-term evidence of the need for graduates in the job market.

**Employment Trends**

Texas is home to the second-largest concentration of materials-processing plants in the world in the Houston and Corpus Christi areas. Within the state is one of the nation's largest complexes of oil/gas and oil/gas services industrial firms. The Dallas and Austin metropolitan areas have photovoltaic cell and other semiconductor fabrication, research, and development operations (Freescale, AMD, TI, National Instruments, Samsung, and Sematech), with smaller, energy-materials concerns in almost every large and intermediate sized metropolitan area. Houston is a hub for the medical industry and, more recently, for alternative energy firms. Moreover, the state already houses many aerospace companies and currently is attempting to attract new technology companies aligned with recent national initiatives that promote new commercial space companies\(^1\). Polymer/plastics production and processing in the state rivals the rest of the U.S. combined (Dow, Huntsman, Exxon-Mobil, BASF, BP, 3M, Chevron, Shell, SABIC, LyondellBasell, and others have a large presence). According to the Overview of the Texas Economy\(^2\), Texas added more jobs than any other state in 2014 and led the nation in job growth for the fifth consecutive year.

These and many other important industries rely directly or indirectly on developing new materials that enable future technological breakthroughs: advanced coating technologies to ameliorate corrosion in the oil and gas industry, advanced high temperature structural materials for propulsion and thermal shielding in aerospace vehicles, advanced semiconductor materials to enhance electronic device efficiency, new polymeric materials with multi-functional capabilities. As current technologies reach their operating limits, the need to discover, develop and deploy new materials capable of enabling the next generation technologies will only increase.

---

*Evidence of a dynamic market -- the future industry projections for Texas show a broad range of occupations for B.S. graduates in materials science and engineering. This is compelling evidence to create a new degree program.*

It is thus not surprising that current trends suggest a healthy growth in the demand for materials scientists and engineers in the near and the medium term. According to the Bureau of Labor Statistics (BLS) Job Outlook for 2012 to 2022\(^3\) the national discipline of engineering will see a nine percent (9%) increase in employment over the next decade. Because the workforce is aging, over sixty-seven percent (67%) of the additional job openings from 2012-2022 will come from replacement positions for those who retire or leave the workforce\(^4\).

According to the Occupational Outlook Handbook by BLS, the number of new jobs will increase 2.2 percent across the nation for B.S. graduates in materials science and engineering graduates between 2012 and 2022\(^3\). More importantly, according to BLS, job prospects for materials scientists and engineers is favorable as they will be needed to fill positions as more experienced materials scientists and engineers are promoted or retire. Every year between 2012 and 2022, three percent (3%) of all-existing positions will be replaced with new B.S. graduates in materials science and engineering, indicating that thirty percent (30%) of the entire workforce will need to be replaced in the next 10 years. Prospects should also be positive for those trained in specialized fields of materials engineering such as ceramics, corrosion, electronic materials, failure analysis, polymers, and biomaterials.

According to the Texas Workforce Commission (TWC) projections\(^4\) shown in Table 1, there will be a 16.4 % increase in overall job openings for B.S. graduates in materials science and engineering between

Request for New B.S. Degree Program
Page 6
2012-2022. There will be approximately 110 annual job openings in Texas alone each year requiring a B.S. in materials science and engineering, seventy percent (70%) of the new jobs each year will be replacements for retirements within the workforce, and approximately forty (40) jobs will be available annually due to growth\(^4\). However, the undergraduate programs in Texas (University of Texas at El Paso, University of North Texas, and Rice University) have only granted an average of 27 B.S. degrees per year during the last five (5) years without a notable increase in the number of B.S. graduates\(^5\). Clearly, there is an urgent demand to increase the numbers of B.S. graduates in materials science and engineering in Texas\(^6\).\(^7\).

### Table 1. State and National Trends in Employment for Materials Science and Engineering between 2012 and 2022

<table>
<thead>
<tr>
<th>United States</th>
<th>Employment 2012</th>
<th>Employment 2022</th>
<th>Percent Change</th>
<th>Average Annual Jobs Due to Growth*</th>
<th>Average Annual Jobs Due to Replacements*</th>
<th>Projected Annual Job Openings</th>
<th>Total Job Openings Over the Next Decade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials Science and Engineers*</td>
<td>31,500</td>
<td>32,200</td>
<td>2.20%</td>
<td>70</td>
<td>940</td>
<td>1,010</td>
<td>10,100</td>
</tr>
<tr>
<td>Texas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment 2012</td>
<td>2012</td>
<td>2022</td>
<td>Percent Change</td>
<td>Average Annual Jobs Due to Growth</td>
<td>Average Annual Jobs Due to Replacements</td>
<td>Projected Annual Job Openings</td>
<td>Total Job Openings Over the Next Decade</td>
</tr>
<tr>
<td>Materials Science and Engineers***</td>
<td>2,320</td>
<td>2,700</td>
<td>16.40%</td>
<td>40</td>
<td>70</td>
<td>110</td>
<td>1,100</td>
</tr>
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</table>

\(^1\)Projected Annual Job Openings refers to the average annual job openings due to growth and net replacement.


\(^4\)Texas Workforce Commission, Labor Market & Career Information Department

The BLS data in Figure 1 and Table 2 show Texas has the second highest employment level in both materials science and materials engineering occupations in the nation. Considering the fact that there will be a substantial job growth in Texas in the next decade and about 30% of the existing positions need to be replaced due to retirement or promotion, there will be many job openings with high annual pay (Table 2) for graduates from materials science and engineering\(^6\). However, B.S. degrees awarded in materials science and engineering shows Texas is not among the top 10 states\(^5\). Examining the employment levels in Texas and in the nation for materials scientists and engineers (with a B.S.), it is clear that our higher education system in Texas is not providing enough qualified professionals in materials science and engineering to meet our state or national employment needs.

**Evidence of a dynamic market -- the future industry projections for Texas show a broad range of occupations for B.S. graduates in materials science and engineering. This is compelling evidence to create a new degree program.**
Figure 1. Employment of Materials Scientists and Engineers by State, May, 2014
EMPLOYMENT: Population of professionals employed in materials science and engineering.
http://www.bls.gov/oes/current/oes172131.htm

Table 2. States with the Highest Employment Level in Materials Science and Engineering
Showing Texas has the Second Highest Employment Level in Both Categories.

<table>
<thead>
<tr>
<th>State</th>
<th>Employment for Materials Engineers</th>
<th>Employment per thousand jobs</th>
<th>Hourly mean wage</th>
<th>Annual mean wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>2,310</td>
<td>0.15</td>
<td>$52.40</td>
<td>$108,980</td>
</tr>
<tr>
<td>Texas</td>
<td>2,000</td>
<td>0.18</td>
<td>$44.79</td>
<td>$93,170</td>
</tr>
<tr>
<td>New York</td>
<td>1,560</td>
<td>0.18</td>
<td>$42.61</td>
<td>$88,620</td>
</tr>
<tr>
<td>Ohio</td>
<td>1,490</td>
<td>0.29</td>
<td>$43.83</td>
<td>$91,160</td>
</tr>
<tr>
<td>Michigan</td>
<td>1,460</td>
<td>0.36</td>
<td>$37.68</td>
<td>$78,380</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>State</th>
<th>Employment for Materials Scientists</th>
<th>Employment per thousand jobs</th>
<th>Hourly mean wage</th>
<th>Annual mean wage</th>
</tr>
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<tbody>
<tr>
<td>California</td>
<td>1,120</td>
<td>0.07</td>
<td>$48.52</td>
<td>$100,930</td>
</tr>
<tr>
<td>Texas</td>
<td>540</td>
<td>0.05</td>
<td>$51.73</td>
<td>$107,610</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>520</td>
<td>0.16</td>
<td>$40.76</td>
<td>$84,780</td>
</tr>
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<td>Ohio</td>
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<td>0.10</td>
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</tr>
<tr>
<td>New York</td>
<td>460</td>
<td>0.05</td>
<td>$47.10</td>
<td>$97,960</td>
</tr>
</tbody>
</table>

EMPLOYMENT: Population of professionals employed in materials science and engineering.
One clear implication from studies of energy efficient technologies and practices is a growing need for individuals with knowledge and skills related to basic materials design for energy efficiency, energy creation, and manufacturing\textsuperscript{14}. Evidence suggests that there will be a skill shortage among the current workforce to meet the demand to conserve existing resources and enhance sustainability. From the report *Greening of the World of Work: Implications for O*NET-SOC and New and Emerging Occupations*\textsuperscript{8}, materials science and engineering is an employment cluster with potential to have substantial impact on the primary building blocks needed for greening our overall national occupations. The “greening” of occupations refers to the extent to which green economy activities and technologies increase the demand for existing occupations, shape the work and worker requirements needed for occupational performance, or generate unique work and worker requirements.

Figure 2 shows the long-term projections for selected industries where materials science and engineering graduates would likely obtain employment\textsuperscript{10,11}. The growth rates in the manufacturing industries show a strong demand over the decade and a need for graduates with expertise in fundamental materials science and engineering to fill the openings and growth in these areas\textsuperscript{14}. The “Materials” cluster once used broadly in occupational descriptions will break down into subcategories to more accurately reflect the necessary knowledge in materials design, development, use, and degradation/failure analysis\textsuperscript{14}.

**Figure 2.** Long-Term Industry Projections in Texas related to Materials Science and Engineering, by Selected Industry and Growth Rate, 2012-2022
SOURCE: The Labor Market & Career Information Department (LMCI) of the Texas Workforce Commission
TRACER: Texas Labor Market Information.

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The Student Engineers' Council (SEC) at Texas A&M University hosts a career fair each fall for national and international companies to visit the campus to recruit potential employees and interns. The 2015 Fall Career Fair had over 415 companies in attendance. Twenty percent (20%) of those companies (83) self-identified as specifically recruiting materials science and engineering majors, even though Texas A&M does not currently have an undergraduate program. **Companies want and need new materials science and engineering graduates to meet their current and future staffing needs.**

Planning necessitates providing a workforce educated in the design, development, fabrication and selection of materials to serve these industries that will be responsible for a large share of the future growth of the Texas economy and that of the nation.
"Graduate Programs" as an Employer

Industry is not the only competitor in the market for new B.S. graduates in materials science and engineering. For many industry positions, there is a need to prepare high-quality B.S. graduates who will undertake additional training before pursuing research-focused careers. Graduate programs—especially those in the "Top 20" Universities, heavily recruit from state universities such as Texas A&M. It is estimated that thirty percent (30%) of our MSEN B.S. graduates will choose to pursue graduate school.

Figure 3 presents the longitudinal average annual demand for professionals when the BLS and TWC data\(^3\), \(^4\), \(^5\), \(^10\) on potential graduate student opportunities are combined for the state of Texas. When the supply of B.S. graduates produced in Texas is plotted, it is obvious that Texas is not producing enough graduates to meet the industry and research needs of the state.

![Figure 3. Average Annual Demand Forecast for Professionals with Materials Science and Engineering Expertise in Texas, 2012-2022](image)

**Figure 3.** Average Annual Demand Forecast for Professionals with Materials Science and Engineering Expertise in Texas, 2012-2022

*B.S. Degrees Awarded Source: American Society for Engineering Education (ASEE), 2015*

*National Data Source: Bureau of Labor Statistics, Office of Occupational Statistics and Employment Projections*

*State Data Source: Texas Workforce Commission, Labor Market & Career Information Department*

**METHODOLOGY:** National Demand for Graduate Students: The total domestic M.S. and Ph.D. graduates were used as the baseline demand for domestic graduate students and a +5% percent change was applied annually to estimate future demand. National Average Annual Industry Demand forecasted for the State Texas in Materials Science and Engineering was provided by BLS and TWC.

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While Figure 3 illustrates the state demand, Figure 4 presents the national annual demand forecast for professionals with materials science and engineering expertise over the next decade. The national supply of B.S. graduates does not meet the combined need to supply our research institutions with qualified graduate students or industry with qualified employees.

Figure 4. Average Annual Demand Forecast for Professionals with Materials Science and Engineering Expertise Nationally, 2012-2022

B.S. Degrees Awarded Source: American Society for Engineering Education (ASEE), 2015

State Data Source: Texas Workforce Commission, Labor Market & Career Information Department

METHODOLOGY: National Demand for Graduate Students: The total domestic M.S. and Ph.D. graduates were used as the baseline demand for domestic graduate students and a +5% percent change was applied annually to estimate future demand. National Average Annual Industry Demand forecasted for the State Texas in Materials Science and Engineering was provided by BLS and TWC.
Building Domestic Capacity

In the spring of 2007, an Issues in Science and Technology article discussed the increasing demand for engineering graduates and the shortage experienced in hiring Ph.D. graduates for faculty positions. The issue of having to compete with industry for qualified B.S. graduates influences our nation and our state as we compete not only among other institutions of higher education for graduate students but industry positions both domestic and abroad. The need to produce enough domestic students completing B.S. degrees in materials science and engineering is required for us to compete for potential masters and doctoral graduate students through the B.S. graduate supply.

In 2014, approximately 6,000 students were enrolled in graduate (M.S.+Ph.D.) programs in materials science and engineering across the country. Of these, forty-six percent (46%) of the students were domestic and fifty-four percent (54%) foreign nationals.

Figure 5 illustrates that in 2014, there were 1,894 graduate (M.S. + Ph.D.) degrees awarded in materials science and engineering with forty-nine percent (49%) domestic students and fifty-one percent (51%) foreign nationals. In other words, nationally, nine-hundred thirty-four (934) graduate degrees were awarded to U.S. Citizens. Considering the number of degrees awarded and industry needs in Figures 3 and 4, the pool from which U.S. schools may recruit domestic B.S. graduates for graduate programs is quite small for materials science and engineering.

Figure 5. Historic Graduate Degrees Awarded in Materials Science and Engineering by Citizenship Status, ASEE

Primary Source: ASEE Engineering Data Management System, 2015
In Texas for 2014, four of the eight graduate degree-granting institutions had more than 50% of their master's and doctoral degrees awarded to foreign nationals. Overall, out of one-hundred eight (108) graduate (M.S. + Ph.D.) degrees awarded in Texas, sixty-six (66) were to international students\(^5\). At Texas A&M University, only thirty percent (30%) of 135 graduate students in the MSEN department are domestic students; there is a striking lack of sufficient domestic applicants to choose from. Therefore, there is an urgent need to produce more B.S. degrees in Texas.

**Industry Survey**

The MSEN Department surveyed over 300 industry representatives by email in fall 2015. Over 120 senior members of industry responded to the survey, representing a broad range of U.S. States, Europe, and Asia (see Appendix B). The survey reported an industry need and employment market for graduates with a Bachelor of Science in materials science and engineering. Over **ninety-eight percent (98%)** of the respondents reported a new MSEN B.S. degree from Texas A&M would be beneficial to the state and as a national resource for materials science and engineering expertise. Over **ninety-five percent (95%)** reported they would hire a MSEN B.S. graduate from Texas A&M. Respondents reported **ninety-four percent (94%)** of the organizations had employees who currently have or need materials properties, characterization, processing or selection knowledge or expertise.

<table>
<thead>
<tr>
<th>Table 3. Most Commonly Recruited Science and Engineering Majors for Materials Science and Engineering Jobs, Fall 2015 Industry Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials Science and Engineering</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Metallurgy</td>
</tr>
<tr>
<td>Chemical Engineering</td>
</tr>
<tr>
<td>Electrical Engineering</td>
</tr>
</tbody>
</table>

**Table 4. Desired Knowledge Areas, Fall 2015 Industry Response**

| Materials Failure  | 72 |
| Materials Processing | 66 |
| Metallurgy          | 65 |
| Coatings            | 62 |
| Corrosion           | 59 |

**SOURCE:** Fall 2015 Industry Survey, Department of Materials Science and Engineering, TAMU

Materials sciences and engineering was the most commonly recruited major for those hiring new materials science and engineering professionals. Table 3 shows Mechanical Engineering (second) and Metallurgy (third) as resource pools for materials science and engineering new hires.

The knowledge and skills most desired in new employees by industry centered on scientific knowledge areas in Materials Failure and Processing. Table 4 shows the five (5) knowledge areas most demanded in new hires from industry participants in the study.

This information strongly correlates with the core curriculum proposed by MSEN for its B.S. degree designed around strong courses in science and provides interest areas for specialty focus for students as they pursue and develop their degree program.

Responses for projected job openings show a strong and steady demand for new graduates, and provide a more positive picture of job openings than the national averages reported by BLS estimates. The entire survey is available in Appendix B.

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B. **Student Demand** — Provide short- and long-term evidence of demand for the program.

According to Texas Higher Education Coordinating Board (THECB), there will be an average of 6.9% increase in enrollment of all Texas public universities from 2015 to 2020\(^1\). The Dwight Look College of Engineering at Texas A&M is in the process of expanding the engineering programs so that the enrollment will grow to 25,000 by 2025. The Look College currently admits all freshmen into the general engineering program. The students declare their major at the end of the first year. Based on the recent student survey of more than 1,000 undergraduate students on campus, among sophomores and potential freshmen, there will be significant number of students interested in materials science and engineering with existing recruitment efforts. The Texas A&M University Student Survey is attached as Appendix C.

**PEER Institution Comparisons**

The Dwight Look College of Engineering is one of the largest engineering schools in the country, ranking third in undergraduate enrollment and ninth in graduate enrollment by the American Society for Engineering Education (ASEE). Our college consistently ranks among the nation's top public undergraduate and graduate engineering programs, according to *U.S. News & World Report*.

Table 5 presents historic enrollment from 2010-2014 for B.S. materials science and engineering programs in the 2015 U.S. World News and Report’s "Top Ten Engineering Schools"\(^2\). Most institutions comparable to Texas A&M University have sizeable undergraduate programs in materials science and engineering. More importantly, the major public universities such as Georgia Tech, University of Illinois in Urbana-Champaign, University of Michigan, and UC-Berkeley have experienced significant growth in their engineering enrollment in the last 5 years. Building on the success of our graduate program, establishing an undergraduate program at this time is the next logical step in establishing a strong materials science and engineering department at Texas A&M.

<table>
<thead>
<tr>
<th>University</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts Institute of Technology</td>
<td>134</td>
<td>145</td>
<td>136</td>
<td>126</td>
<td>113</td>
</tr>
<tr>
<td>Stanford University</td>
<td>40</td>
<td>42</td>
<td>28</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>University of California—Berkeley</td>
<td>85</td>
<td>82</td>
<td>77</td>
<td>99</td>
<td>103</td>
</tr>
<tr>
<td>California Institute of Technology</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>University of Illinois—Urbana-Champaign</td>
<td>309</td>
<td>379</td>
<td>385</td>
<td>410</td>
<td>409</td>
</tr>
<tr>
<td>Carnegie Mellon University</td>
<td>112</td>
<td>116</td>
<td>120</td>
<td>128</td>
<td>134</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>124</td>
<td>153</td>
<td>260</td>
<td>259</td>
<td>321</td>
</tr>
<tr>
<td>University of Michigan—Ann Arbor</td>
<td>122</td>
<td>119</td>
<td>137</td>
<td>147</td>
<td>161</td>
</tr>
<tr>
<td>Cornell</td>
<td>85</td>
<td>94</td>
<td>79</td>
<td>71</td>
<td>69</td>
</tr>
<tr>
<td>Purdue</td>
<td>140</td>
<td>115</td>
<td>128</td>
<td>137</td>
<td>153</td>
</tr>
</tbody>
</table>

* No freshman class  
** Data Unavailable  
Source: ASEE Engineering Data Management System, 2015

According to the American Society for Engineering Education (ASEE), Figure 6 reports 1,440 Bachelor’s degrees awarded in 2013-2014 in materials science and engineering, ranking this degree discipline 12\(^{th}\) among the 23 engineering disciplines tracked\(^3\). Of the 23 engineering disciplines tracked by ASEE, Look College awards degrees in 15 of the disciplines. Proposed B.S. programs in Materials Science and
Engineering; Environmental Engineering; Multidisciplinary Technology and Interdisciplinary Studies will increase our engineering discipline numbers to 19.

![Diagram showing B.S. degrees awarded by discipline for 2014, ASEE](image)

**Figure 6.** Bachelor’s Degrees Awarded by Discipline 2014, ASEE


Nationally, degrees awarded have showed incremental increases with steady positive production of graduates at all levels (B.S., M.S., and Ph.D.). According to ASEE, bachelor’s degrees grew by six percent (6%) during the past year in all engineering areas continuing a decade-long increase.

Most engineering disciplines saw gains between three percent (3%) and six percent (6%) during the past year. Materials Science and Engineering saw an overall increase in B.S. degrees awarded of twenty-five percent (25%) between 2010 and 2014 as shown in Figure 7. At the masters level, degrees awarded increased by almost fifty percent (50%), while doctorates experienced approximately a twenty-three percent (23%) increase in the number of Ph.D.s awarded between 2010 and 2014. This consistent growth in materials science and engineering programs provides more evidence for the need to establish a B.S. program at Texas A&M University.
The Texas A&M University Student Survey

The MSEN Department initiated a survey of undergraduate students enrolled in a series of selected lower level science and engineering classes to gauge interest in a B.S. degree in materials science and engineering. The courses surveyed were Physics 208 and 218, Chemistry 101, 103, and 107, MEEN 222, 360, and 475, and ENGR 111 and 112. Approximately 1,000 students responded to the survey (see Appendix C for the Texas A&M University Student Survey).

Almost twenty-nine percent (29%) of the student reported they would have considered a major in MSEN as one of their top 3 or first choice as a major. Over sixty percent (60%) of the students surveyed would have explored or considered a major in materials science and engineering. Fifty percent (50%) of the students surveyed reported they were interested in materials science and engineering and almost twenty percent (20%) reported being very interested. The majority of students surveyed were in their sophomore or junior year while just over thirty percent (33.7%) were seniors or had completed more than 90 credit hours.

This interest from current students is moderated by the fact that they are not currently exposed to materials science as undergraduates in their entry level engineering courses. Once the B.S. degree is approved, MSEN would participate in undergraduate recruitment activities during the freshman year and provide materials science and engineering educational units for the general level engineering courses.
Supply of Graduates in Texas

There are currently three institutions of higher education in Texas awarding Bachelors of Science in materials science and engineering. Table 6 shows the degrees awarded by year and level for materials science and engineering programs in the state of Texas. Combined, these degree-granting institutions are producing about 30 B.S. degrees each year:

- University of North Texas
- University of Texas—El Paso (Metallurgy)
- Rice University

Table 6. B.S., M.S., Ph.D. Degrees Awarded in Materials Science and Engineering in Texas, 2010-2014

<table>
<thead>
<tr>
<th>University</th>
<th>Program Name</th>
<th>Degree</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice University **</td>
<td>Materials Science</td>
<td>B.S.</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.S.</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Texas A&amp;M University</td>
<td>Materials Science and Engineering</td>
<td>M.S.</td>
<td>4</td>
<td>4</td>
<td>9</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>5</td>
<td>9</td>
<td>24</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Texas State University</td>
<td>Materials Science, Engineering,</td>
<td>M.S.</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Commercialization</td>
<td>Ph.D.</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>*</td>
</tr>
<tr>
<td>University of Houston</td>
<td>Materials Science and Engineering</td>
<td>M.S.</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>0</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>University of North Texas</td>
<td>Materials Science and Engineering</td>
<td>B.S.</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.S.</td>
<td>4</td>
<td>7</td>
<td>8</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>University of Texas at Arlington</td>
<td>Materials Science and Engineering</td>
<td>M.S.</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>University of Texas at Austin</td>
<td>Materials Science and Engineering</td>
<td>M.S.</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>University of Texas at Dallas</td>
<td>Materials Science and Engineering</td>
<td>M.S.</td>
<td>3</td>
<td>9</td>
<td>12</td>
<td>10</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>0</td>
<td>*</td>
</tr>
<tr>
<td>University of Texas at El Paso</td>
<td>Metallurgical and Materials</td>
<td>B.S.</td>
<td>19</td>
<td>8</td>
<td>25</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M.S.</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ph.D.</td>
<td>4</td>
<td>2</td>
<td>11</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>University of Texas at San Antonio</td>
<td>Materials Science and Engineering</td>
<td>M.S.</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

1 Degrees Awarded from the Interdisciplinary Program in College of Engineering at TAMU
* Data unavailable
** Data Source: National Center for Educational Statistics, 2012-13
Primary Source: ASEE Engineering Data Management System, 2015

More strikingly, the State of Texas significantly lags behind in producing adequate numbers of B.S. graduates in materials science and engineering compared to other large economy states. As mentioned above, Texas only has three (3) undergraduate programs while California has seven (7) undergraduate programs in materials science and engineering, Ohio has six (6), and Pennsylvania has six (6) programs. The enrollment and the numbers of B.S. graduates from those programs have increased 5% annually over the last five years while the existing number of graduates from Texas remained nearly constant over that

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same period (24 degrees in 2010, 18 in 2011, 36 in 2012, 22 in 2013, and 33 in 2014, see Table 6). Therefore, there is a need for an undergraduate program in a flagship Texas school to produce enough B.S. graduates to serve the Texas economy and satisfy demand.

Below, Figure 8 shows the trends in B.S. degrees awarded in other large states such as California, Illinois, Ohio, and Pennsylvania.

Figure 8. Historic B.S. Degrees Awarded in Materials Science and Engineering by Selected State, 2010-2014

Source: ASEE Engineering Data Management System, 2014
C. **Enrollment Projections** – Use this table to show the estimated cumulative headcount and full-time student equivalent (FTSE) enrollment for the first five years of the program. *(Include majors only and consider attrition and graduation.)*

The Dwight Look College of Engineering currently admits freshmen into the general engineering program whereby most students follow a common first-year engineering curriculum. The same first-year curriculum will be required for the B.S. MSEN degree program. Students interested in the proposed B.S. MSEN degree program will apply using the same entry-to-a-major process for all existing engineering majors. Because the large majority of engineering majors are full-time students, it is assumed that most B.S. MSEN majors will be full-time students.

It is expected that the proposed B.S. materials science and engineering program will initially be limited to a small number of students (50 new sophomore students in the first year). The first-year engineering unified curriculum required by the Look College provides a one-year lead-time to recruit and populate appropriate second-year and third-year courses as enrollment progresses. Initial enrollments will come primarily from the current residential headcount as students migrate in from other majors or from the Freshmen Engineering program or transfer from Look College community college programs throughout the state. We expect the process of establishing a full program with complete course offerings would occur over a five-year period. A comprehensive recruitment program in years 1 and 2 will focus on attracting domestic students from Texas, and in particular, among the underrepresented student groups and first-generation college students. As it matures, the MSEN undergraduate program would like to accept 100 undergraduate students per year. Table 7 illustrates a projected number of 300 undergraduate students with an eighty-five percent (85%) retention rate and an average graduation time of less than 4.5 years.

### Table 7. Enrollment Projections for the Proposed Bachelor of Science Degree Program at Texas A&M University

<table>
<thead>
<tr>
<th>Year</th>
<th>Change of Major/Transfers</th>
<th>New Students</th>
<th>Attrition</th>
<th>Graduation</th>
<th>Cumulative Headcount</th>
<th>Cumulative FTES (<em>new only</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>60</td>
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<td>80</td>
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<td>80</td>
<td>13</td>
<td>64</td>
<td>285</td>
<td>231</td>
</tr>
</tbody>
</table>
II. Quality

A. **Degree Requirements** – Use this table to show the degree requirements of the program. (Modify the table as needed; if necessary, replicate the table for more than one option.)

Table 8 is a summary of the proposed degree requirements for the B.S. MSEN program. These requirements are subdivided into major categories. A justification for exceeding the 120-hour SCH limit is provided. The general body of knowledge includes the first year mathematics/science/engineering sequence common to all engineering undergraduates (27 SCH). Required MSEN Core Courses consist of 59 SCH of additional courses necessary to fulfill the University Core Curriculum (UCC) 24 SCH. Nine hours of directed MSEN technical electives and additional nine hours of specialty technical area electives are included in the B.S. MSEN program. The specialty technical electives will include courses relevant to materials science and engineering. Given our constituent interdisciplinary culture, some courses will be taught from other departments such as biomaterials courses from the biomedical engineering department, energy related materials courses from the chemical engineering and chemistry departments, electronic materials courses from the electrical engineering and physics departments, etc. Because of the very interdisciplinary nature of materials science and engineering, these specialty technical electives will provide flexibility for interested students to get a well-rounded education in an interdisciplinary environment.

**Table 8. Proposed Degree Requirements for a Bachelor of Science in Materials Science and Engineering at Texas A&M University**

<table>
<thead>
<tr>
<th>Category</th>
<th>Semester Credit Hours</th>
<th>Clock Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education Core Curriculum <em>(bachelor's degree only)</em></td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>MSEN Core Courses</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>MSEN Technical Electives</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Specialty Technical Electives</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Other <em>(Specify, e.g., internships, clinical work)</em></td>
<td>(if not included above)</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>128</td>
<td></td>
</tr>
</tbody>
</table>

Note: A Bachelor degree should not exceed 120 Semester Credit Hours (SCH) per Board rule 5.44 (a) (3). Those that exceed 120 SCH must provide detailed documentation describing the compelling academic reason for the number of required hours, such as programmatic accreditation requirements, statutory requirements, or licensure/certification requirements that cannot be met without exceeding the 120-hour limit.

We request a waiver to exceed the required 120 SCH maximum for a Bachelor’s program so that this program is on par with existing engineering programs in the Dwight Look College of Engineering. The 128 SCH requirement for our existing engineering programs will satisfy ABET requirements for depth and breadth in the engineering discipline, math and science, and satisfy the core curriculum requirements. The 128 SCH requirement has helped position seven current B.S. degree programs offered by the Dwight Look College of Engineering to be ranked among the top 10 programs offered by public institutions in the nation. The proposed B.S. in MSEN will require similar depth and breadth to satisfy ABET accreditation and core curriculum requirements.

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Highlights
Proposed Bachelor of Science in Materials Science and Engineering

- **Flexibility** to engage in one or more of several defined emphasis areas, or with guidance of a faculty mentor, create a custom emphasis degree plan.
- **Opportunities** to participate in internships with industry partners, and research in academic and government laboratories.
- **Integration** of laboratory experience with computational materials science simulation.
- **Preparation** for employment as a professional engineer across a range of industries, including energy, biomedical, semiconductor, and defense.

Educational Objectives

MSEN graduates will be prepared to pursue careers as materials scientists and engineers, pursue advanced graduate study, or to apply their knowledge in other fields such as law, medicine or business. Graduates from our department will have the following skills:

- Apply fundamental materials processing, structure, properties, and performance relationships to identify and solve materials-related challenges.
- Master a broad suite of synthesis, characterization, and simulation techniques.
- Thrive in multidisciplinary engineering environments.
- Bridge the gap between fundamental research (science) and technology (engineering).
- Communicate effectively, both orally and in writing.
- Advance as future leaders in specific materials emphasis areas.
- Demonstrate an increased level of leadership and responsibility.
- Exhibit a commitment to professional ethics in their professional career.

Student Outcomes:

- An appropriate mastery of the knowledge, techniques, skills and modern tools of complex systems that span multiple engineering technology disciplines.
- An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology.
- An ability to conduct standard tests and measurements; to conduct, analyze and interpret experiments, and to apply experimental results to improve processes.
- An ability to apply creativity in the design of complex systems that span multiple engineering technology disciplines.
- An ability to function effectively on teams.
- An ability to identify, analyze and solve technical problems.
- An ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.
- An understanding of the need for and an ability to engage in self-directed continuing professional development.
- An ability to understand professional, ethical and social responsibilities.
- A respect for diversity and knowledge of contemporary professional, societal and global issues.
- A commitment to quality, timeliness, and continuous improvement.
B. Curriculum – Use these tables to identify the required courses and prescribed electives of the program. Note with an asterisk (*) courses that would be added if the program is approved. (Add and delete rows as needed. If applicable, replicate the tables for different tracks/options.).

The curriculum meets requirements specified by all stakeholders for our MSEN program. First, the curriculum satisfies the University’s Core Curriculum (UCC), shown in Table 9. Students in the major will complete all the courses needed to become well-rounded persons with knowledge of local, national, and global issues related to their major and society-at-large.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>SCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>Life and Physical Science</td>
<td>6</td>
</tr>
<tr>
<td>Language, Philosophy and Culture</td>
<td>3</td>
</tr>
<tr>
<td>Creative Arts</td>
<td>3</td>
</tr>
<tr>
<td>American History</td>
<td>6</td>
</tr>
<tr>
<td>Government/Political Science</td>
<td>6</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>3</td>
</tr>
</tbody>
</table>

The MSEN curriculum follows the common body of knowledge in mathematics/science/engineering sequence defined for all undergraduate engineering students. Table 10 lists the courses that students cover during the first year in mathematics/science/engineering. In addition to the required general body of knowledge for engineering, the college requires two UCC electives in the first year. The general body of knowledge courses teach students about fundamentals common to all engineering majors while they learn about each major in the college. Between the freshman and sophomore years, students apply for entry to a major.

Finally, students admitted to the Department of Materials Science and Engineering will follow the course sequence shown in Table 11.

<table>
<thead>
<tr>
<th>Fall</th>
<th>SCH</th>
<th>Pre/Co-reqs</th>
<th>Spring</th>
<th>SCH</th>
<th>Pre/Co-reqs</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 151 - Eng. Math I</td>
<td>4</td>
<td>MATH 150</td>
<td>MATH 152 - Eng. Math II</td>
<td>4</td>
<td>MATH 151</td>
</tr>
<tr>
<td>ENGR 111 - Found. of Eng.</td>
<td>2</td>
<td>PHYS 218 - Mechanics</td>
<td>4</td>
<td>MATH 151</td>
<td></td>
</tr>
<tr>
<td>ENGL 104 - Comp &amp; Rhetoric</td>
<td>3</td>
<td>ENGR 112 - Found. of Eng.</td>
<td>2</td>
<td>ENGR 111</td>
<td></td>
</tr>
</tbody>
</table>

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Table 11. Bachelor of Science Degree Program in Materials Science and Engineering by Semester

<table>
<thead>
<tr>
<th>Degree Plan in Materials Science and Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRESHMAN YEAR (Common Engineering First Year)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall</th>
<th>Pre/Co-reqs</th>
<th>Spring</th>
<th>Pre/Co-reqs</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 151* - Eng. Math I</td>
<td>4</td>
<td>MATH 152* - Eng. Math II</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 101/111* - Fund. Chem I</td>
<td>4</td>
<td>CHEM 102/112* - Fund. Chem II</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 111* - Found. of Eng.</td>
<td>2</td>
<td>PHYS 218* - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>ENGL 104 - Comp &amp; Rhetoric</td>
<td>3</td>
<td>ENGR 112* - Found. of Eng.</td>
<td>2</td>
</tr>
<tr>
<td>UCC Elective</td>
<td>3</td>
<td>UCC Elective</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

| SOPHOMORE YEAR |

<table>
<thead>
<tr>
<th>Fall</th>
<th>Pre/Co-reqs</th>
<th>Spring</th>
<th>Pre/Co-reqs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 208* - Elect. and Optics</td>
<td>4</td>
<td>MATH 307* - Analytical Mthds for Materials Sci Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MATH 251* - Eng Math III</td>
<td>3</td>
<td>MSEN 240* - Kinetics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 201* - Fundamentals of Materials</td>
<td>3</td>
<td>MSEN 250* - Soft Matter</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 210* - Thermodynamics of Materials</td>
<td>3</td>
<td>MSEN 310* - Structure of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 220* - Chemistry &amp; Physics of Inorganic Materials (in future CHEM/MSEN)</td>
<td>3</td>
<td>MSEN 301* - Unified Materials Lab 1 w</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MSEN 281* - Materials Seminar</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

| JUNIOR YEAR |

<table>
<thead>
<tr>
<th>Fall</th>
<th>Pre/Co-reqs</th>
<th>Spring</th>
<th>Pre/Co-reqs</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSEN 460* - Functional Materials Prop</td>
<td>3</td>
<td>MSEN 220, MSEN 310</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 302* - Unified Materials Lab 2 w</td>
<td>3</td>
<td>UCC Elective</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 330* - Num Mthds for Mat Sci Eng</td>
<td>3</td>
<td>MSEN 400* - Design Analysis Mat Exp</td>
<td>3</td>
</tr>
<tr>
<td>MSEN Tech Elective 1*</td>
<td>3</td>
<td>UCC Comm. Elective (COMM 205 or ENGL 210)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Specialty Elective 1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

| SENIOR YEAR |

<table>
<thead>
<tr>
<th>Fall</th>
<th>Pre/Co-reqs</th>
<th>Spring</th>
<th>Pre/Co-reqs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 482 - Ethic. &amp; Eng. w</td>
<td>3</td>
<td>MSEN 402* - Materials Research Design II</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 401* - Materials Research Design I</td>
<td>3</td>
<td>MSEN Tech Elective 3*</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 480* - Communicating Mater. Sci Eng</td>
<td>3</td>
<td>Specialty Elective 3</td>
<td>3</td>
</tr>
<tr>
<td>MSEN Tech Elective 2*</td>
<td>3</td>
<td>UCC Elective</td>
<td>3</td>
</tr>
<tr>
<td>Specialty Elective 2</td>
<td>3</td>
<td>UCC Elective</td>
<td>3</td>
</tr>
<tr>
<td>UCC Elective</td>
<td>3</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>co-rec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or placement exam</td>
</tr>
<tr>
<td>w writing intensive class</td>
</tr>
<tr>
<td>c communications intensive class</td>
</tr>
<tr>
<td>* require a 'C' or better for progress towards MSEN</td>
</tr>
<tr>
<td>TBD - To be developed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Engineering First Year</th>
<th>27 SCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCC Electives</td>
<td>24 SCH</td>
</tr>
<tr>
<td>MSEN Core</td>
<td>59 SCH</td>
</tr>
<tr>
<td>MSEN Technical Electives</td>
<td>9 SCH</td>
</tr>
<tr>
<td>Specialty Technical Electives</td>
<td>9 SCH</td>
</tr>
<tr>
<td>TOTAL</td>
<td>128 SCH</td>
</tr>
</tbody>
</table>

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Core MSEN Courses

The materials science and engineering core courses build on a strong foundation of chemistry, physics, and mathematics, required to explore the fundamental concepts and techniques that are critical to materials science and engineering. The core sequence has these strengths:

- The unified materials laboratories offer practical experiential learning combined with theory application in materials processing, characterization, and simulation that runs from sophomore year through the capstone senior design sequence.
- The course sequence emphasizes written and oral communication skills essential for practicing scientists and engineers.
- Quantitative and predictive computational materials science method courses introduce methods that are rapidly invigorating the field.
- The senior capstone design courses offer flexibility: students may apply the scientific research process, or contribute to a team-based materials design challenge working on a real world problem sponsored by industrial partners.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Status:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSEN 201</td>
<td>Fundamentals of Materials Science and Engineering. Credit 3. (3-0)</td>
<td>existing</td>
</tr>
<tr>
<td>MSEN 210</td>
<td>Thermodynamics of Materials. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 220</td>
<td>Chemistry and Physics of Inorganic Materials. Credit 3. (3-0) (To be cross listed as CHEM/MSEN 220 in the future)</td>
<td>new</td>
</tr>
<tr>
<td>MATH 307</td>
<td>Analytical Methods for Materials Scientists and Engineers. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 240</td>
<td>Kinetics of Materials. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 250</td>
<td>Soft Matter. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 281</td>
<td>Materials Seminar. Credit 1. (1-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 301</td>
<td>Unified Materials Lab I. Credit 3. (2-3) Lab</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 302</td>
<td>Unified Materials Lab II. Credit 3. (2-3) Lab</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 310</td>
<td>Structure of Materials. Credit 3 (3-0)</td>
<td>existing</td>
</tr>
<tr>
<td>MSEN 320</td>
<td>Deformation and Failure Mechanisms in Engineering Materials. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 330</td>
<td>Numerical Methods for Materials Scientists and Engineers. Credit 3. (2-3)</td>
<td>Lab</td>
</tr>
<tr>
<td>MSEN 340</td>
<td>Case Studies in Materials. Credit 2. (2-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 370</td>
<td>Introduction to Computational Materials Science and Engineering. Credit 3. (2-3) Lab</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 400</td>
<td>Design and Analysis of Materials Experiments. Credit 3. (2-3) Lab</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 401</td>
<td>Materials Research and Design I. Credit 3. (2-3) Lab</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 402</td>
<td>Materials Research and Design II. Credit 3. (2-3) Lab</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 460</td>
<td>Properties of Functional Materials. Credit 3. (3-0) Lab</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 480</td>
<td>Communicating Materials Science and Engineering. Credit 1. (1-0) c</td>
<td>new</td>
</tr>
</tbody>
</table>
**Elective MSEN Courses**

Students have 18 SCH of elective courses – 9 SCH MSEN technical electives and 9 SCH specialty technical electives – to develop a flexible curriculum enhancing students’ experience enabling students to pursue interests complementary to their chosen major. Together with a Faculty Mentor/Advisor, students will create individualized degree plans that might center on (but are not limited to) one or more of the following emphasis areas:

- Polymers and Soft Materials
- Computational Materials Science
- Corrosion Engineering
- Materials Design, Processing and Characterization
- Structural Materials

Selecting an area of emphasis is not a requirement, but an option. Emphasis areas normally involve taking nine (9) technical elective hours. With nine (9) specialty elective hours, students may also choose to pursue a second specialization area. Alternatively, they may choose to use specialty elective hours to complement and strengthen their selected single emphasis area. For example, students specializing in corrosion engineering may take three (3) foundational corrosion courses, and any specialty technical electives in the areas related to corrosion, such as mechanics, fracture mechanics, fatigue, or coatings. Students specializing in polymers and soft materials may strengthen their specialization by adding courses in composites, or practical lab-based polymer courses. Students will also have the ability to increase the fundamentals of a broad materials science and engineering degree through using these specialty electives to strengthen their core knowledge in the basics of ceramics, polymers, composites, or metals.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSEN 410</td>
<td>Materials Processing. Credit 3. (2-3)</td>
<td>Lab existing</td>
</tr>
<tr>
<td>MSEN 415</td>
<td>Defects in Solids. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 420</td>
<td>Polymer Science. Credit 3. (3-0)</td>
<td>existing</td>
</tr>
<tr>
<td>MSEN 426</td>
<td>Polymer Laboratories. Credit 3. (2-3)</td>
<td>Lab new</td>
</tr>
<tr>
<td>MSEN 430</td>
<td>Nanomaterials Science. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 440</td>
<td>Materials Electrochemistry and Corrosion. Credit 3. (3-0)</td>
<td>existing</td>
</tr>
<tr>
<td>MSEN 444</td>
<td>Corrosion and Electrochemistry Laboratory. Credit 3. (2-3)</td>
<td>Lab new</td>
</tr>
<tr>
<td>MSEN 446</td>
<td>Corrosion Prevention and Control Methods. Credit 3. (3-0)</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 458</td>
<td>Fundamentals of Ceramics. Credit 3. (3-0)</td>
<td>stack (w/ existing)</td>
</tr>
<tr>
<td>MSEN 462</td>
<td>Advanced Materials Characterization. Credit 3. (2-3)</td>
<td>Lab new</td>
</tr>
<tr>
<td>MSEN 472</td>
<td>Atomistic Simulation of Materials. Credit 3. (3-0)</td>
<td>stack (w/ existing)</td>
</tr>
<tr>
<td>MSEN 474</td>
<td>Materials Modeling of Phase Transformation and Microstructural Evolution. Credit 3. (2-3)</td>
<td>Lab stack (w/ existing)</td>
</tr>
<tr>
<td>MSEN 476</td>
<td>Multi-scale Computations Materials Science. Credit 3. (2-3)</td>
<td>Lab new</td>
</tr>
<tr>
<td>MSEN 484</td>
<td>Internship. Credit 0-4.</td>
<td>new</td>
</tr>
<tr>
<td>MSEN 485</td>
<td>Directed Studies. Credit 0-4.</td>
<td>existing</td>
</tr>
<tr>
<td>MSEN 491</td>
<td>Research. Credit 0-4.</td>
<td>existing</td>
</tr>
<tr>
<td>MEEN 455</td>
<td>Engineering with Plastics. Credit 3. (3-0)</td>
<td>existing: MEEN</td>
</tr>
<tr>
<td>MEEN 458</td>
<td>Processing and Characterization of Polymers. Credit 3 (3-0)</td>
<td>existing: MEEN</td>
</tr>
<tr>
<td>MEEN 471</td>
<td>Elements of Composite Materials. Credit 3 (3-0)</td>
<td>existing: MEEN</td>
</tr>
</tbody>
</table>

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C. **Faculty** – Use these tables to provide information about Core and Support faculty. Add an asterisk (*) before the name of the individual who will have direct administrative responsibilities for the program.

**Program Faculty**
The Bachelor of Science faculty in MSEN are the faculty with more than 0% full-time equivalent (FTE) appointment in the Department of Materials Science and Engineering. The names and information of the program faculty members, address the ABET Faculty Criterion.

**Table 14. Core Faculty in Materials Science and Engineering at Texas A&M University**

<table>
<thead>
<tr>
<th>Name of Core Faculty and Faculty Rank</th>
<th>Highest Degree and Awarding Institution</th>
<th>Courses Assigned in Program</th>
<th>% Time Assigned To Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arroyave, Raymundo</td>
<td>Ph.D. Materials Science; Massachusetts Institute of Technology; Cambridge, MA**</td>
<td>MSEN 210; MSEN 240.</td>
<td>50%</td>
</tr>
<tr>
<td>Benzerga, Amine</td>
<td>Ph.D., Material Science &amp; Engineering, Ecole des Mines de Paris, France**</td>
<td>MSEN 474.</td>
<td>15%</td>
</tr>
<tr>
<td>Cagin, Tahir</td>
<td>Ph.D. Physics, Clemson University, Greenville, SC**</td>
<td>MSEN 220.</td>
<td>50%</td>
</tr>
<tr>
<td>Castaneda-Lopez, Homero</td>
<td>Ph.D. Materials Science and Eng., Penn State University, University Park, PA**</td>
<td>MSEN 444; MSEN 446.</td>
<td>50%</td>
</tr>
<tr>
<td>Creasy, Terry</td>
<td>Ph.D. Mechanical Engineering, University of Delaware **</td>
<td>MSEN 301; MSEN 302; MSEN 458; MSEN 471.</td>
<td>50%</td>
</tr>
<tr>
<td>Demkowicz, Michael</td>
<td>Ph.D. Mechanical Engineering, Massachusetts Institute of Technology**</td>
<td>MSEN 415; MSEN 484.</td>
<td>50%</td>
</tr>
<tr>
<td>Hartwig, K. Ted</td>
<td>Ph.D. Metallurgical Engineering University of Wisconsin, Madison** PE (Texas)</td>
<td>MSEN 340; MSEN 400; MSEN 480.</td>
<td>35%</td>
</tr>
<tr>
<td>*Karaman, Ibrahim</td>
<td>Ph.D. Mechanical Engineering, University of Illinois, Urbana-Champaign, Illinois**</td>
<td>MSEN 201; MSEN 430.</td>
<td>50%</td>
</tr>
<tr>
<td>Lin, Pao-Tai</td>
<td>Ph.D., Materials Science and Engineering, Northwestern University**</td>
<td>MSEN 460.</td>
<td>15%</td>
</tr>
<tr>
<td>Needleman, Alan</td>
<td>Ph.D., Harvard University**</td>
<td>MSEN 320.</td>
<td>35%</td>
</tr>
</tbody>
</table>

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Page 27
Table 14. Continued. Core Faculty in Materials Science and Engineering at Texas A&M University

<table>
<thead>
<tr>
<th>Name of Core Faculty and Faculty Rank</th>
<th>Highest Degree and Awarding Institution</th>
<th>Courses Assigned in Program</th>
<th>% Time Assigned To Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qian, Xiaofeng Assistant Professor</td>
<td>Ph.D. Nuclear Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA**</td>
<td>MSEN 330; MSEN 472.</td>
<td>50%</td>
</tr>
<tr>
<td>*Radovic, Miladin Associate Professor and Associate Department Head</td>
<td>Ph.D., Materials Science and Engineering, Drexel University, Philadelphia, PA**</td>
<td>MSEN 410; MSEN 458.</td>
<td>50%</td>
</tr>
<tr>
<td>Shamberger, Patrick Assistant Professor</td>
<td>Ph.D. Materials Science and Engineering, University of Washington; Seattle, WA**</td>
<td>MSEN 310; MSEN 462.</td>
<td>50%</td>
</tr>
<tr>
<td>Srivastava, Ankit Assistant Professor</td>
<td>Ph.D. Materials Science and Engineering, University of North Texas, Denton, TX**</td>
<td>MSEN 230; MSEN 370.</td>
<td>50%</td>
</tr>
<tr>
<td>Sue, Hung-Jue TEES Professor</td>
<td>Ph. D. Macromolecular Science and Engineering Program, The University of Michigan, Ann Arbor, MI**</td>
<td>MSEN 426; MSEN 455.</td>
<td>50%</td>
</tr>
<tr>
<td>Sukhishvili, Svetlana Professor</td>
<td>Ph.D. Polymer Chemistry, Moscow State University, Russia**</td>
<td>MSEN 250; MSEN 420.</td>
<td>50%</td>
</tr>
<tr>
<td>Talreja, Ramesh Professor</td>
<td>PhD and Doctor of Technical Sciences degree, Technical University of Denmark**</td>
<td>MSEN 401; MSEN 402.</td>
<td>15%</td>
</tr>
</tbody>
</table>

**Faculty have been certified following the Texas A&M University Faculty Credentials Guidelines, the Southern Association of College and Schools Commission on Colleges (SACSCOC), and all ABET guidelines.

Table 15. Support Faculty in Materials Science and Engineering at Texas A&M University

<table>
<thead>
<tr>
<th>Name of Core Faculty and Faculty Rank</th>
<th>Highest Degree and Awarding Institution</th>
<th>Courses Assigned in Program</th>
<th>% Time Assigned To Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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D. **Students** – Describe general recruitment efforts and admission requirements. In accordance with the institution's Uniform Recruitment and Retention Strategy, describe plans to recruit, retain, and graduate students from underrepresented groups for the program.

The Look College admits all entering freshmen into a general engineering pool for which most students follow a common freshman year. Students may apply to the Bachelor of Science in Materials Science and Engineering degree program through the College entry-to-a-major (ETAM) process, as early as their second semester of study. Materials Science and Engineering Students will be admitted according to the Look College guidelines and in addition, the MSEN department will employ the following strategies:

a) Details for applying to the B.S. MSEN degree program will be made known to students consistent with the process for informing all Engineering students about the ETAM process.

b) Interested engineering students are required to meet with the Director of Undergraduate Degree Programs and the undergraduate program coordinator to discuss the program’s purpose and identify the student’s interests in the MSEN degree program.

c) Students then submit a tentative degree plan to the Director of Undergraduate Degree Programs and MSEN Admission Committee for review.

d) Steps (b) and (c) above must be completed before students apply to the B.S. MSEN degree program. The Director of Undergraduate Degree Programs will oversee the review process for the ETAM MSEN applications. Admission into the B.S. MSEN degree program will be based on a comprehensive review of the ETAM application by the MSEN Admission Committee.

e) To be eligible for the program, students must have completed an engineering course (e.g., ENGR 111), a science course, and a mathematics course in an existing engineering curriculum at Texas A&M University. In addition, students must have a minimum overall Texas A&M University grade point average (GPA) of 2.0 at the time of entry.

Students applying to the Bachelor of Science in Materials Science and Engineering degree from other Look College Departments and College of Science through a change of curriculum request will be considered if the following two conditions are satisfied: (1) the student has completed less than 70% of the curriculum in an engineering degree program (including freshman engineering courses and core curriculum courses), and (2) the student has an overall Texas A&M University GPA no less than 3.25. Transfer students will not be given credit toward the degree program for courses in which a grade less than C was received. The Director of Undergraduate Degree Programs will oversee the change of curriculum process.

MSEN will leverage the efforts of existing Look College programs to recruit, retain, and graduate students, including those from underrepresented groups (women, African American, Hispanic/ Latino, Native American) for the B.S. program. For example, one effort will utilize the Engineering Academies program, which is a partnership with two-year institutions around the state of Texas. This program offers students simultaneous co-enrollment in the TAMU Look College and a partner two-year institution. Several of the partner institutions are Hispanic serving and minority serving institutions and therefore represent the growing underrepresented minority population in the state of Texas and the country. Another program is the ENGAGE (Engineering Aggies Gaining Experience) program. This program seeks to increase the number of underrepresented minority students and women in the Look College through established partnerships with 37 Texas high schools. Some of the widespread activities within this program include invitational events for 10th to 12th grade students, the Aggieland Saturday Open House, High School Counselor Retreats, Summer Engineering Camps, and Peer Mentor opportunities. A third program is the Women in Engineering (WE) Program. This program offers outreach, recruitment and retention to female students entering engineering degree programs. It helps increase the percentage of women in engineering through WE IDEAS summer camps and “choosing a major” events. Finally, to help increase student retention, students in the B.S. MSEN program will be encouraged to participate in the Engineering Living Learning Community Program. This program houses approximately 650 engineering students and creates
a community of scholars. The community helps the overall transition to college through small focus-group interactions, second year peer mentors that also reside in the dorms, and by emphasizing a commitment to academic excellence.

In summary, Look College recruitment and enrichment programs and retention activities include:

<table>
<thead>
<tr>
<th>Recruitment</th>
<th>Retention Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Aggieland Saturday</td>
<td>• Academic Support Services</td>
</tr>
<tr>
<td>• Student Ambassadors</td>
<td>• ENGR 111 and 112 Help Sessions</td>
</tr>
<tr>
<td>• National Scholars</td>
<td>• Engineering Living Learning Community</td>
</tr>
<tr>
<td>• Military Veterans (AggiE-Vets)</td>
<td>• Military Veterans (AggiE-Vets)</td>
</tr>
<tr>
<td>• Graduate Students</td>
<td>• Scholarships</td>
</tr>
<tr>
<td>• Transferring into Engineering</td>
<td>• Success Program</td>
</tr>
<tr>
<td>• Engineering Living Learning Community</td>
<td>• Y2 RISE (Resources for second-year students)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enrichment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Study Abroad</td>
<td>• Supplemental Instruction (Department of Mathematics Programs)</td>
</tr>
<tr>
<td>• Engineering Organizations</td>
<td>• Academic Support Services (Peer Tutoring, Office Hours, Success Program (Resources for first generation and economically disadvantaged students))</td>
</tr>
<tr>
<td>• Certificate Programs</td>
<td></td>
</tr>
<tr>
<td>• Undergraduate Research</td>
<td></td>
</tr>
<tr>
<td>• Engineering Honors</td>
<td></td>
</tr>
<tr>
<td>• Design Competitions</td>
<td></td>
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<tr>
<td>• FE Exam</td>
<td></td>
</tr>
<tr>
<td>• Graduate Students</td>
<td></td>
</tr>
<tr>
<td>• Zachry Leadership Program</td>
<td></td>
</tr>
</tbody>
</table>

E. **Library** – Provide the library director’s assessment of library resources necessary for the program. Describe plans to build the library holdings to support the program.

Existing Library Resources are sufficient and will be used to support ABET Facilities Criterion. The library services and the computing and information infrastructure at Texas A&M is adequate to support the scholarly and professional activities of the MSEN students and faculty.

Characteristics of the Texas A&M University Libraries:

- 5.4 million volumes including 1.5 million eBooks
- $47 million in total library expenditures
- $27 million in total library materials expenditures (57% of total library expenditures devoted to library materials)
- $20 million in eResource expenditures (74% of total library materials expenditures devoted to information resources available 24/7)
- 135K Serials, 93% of which are available in eFormat and thus available 24/7
- 2,281 Databases available
- Ranks 1st in nation for serials expenditures among ARL US Public Universities
- Ranks 1st in nation for total library expenditures among ARL US Public Universities

For FY2013/2014 ranks 18th among all ARL Public Universities meeting the University’s Vision 2020 Imperative 7 Goal

* According to Association of Research Libraries (ARL) statistics
F. **Facilities and Equipment** – Describe the availability and adequacy of facilities and equipment to support the program. Describe plans for facility and equipment improvements/additions.

The Look College is presently building a transformative education space: the Zachry Engineering Education Center. This 550,000 square feet building will provide state-of-the-art space and equipment for transformative learning and discovery. The center is scheduled to be completed by Fall 2017.

The Materials Science and Engineering department is leading the Materials Laboratory design effort to assure that undergraduates in MSEN and other majors will have advanced materials processing, testing, and design space. The Materials Laboratory, 3800 square feet, will house equipment for all aspects of materials education from invention to inspection. The equipment plan includes thermo-physical evaluation, scanning electron microscopy, and small scale manufacturing stations to address student needs for the next ten (10) years of technology advancement. The EEC has eight (8) additional laboratories that students can access for cross-disciplinary education. In addition, the building will have open collaboration spaces where students can assemble in teams to conduct materials design projects. To complete the EEC, the department will support the capstone design sequence with a collaboration workroom and an instrumentation space for seniors in the major to work on major design projects. Finally, faculty within the department have research laboratories with novel, and advanced devices at the forefront of engineering research and education. Undergraduate students in honors and research courses can access these facilities to enhance their education as they contribute to advancing the body of knowledge in advanced materials science and engineering.

Furthermore, the newly established 16,000 sq. ft. Engineering Innovation Center (EIC) in the College is well equipped to support interdisciplinary interactions among undergraduate students at various stages of the program. EIC resources include more than 7,000 sq. ft. of multiuser collaboration spaces available to students for extended hours including weekends; it includes a 5,600 sq. ft. fabrication area with access to 3D printing, laser cutters, lathes and mills to support the development of multidisciplinary team project prototypes, and access to conference rooms for remote collaborations with industry. Furthermore, EIC offers student access to informal programs such as Aggies Invent and Pop-Up Classes that promote collaborations across majors, innovation, and entrepreneurship.

In addition, the MSEN department will house a 1,500 sq. ft. undergraduate lab space in the Reed McDonald Building for materials processing experiments that the aforementioned facilities will not have. This laboratory will be established and maintained using differential tuition funds.

Materials Science and Engineering faculty will chair the materials laboratory committee and use differential tuition funds to keep all the materials laboratories updated with equipment as the technology continues to advance. Research laboratories undergo continuous improvement to keep pace with state, national, and world needs. In addition, these facilities will be used in combination with the library, and computing and information infrastructure to support ABET Facilities Criterion.

G. **Accreditation** – If the discipline has a national accrediting body, describe plans to obtain accreditation or provide a rationale for not pursuing accreditation.

ABET, incorporated as the Accreditation Board for Engineering and Technology, Inc., is a non-governmental organization that accredits post-secondary education programs in "applied science, computing, engineering, and engineering technology". The MSEN program curriculum is designed to meet the General Criteria of the Engineering Accreditation Commission of ABET. The applicable criteria for materials science and engineering are the program criteria for Materials, Metallurgical, Ceramics and similarly named engineering programs. The lead society from which program evaluators are appointed is

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The Minerals, Metals & Materials Society (TMS). ABET requires that an institution seeking accreditation for a new engineering degree program apply for an accreditation visit in the first fall after students have graduated from the new degree program. Further, an institution cannot seek accreditation until students have graduated from the new degree program. All other engineering programs in the Look College are accredited by the Engineering Accreditation Commission of ABET. The TAMU Look College is very familiar with expectations for accredited engineering programs. The College will use its experience with the accreditation process in seeking accreditation for the MSEN degree program at the appropriate time.

Current ABET curriculum requirements for Materials, Metallurgical, Ceramics and Similarly Named Engineering Programs follow:

“"The curriculum must prepare graduates to apply advanced science (such as chemistry, biology and physics), computational techniques and engineering principles to materials systems implied by the program modifier, e.g., ceramics, metals, polymers, biomaterials, composite materials; to integrate the understanding of the scientific and engineering principles underlying the four major elements of the field: structure, properties, processing, and performance related to material systems appropriate to the field; to apply and integrate knowledge from each of the above four elements of the field using experimental, computational and statistical methods to solve materials problems including selection and design consistent with the program educational objectives."" 16

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**Adding the Bachelor of Science in Materials Science and Engineering at Texas A&M is necessary in order to increase our competitiveness in the key metrics contributing to the vision and mission of our University.**

---

H. **Evaluation** – Describe the evaluation process that will be used to assess the quality and effectiveness of the new degree program.

The General Criteria of the Engineering Accreditation Commission of ABET include eight criteria: Students, Program Educational Objectives, Student Outcomes, Continuous Improvement, Curriculum, Faculty, Facilities, and Institutional Support. Within the Dwight Look College, institutional processes and resources that support applications for accreditation for existing engineering programs are available for the following criteria: Students, Facilities, and Institutional Support.

The criterion for **Faculty** 16 has been met by the outstanding engineering faculty across the Look College. MSEN will continue to recruit and hire faculty whose qualifications satisfy the criterion for Faculty. **Program Educational Objectives** 16 have been developed and are included in this application. They will be refined using continuous improvement methodology. We plan for regular review of the Program Educational Objectives by program stakeholders, including faculty, students and industry. In this way, the Program Educational Objectives criterion will be satisfied.

The **Student Outcomes** 16 criterion requires documented student outcomes that prepare graduates to attain the program educational objectives. These outcomes have been outlined and are included in this application. It is expected that this criterion will be satisfied upon additional documentation and review as the program matures. The requirements for the **Curriculum** 16 criterion were carefully considered in preparing the curriculum for the B.S. MSEN degree program. Utilizing the tools in a continuous improvement process, we plan for implementation of adjustments in the curriculum required. Therefore, it is expected that the Curriculum criterion will be satisfied.

---

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The final criterion is Continuous Improvement\(^{16}\), which requires that there is a process to evaluate achievement of student outcomes and a process to improve achievement of student outcomes. There are several approaches to satisfying the Continuous Improvement criterion using a number of feedback mechanisms. The first will be course evaluations conducted by MSEN faculty teaching MSEN courses on a semester basis that will determine if the specific course objectives that are mapped to program outcomes have been met for each course. These data will then feed into a Learning Outcomes assessment across the entire program. Once each year, the Industrial Advisory Board, will review the Senior Capstone projects that MSEN students are engaged in to evaluate how each student learning outcome is being achieved. These two processes will guide the activities undertaken by the MSEN program to improve the curriculum and learning processes. In addition, the B.S. MSEN program will include information and feedback provided by the Graduating Senior Survey, the Departmental Advisor Form, Former Student Survey, and Employer Survey, as the program matures. Results from the evaluation could be used to alter the requirements on the courses used to satisfy the requirements for materials science and engineering topics and directed electives. Given the experience of the Look College with respect to the Continuous Improvement criterion, it is expected that the Continuous Improvement criterion will be satisfied.
III. Costs and Funding

Approximately fifty percent (50%) of the new MSEN curriculum will leverage current MSEN courses and Look College laboratories already in place. Most of the costs associated with the five-year startup plan for the MSEN program will be for the development and delivery of new (or highly modified) courses to support the new curriculum, including faculty salary, staff salary for student recruiting and enrollment advising, improved facilities and additional equipment.

The Faculty required to deliver the MSEN curriculum will grow from today’s 14 Full-Time-Equivalent (FTE) to 19 FTE (which includes three new full time tenure track faculty and two new non-tenure track professor of practice / lecturer) faculty over the five-year startup period to support program advising and new course development and delivery. From year three (3) to five (5), the need for lecturers will grow from one (1) to three (3) FTEs to support growth requirements for new sections of current and new MSEN courses. Graduate Assistant Teaching (GAT) support will grow to ten (10) in the first five years to accommodate additional lab sections of current and new lab courses. Administrative costs will include a full-time program coordinator beginning in year one (1). The five-year funding plan includes use of reallocated funds derived from the hiring of new faculty members who will focus on MSEN undergraduate courses. In addition to the estimated $945,000 of anticipated reallocated funds for faculty hiring, $2,037,868 will come from additional Differential Tuition (DT) funding that will be generated and used for non-tenure track professor of practice / lecturer salaries, full time program coordinator staff salary, GAT support, establishment of an undergraduate laboratory, procurement of new laboratory equipment, and lab supplies.

A. Five-Year Costs and Funding Sources - this table to shows five-year costs and sources of funding for the program.

Table 15. Five-Year Costs and Funding Sources

<table>
<thead>
<tr>
<th>Five-Year Costs</th>
<th>Five-Year Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel(^1)</td>
<td>$2,003,200</td>
</tr>
<tr>
<td>Facilities and Equipment</td>
<td>$927,668</td>
</tr>
<tr>
<td>Library, Supplies, and Materials</td>
<td>$26,500</td>
</tr>
<tr>
<td>Other(^2)</td>
<td>$25,500</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td><strong>$2,982,868</strong></td>
</tr>
<tr>
<td>Reallocated Funds</td>
<td>$945,000</td>
</tr>
<tr>
<td>Anticipated New Formula Funding(^3)</td>
<td>$0</td>
</tr>
<tr>
<td>Special Item Funding</td>
<td>$0</td>
</tr>
<tr>
<td>Other(^4) (includes DT funds)</td>
<td>$2,037,868</td>
</tr>
</tbody>
</table>

1. Report costs for new faculty hires, graduate assistants, and technical support personnel. For new faculty, prorate individual salaries as a percentage of the time assigned to the program. If existing faculty will contribute to program, include costs necessary to maintain existing programs (e.g., cost of adjunct to cover courses previously taught by faculty who would teach in new program).
2. Specify other costs here (e.g., administrative costs, travel).
3. Indicate formula funding for students new to the institution because of the program; formula funding should be included only for years three through five of the program and should reflect enrollment projections for years three through five.
4. Report other sources of funding here. In-hand grants, “likely” future grants, and designated tuition and fees can be included.

---

\(^1\) Please use the “Program Funding Estimation Tool” found on the CB website to correctly estimate state funding.

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1. **Adequacy of Funding and Notification of Other Institutions** – The chief executive or chief academic officer shall sign the following statements:

I certify that the institution has adequate funds to cover the costs of the new program. Furthermore, the new program will not reduce the effectiveness or quality of existing programs at the institution.

I certify that my institution has notified all public institutions within 50 miles of the teaching site of our intention to offer the program at least 30 days prior to submitting this request. I also certify that if any objections were received, those objections were resolved prior to the submission of this request.

Chief Executive Officer/Chief Academic Officer  
Date

2. **Board of Regents or Designee Approval** – A member of the Board of Regents or designee shall sign the following statement:

*On behalf of the Board of Regents, I approve the program.*

Board of Regents (Designee)  
Date of Approval
February 4, 2016

To: Texas A&M University Curriculum Committee

From: Mr. David H. Carlson
Dean of University Libraries

RE: Assessment of Resources for Materials Science and Engineering New BS Program

Materials are critical to numerous areas of engineering, consequently the Texas A&M University Libraries has been collecting and providing access to books, engineering/testing standards, databases, handbooks, journals, magazines, and technical reports in materials science for decades. Over the last several years the University Libraries has expanded access to a number of resources that specifically support materials science (e.g., ACerS-NIST Phase Equilibria Diagrams, Cambridge Structural Database, and SpringerMaterials) and engineering in general (e.g., McGraw Hill’s AccessEngineering and ASTM Compass). We have access to several online engineering ebook collections (e.g., Knovel, ENGnetBASE, AccessEngineering) containing over 1,000 important works, including many in materials science. Much of our existing materials science print and ebook collection would support an undergraduate materials science program. Aside from continuing to acquire additional print and online materials science books as published, no additional library resources are needed to support an undergraduate Materials Science & Engineering program.

In summary, Texas A&M University Libraries’ collection of resources in the area of materials science and engineering is strong and no additional library resources are needed to support an undergraduate Materials Science & Engineering program.

If you have any further questions, please feel free to contact me.
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   Student Survey ..................................................... 41
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APPENDIX A

References


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New B.S. Degree

Do you believe a new Bachelor of Science in Materials Science and Engineering in Texas would be beneficial for the future of Texas and the Nation?

- [ ] Yes
- [ ] No
- [ ] Don't know

Anticipated Demand

Please provide your best estimate of the number of job openings in your company or organization for professionals with a Bachelor of Science in Materials Science and Engineering.

- [ ] 0
- [ ] 1
- [ ] 2
- [ ] 3
- [ ] 4
- [ ] 5
- [ ] 6
- [ ] 7
- [ ] 8
- [ ] 9
- [ ] 10 or more

Space for comments:

Would you Hire?

Would you hire a B.S. graduate in Materials Science and Engineering?

- [ ] Yes
- [ ] No

Want to know more?

We intend to prepare graduates with practical job skills for materials-related careers. Would you be interested in participating in any of the following? (select all that apply)

- [ ] Student Research
- [ ] Internship
- [ ] Mentorship Opportunities
- [ ] Supporting to classes or student organizations
- [ ] Research Collaborations
- [ ] Providing training opportunities for our campus senior design course
- [ ] Other (specify below):

Other:

Thank you for participating in our survey.

We value your comments and your time.

Materials Science
Engineering
Texas A&M University

If you have any comments or concerns about this survey, please contact:

Strategic Planning & Undergraduate Program Development Committee
Department of Materials Science & Engineering
College of Engineering
Texas A&M University

Phone: (979) 845-1150
E-mail: parrish@tamu.edu

The Department of Materials Science & Engineering at Texas A&M University is a member of the American Society for Engineering Education. These B.S. and Engineering is a member of the American Society for Engineering Education.

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APPENDIX C
Texas A&M Student Survey
Initiated November 2, 2015 – Summarized November 30, 2015

Department of Materials Science and Engineering (MSEN) SURVEY

Bachelor of Science in Materials Science and Engineering

The Dwight Look College of Engineering and the College of Science will propose a new undergraduate Bachelor of Science (BS) in Materials Science and Engineering to be launched in Fall 2017.

The MSEN major includes a series of core MSEN courses (59 crh) to provide a strong common foundation in the fundamental principles of materials science and engineering, a series of technical electives within MSEN (9 crh) to provide students depth in a particular emphasis area, and a series of free electives (9 crh) to allow students the flexibility to explore interdisciplinary studies, or to focus in greater depth in one or more MSEN areas.

Q1 Knowing what you know now, if a major in Materials Science and Engineering (MSEN) was an option when you selected your major:

○ A. I would have ranked a major in MSEN as my first choice
○ B. I would have considered a major in MSEN as one of my top 3 choices
○ C. I would have explored the MSEN major.
○ D. I would not have considered MSEN as a major.
○ E. I don’t know.

Currently, your major is:

Q2 Q3 Q4 Q5
○ A. AERO ○ A. CVEN ○ A. MSEN ○ A. COLLEGE OF GEOSCIENCES
○ B. BAEN ○ B. CSCE ○ B. PETE ○ B. COLLEGE OF SCIENCE
○ C. BMED ○ C. ENS ○ C. COLLEGE OF AG & LIFE SCI ○ C. OTHER
○ D. CHEM ○ D. ECEN ○ D. COLLEGE OF ARCH ○ D. GENERAL ENGINEERING
○ E. CHEM ○ E. ENTC ○ E. S. MAYS SCHOOL OF BUSINESS ○ E. Have not chosen a Major

Q6 How interested are you in materials science and engineering?
○ A. Very Interested
○ B. Interested
○ C. Neutral
○ D. Not Very Interested
○ E. Not Interested

Q7 What year are you in your studies?
○ A. Freshman
○ B. Sophomore
○ C. Junior
○ D. Senior
○ E. Senior [more than 90 hrs]

Q8 What is the likelihood you will change your major to materials science and engineering?
○ A. Highly likely
○ B. Likely
○ C. Neutral
○ D. Not likely
○ E. Not at all likely

Q9 Do you like the idea of Texas A&M University offering a new BS in materials science and engineering?
○ A. Yes
○ B. Neutral
○ C. No

Thanks Ags! We Care what you think!

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APPENDIX D

ACADEMICS

Advising
The Bachelor of Science program will be managed by the Department of Materials Science and Engineering in the Dwight Look College of Engineering and College of Science at Texas A&M University. In addition to the formal staff Academic Undergraduate Advisor, each student will be assigned (starting in the first semester of the sophomore year) a faculty mentor who will provide advice on the optimal, individualized degree program, to meet each student’s career goals and objectives. Specifically, the faculty mentor will advise on matters related to possible emphasis areas as well as other curriculum components that can contribute to the enrichment of the educational experience of the students. Pairing of students and advisors will be conducted to maximize the overlap in UG self-identified goals, with technical areas of expertise of faculty advisors. This process will occur on the basis of personal statements of interest that UG students generate during their sophomore year in “MSEN 201: Fundamentals of Materials Science” – a survey course designed to expose students to a wide breadth of the field of materials science and engineering. Advising during the sophomore and junior years will be focused on possible emphasis areas, while advising during the senior year will be centered on maximizing students’ post-graduation ambitions.

An Advising Committee within the department will be composed of the Director of the Undergraduate Program (faculty member), the Academic Undergraduate Advisor (staff member) and three (3) faculty appointed by the Department Head.

Admission
Engineering students may apply by three avenues:

1. Admission by Entry-to-a-Major Process. Entry to a Major for students who were admitted to General Engineering in the Dwight Look College of Engineering or the Engineering Academies.

2. Admission by Change of Curriculum. Change of Curriculum for students already attending Texas A&M University in majors other than the materials science and engineering Undergraduate Program.

3. Admission by Transfer. Transfer from colleges and universities outside of Texas A&M University.

The Department of Materials Sciences and Engineering will follow the guidelines and policies set out by the Look College official academic procedures for admission and transfer.
APPENDIX E

College / University Procedures

The Dwight Look College of Engineering has a dynamic unit: Engineering Academic Student Affairs (EASA). This unit provides consistent and dynamic information for all undergraduate and graduate students related to entry-to-a-major and transfer or admission requirements. Access to academic advisors and all admittance procedures can be located online via: http://engineering.tamu.edu/academics/advisors-procedures/advisors.

MSEN will follow and look to EASA to guide any admission and transfer issues related to undergraduates. The following are a few of the details regarding entry-to-a-major, transfer eligibility and automatic admissions.

Entry-To-A-Major
http://engineering.tamu.edu/academics/advisors-procedures/entry-to-a-major

The entry-to-a-major (ETAM) process is designed for students to take ownership of their future to identify at least three majors that are a good match for their career goals and academic performance. The general engineering advisors, as well as departmental advisors, are available for questions and advice. Students are encouraged to leverage additional resources, including the career center and departmental faculty to get career advice.

The ETAM process utilizes a priority method that is designed to place students in the highest rank major based upon capacity and student performance. Students will no longer have the option to accept or deny a decision. For the case that a student determines that the highest rank major is not a good match, students have the option to pursue a change of curriculum to a different major within the Look College or Texas A&M University.

Students must apply to three majors with the option to select up to five majors. Majors must be ranked in order of preference. Students are strongly encouraged to apply during the spring/summer cycle.

Fall 2017 dates for admission will be posted in the near future. Students who are not in a major after the fall 2016 cycle will work closely with a general engineering advisor to enter into a major.

All deadlines are by 11:59 p.m. Central Time on the date specified.

Automatic Admits

• The entry-to-a-major process includes automatic admission to the first choice major for students with a 3.5 cumulative GPA after the first two semesters for the spring/summer application process only.

• Students are required to have completed two engineering courses, two science courses, and two math courses (one of which must be at least Math 151), all with a grade of C or higher. Exceptions will be made as needed for students who enter with credit for math and science courses.
Changing Majors
http://engineering.tamu.edu/academics/advisors-procedures/changing-majors

Eligibility Requirements

• Student eligibility will be based upon at least two semesters of course work at Texas A&M University.
• Students are eligible based upon courses completed by the end of the semester in which the application is submitted (e.g., for students who submit an application during the spring semester, the eligibility is based upon the courses completed at the end of the spring semester).
• Students must be in good academic standing (e.g., requires a cumulative GPA of at least 2.0) and not be on academic probation at the end of the semester during which the application is submitted (e.g., requires the term GPA of at least 2.0).

Required Coursework

General engineering students are required to complete at least the following courses at Texas A&M University with a minimum grade of C or higher:

• Engineering: Two engineering courses from the following list – ENGR 111, ENGR 112, CSCE 111, CSCE 121, CSCE 221; for students who start in ENGR 289, the requirement is one engineering course.

• Science: Two science courses from the following list – PHYS 218*, PHYS 208*, PHYS 222, CHEM 107/117, CHEM 101/111*, CHEM 102/112*. In addition to the courses listed with asterisks, students with a preference in computer science may also choose from BIOL 101, 107, 111, 112, 113; GEOL 101, 106; GEOG 203/213; ATMO 201/202; RENR 205/215.

• Math: Two math courses from the following list – MATH 151, 152, 251, 253, 304, 308; CSCE 222 (Discrete Math); for students who start in ENGR 289 or MATH 150, the requirement is one math course from the list.

Probation and Block Policies
http://engineering.tamu.edu/academics/advisors-procedures/probation

Appeals
http://engineering.tamu.edu/academics/advisors-procedures/appeals

Further issues regarding admission, transfer, entry-to-a-major and academic progress will utilize the EASA resources outlined in the Look College academic policies: http://engineering.tamu.edu/academics.
Credits 3. 3 Lecture Hours
Pre-reqs: CHEM 101 or 107; PHYS 218
Fundamental principles of materials science and engineering, and their application towards complex engineering challenges; relationship between materials structure and structural and functional properties of engineered materials; property-performance relationships; principle classes of materials, as illustrated through key materials advances; current directions in the field.

Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 201cr, MATH 152cr
Introduction to basic concepts and fundamental laws of thermodynamics; processes and thermodynamic engines; phase equilibria and phase diagrams of simple substances; chemical reactions of condensed phases; computational software for thermodynamic and phase diagram calculations.

MSEN 220, Physics and Chemistry of Inorganic Materials. Reference Page 59. (to be cross-listed in the future as CHEM/MSEN 220)
Credits 3. 3 Lecture Hours
Pre-reqs: CHEM 102 cr, PHYS 208 cr
Structure, properties, and function of materials developed from an atomistic and molecular perspective emphasizing quantum chemical descriptions; elements of solid-state chemistry and physics including bonding, crystal structure and symmetry, origin of electronic band structure; synthesis and characterization tools in materials chemistry; role of finite size effects.

MATH 307, Analytical Methods for Materials Scientists and Engineers. Syllabus Not Provided
Credits 3. 3 Lecture Hours
Pre-reqs: MATH 251
Introduction to analytical methods for developing models and solutions to problems pertinent to the materials science and engineering discipline; crystal symmetries and tensor properties; material response to external fields; constitutive equations and energy minimization; reaction and transformation rates; viscoelastic properties.

Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 210
Application of physical principles that drive the evolution of materials as they approach thermodynamic equilibrium states; topics include: Gibbs free energy, driving forces, point defects, diffusion in solids, interface and grain boundary motion, nucleation, growth, transformation diagrams, precipitation, phase separation, ordering, solidification.

Credits 3. 3 Lecture Hours
Pre-reqs: PHYS 208, CHEM 102, CHEM 112
Structure, properties, and function of various classes of soft matter including colloids, polymers, amphiphils, liquid crystals, and biomacromolecules; basic concepts of viscoelasticity, glass transition, liquid-liquid and liquid-solid transitions and gelation; forces acting between mesoscopic objects; supramolecular self-assembly in soft condensed matter.

Credits 1. 1 Lecture Hours
Pre-reqs: MSEN 201
Seminar series presenting technical advances in the field of materials science and engineering and applications of this field towards solving engineering challenges; presentations from visiting industry and academic speakers, as well as faculty; introduction to current research themes and focal points in industry.

MSEN 301, Unified Materials Lab I Reference Page 75
Writing intensive course
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 240 cr, MSEN 310 cr
Unified materials lab integrating materials synthesis, structural characterization, and property evaluation; theory and practice of experimental and simulation techniques; emphasis on relationship between processing parameters and resulting materials structure.

MSEN 302, Unified Materials Lab II Reference Page 79
Writing intensive course
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 301
Unified materials lab integrating materials synthesis, structural characterization, and property evaluation; theory and practice of experimental and simulation techniques; emphasis on relationship between materials structure and resulting materials physical properties.

MSEN 310, Structure of Materials Reference Page 83.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 201
Materials structure over many orders of scale; structure of non-crystalline materials; symmetry, unit cell, and the atomic structure of crystalline materials; liquid crystals; structural defects in ordered solids; microstructures and hierarchical structures.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 310, or approval of instructor
Survey of deformation and failure mechanisms in different materials, including metals, ceramics, polymers, and composites; effect of atomistic structure, defects and microstructure on deformation and failure; deformation and failure mechanism maps and effects of temperature and deformation rate.

Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 307
The purpose of this course is to introduce students to the use of computing platforms to address scientific/engineering problems related to materials science and engineering. Emphasis will be placed on the use of computer programming to: analyze data, implement mathematical models of materials behavior, the use of numerical methods to solve materials-related problems.

Credits 2. 2 Lecture Hours
Pre-reqs: MSEN 320
Case studies illustrating materials failure and consequences thereof; materials selection process in the face of uncertainty; industry standards and regulatory frameworks; design tradeoffs and cost analysis; ethical and business implications of materials failure.

Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 210, MSEN 330
Studio course introducing methods to simulate materials behavior across multiple scales; topics include: electronic structure calculations, classical molecular dynamics, computational thermodynamics and kinetics of materials, microstructure evolution simulation, continuum models of materials behavior.

MSEN 400, Design and Analysis of Materials Experiments. Reference Page 103.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 220, MSEN 302, MSEN 320
Systematic design of experimental investigations; student teams identify topics in consultation with the instructor and develop experiment designs including establishing the need, associated requirements and objective; conduct experiments; characterize materials; analyze and interpret results; documenting the procedures, analysis, results, and conclusions; present written and oral reports.

MSEN 401, Materials Research and Design I Reference Page 107.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 281, MSEN 340, MSEN 400
The research and design process; need definition, functional analysis, performance requirements, evaluation criteria, conceptual design evaluation; introduction to systems engineering; parametric and risk analysis, failure analysis, material selection, and manufacturability; cost and life cycle issues, project management; topics will come from sponsored research or an industry-sponsored design project.

MSEN 402, Materials Research and Design II Reference Page 111.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 401
Continuation of MSEN 401; development of innovative solutions to research or industry-provided design challenges; structured framework and methodology for design activities; innovation, computational materials science, synthesis/processing, and analysis/characterization of material components; project definition, management, customer interaction and effective team participation; presentations and design reviews.

MSEN 410, Materials Processing Reference Page 115.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: Junior or Senior classification, MSEN 201; or approval of instructor.
The course will provide an introduction to synthesis, properties and processing of technologically important inorganic materials (metals and ceramics). Topics covered will include thermodynamics and kinetics of different materials processing methods, casting, deformation processing, heat treatments, powder processing and sintering, coating and thin films processing, etc.

Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 310
Overview of point, line, and surface defects in solids; relates defect properties to diffusion, deformation, phase transformations; focuses on atomic defects in crystals, with additional examples from liquid crystals, superconductors, and ferromagnets; incorporates atomistic modeling to examine defect structure.

MSEN 420, Polymer Science Reference Page 123.
Credits 3. 3 Lecture Hours
Pre-reqs: PHYS 208, CHEM 102, CHEM 112; or approval of instructor
Types of polymerization and molecular characteristics of polymer chains; single chain statistics and rubber elasticity; phase transitions, glass transition, viscoelasticity and time-temperature superposition; polymer structure at the molecular, microscopic and macroscopic levels; polymer thermosets, thermoplastics, elastomers, fibers, and advanced nanoparticle-filled composites.
MSEN 426, Polymer Laboratories
Reference Page 127.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 250; or approval of instructor
Laboratory class to prepare students who are interested in polymer research with necessary experimental and analytical skills to conduct and analyze experimental work.

MSEN 430, Nanomaterials Science
Reference Page 131.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 310, Junior or Senior classification; or approval of instructor
Nanotechnology and nanomaterials; types, fabrication, characterization methods, and applications; their current roles in technology, and the likely future impact of such systems on industry targeting.

MSEN 440, Materials Electrochemistry and Corrosion
Reference Page 135.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 220; or approval of instructor
Survey of thermodynamic and kinetic fundamentals of electrochemistry; multiscale materials corrosion mechanisms; details of interfacial aqueous electrochemical mechanisms and the environmental effects when materials are exposed to different conditions.

MSEN 444, Corrosion and Electrochemistry Lab
Reference Page 139.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 440
Laboratory practice and principles for corrosion and electrochemistry methods; students will design, carry out, and analyze a series of labs illustrating the most important techniques in the field; course builds to an open-ended corrosion engineering problem resulting in preparation of a technical report for a hypothetical client.

MSEN 446, Corrosion Prevention and Control Methods
Reference Page 145.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 444.
Cathodic protection and coatings as corrosion prevention and control methods for different applications; functional engineering approach to controlling and preventing aqueous corrosion based on engineering methodologies; impressed current, galvanic anodes, organic, inorganic and hybrid coatings; case of studies in the oil and gas, energy, automotive and different industries are included to illustrate the application of each method.

MSEN 458, Fundamentals of Ceramics
Reference Page 147.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 310; or approval of instructor
Structure-property relationships of ceramics and ceramic composites; atomic bonding in ceramics; crystalline and glassy structures; phase equilibria and ceramic reactions; mechanical, electrical, thermal, dielectric, magnetic, and optical properties; and ceramic processing; different properties of ceramics will be related to their underlying structure.

MSEN 460, Properties of Functional Materials
Reference Page 151.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 220, MSEN 310; or approval of instructor
Origins of functional materials properties from their electronic and molecular structure; electron theory in solids; electronic transport and dielectric behavior; optical and magnetic properties; current applications of functional materials.

MSEN 462, Advanced Materials Characterization
Reference Page 155.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 220, MSEN 250, MSEN 310; or approval of instructor
Principles and techniques used in characterization of different materials, including metals, ceramics, polymers, composites, and semiconductor systems; microstructural, chemical/compositional, and surface analysis methods; interpretation and analysis of the characterization results.

MSEN 472, Atomistic Simulation of Materials
Reference Page 159.
Credits 3. 3 Lecture Hours
Pre-reqs: MSEN 370; or approval of instructor
Modern methods of computational modeling and simulation of materials properties and phenomena at the atomistic scale; quantum, classical, and statistical mechanical methods, including semi-empirical atomic and molecular-scale simulations, and other modeling techniques using macroscopic input.

MSEN 474, Materials Modeling of Phase Transformation and Microstructural Evolution.
Reference Page 163.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 370; or approval of instructor
Computer modeling and simulation of microstructural evolution during various phase transformation processes in solid materials, including spinodal decomposition, ordering, martensitic transformation, ferroelectric and ferromagnetic domain evolution, nucleation, growth, solidification.

MSEN 476, Multi-Scale Computational Materials Science.
Reference Page 167.
Credits 3. 2 Lecture Hours, 3 Lab Hours
Pre-reqs: MSEN 370; or approval of instructor
This is a problem-based advanced course illustrating elements of the challenges associated with multi-scale simulations in materials science. As an example, the course will examine the multi-scale modeling of elastic response of a multi-phase microstructure. Elements of uncertainty quantification and propagation will be central to the course.
Communications intensive course
Credits 1. 1 Lecture Hours
Pre-reqs: MSEN 401 or concurrent enrollment
Effective communication of technical topics in materials science and engineering to technical and non-technical audiences; emphasis on oral and visual presentations.

MSEN 484, Internship
Reference Page 175.
Credits 0-4.
Pre-reqs: Junior or Senior classification, approval of instructor
Practical experience working in a professional materials science and engineering setting offered on an individual basis.

MSEN 485, Directed Studies
Reference Page 179.
Credits 0-4.
Pre-reqs: Junior or Senior classification, approval of instructor
Directed study of selected problems in the area of materials science and engineering not covered in other courses. May be taken four times for credit.

MSEN 491, Research
Reference Page 183.
Credits 0-4.
Pre-reqs: Approval of instructor
Research conducted under the direction of faculty members in materials science and engineering. May be taken four times for credit.
APPENDIX G

COURSE SYLLABI
MSEN 201, Fundamentals of Materials Science and Engineering
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Ibrahim Karaman, Reed McDonald Bldg. 235, ikaraman@tamu.edu, 979.862.3923

Course (catalog) description: Fundamental principles of materials science and engineering, and their application towards complex engineering challenges; relationship between materials structure and structural and functional properties of engineered materials; property-performance relationships; principle classes of materials, as illustrated through key materials advances; current directions in the field.

Course Prerequisites: CHEM 101 or 107; PHYS 218

Learning Outcomes: At the end of this course, students should be able to:
1. Relate the role of materials science and engineering in advancing fundamental engineering challenges,
2. Illustrate the relationship between materials synthesis, resulting structure, properties, and performance with examples from modern engineering materials.
3. Describe the differences in macroscopic physical properties for different classes of materials (metals, polymers, ceramics, semiconductors, composites). Explain the physical and chemical origin of these differences.
4. Describe microstructure and atomic structure in materials, and defects in that structure; relate structural properties to that structure.
5. Describe bonding and electronic structure in materials; relate electronic structure to functional materials properties.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Pt 1: Structural Materials and Properties
Week 1 Mechanical Properties of Engineering Materials
Week 2 Cryogenic Metals: Structure of Metals
Week 3 Ultrahard Tool Coatings: Structure of Ceramics
Week 4 Synthetic Rubber: Structure of Polymers
Week 5 Lightweight Aerospace Materials: Structure of Composites
Week 6 Efficient Vehicles: Strengthening Mechanisms in Alloys
Week 7 Design of Steels: Phase Diagrams of Materials
Week 8 Turbine Superalloys: Creep, Fatigue, Fracture
Pt 2: Functional Materials and Properties
Week 9   Fuel Cells: Diffusion in solids
Week 10  Stainless Steel: Corrosion in solids
Week 11  The Integrated Circuit: Electronic Properties
Week 12  Thermal Barrier Materials and Heat Spreaders: Thermal Properties
Week 13  The Hard Disk and the Wind Turbine: Magnetic Properties
Week 14  Photovoltaics and LEDs: Optical Properties

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Understanding of fundamental concepts of Materials Science and Engineering will be evaluated through two in-class exams, and through a final group term paper relating design and engineering of material properties for specific technological applications.

Student understanding will be assessed throughout class in the form of quizzes, HWs, and in-class group activities, to ascertain that students are meeting desired learning outcomes.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Exam #1 (30 %) {Week 9}
Exam #2 (30 %) {Week 15}
Final Group Term Paper (20 %) {Week 14}
Quizzes (5 %)
In-Class Participation (5 %)
Homework (10 %)

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.
**Make-up Policy:**

If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details at [http://studentrules.tamu.edu/rule07](http://studentrules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at [https://studentactivities.tamu.edu/app/sponsauth/index](https://studentactivities.tamu.edu/app/sponsauth/index)
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at [http://attendance.tamu.edu](http://attendance.tamu.edu) or
      b) Confirmation of visit to a healthcare professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**

Aggie Honor Code: "An Aggie does not lie, cheat, or steal or tolerate those who do." For additional information please visit: [http://aggiehonor.tamu.edu](http://aggiehonor.tamu.edu).

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Americans with Disabilities Act (ADA) Policy Statement:
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit http://disability.tamu.edu.
MSEN 210, Thermodynamics of Materials
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Raymundo Arroyave, Reed McDonald Bldg. 218, rarryave@tamu.edu, 979-777-7116

Course (catalog) description: Introduction to basic concepts and fundamental laws of thermodynamics; processes and thermodynamic engines; phase equilibria and phase diagrams of simple substances; chemical reactions of condensed phases; computational software for thermodynamic and phase diagram calculations.

Course Prerequisites: MSEN 201 or registration therein, MATH 152 or registration therein.

Learning Outcomes: At the end of this course, students should be able to:
1. Understand and explain the fundamental laws of thermodynamics
2. Use thermodynamic principles to interpret phase equilibria, and chemical reactions
3. Apply the concept of equilibrium and free energy minimization to construct phase diagrams
4. Calculate phase diagram and thermodynamic properties using computational thermodynamics software.


Supplementary References:
Thermodynamics in Materials Science, Robert DeHoff, CRC Press (2nd Edition)

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:

Week 1  Introduction and Definition of Terms
Week 2  The First Law of Thermodynamics
Week 3  The Second Law of Thermodynamics
Week 4  Statistical Interpretation of Thermodynamics
Week 5  Auxiliary Functions
Week 6  Heat Capacity, Enthalpy, and Entropy
Week 7  The Third Law of Thermodynamics
Week 8  Phase Equilibrium in a One-Component System
Week 9  Introduction to Computational Thermodynamics Software
Week 10  The Behavior of Solutions
Week 11  Gibbs Free Energy, Composition and Phase Diagrams of Binary Systems
Week 12  Reactions involving Pure Condensed Phases and a Gaseous Phase
Week 13  Reaction Equilibria in Systems Containing Components in Condensed Solution
Week 14  Phase Diagrams for Binary Systems in Pressure-Temperature-Composition Space

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Proper understanding and application of thermodynamics will be evaluated through written exams, homework, quizzes, projects, and in-class participations. In addition, students will be guided to use computational software Thermo-Calc for thermodynamic and phase diagram calculations in the projects and homework. These activities will help assess student learning and understanding of the knowledge taught in the course.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Midterm Exam (30%) {Week 7}
Comprehensive Final (35%) {end of semester}
Homework (10%)
Quizzes (10%)
Project (10%)
In-Class Participation (5%)

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at [https://studentactivities.tamu.edu/app/sponsor/auth/index](https://studentactivities.tamu.edu/app/sponsor/auth/index)
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at [http://attendance.tamu.edu](http://attendance.tamu.edu) or
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN220, Physics and Chemistry of Inorganic Materials
(To be cross-listed as CHEM/MSEN 220 in future)
3 Credits

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information: Dr. Sarbajit Banerjee/Dr. James Bateas
Chemistry 222, banerjee@chem.tamu.edu, 979-862-3102
Chemistry 2119C, bateas@chem.tamu.edu, (979) 458-2965

Course (catalog) description: Structure, properties, and function of materials developed from an atomistic
and molecular perspective emphasizing quantum chemical descriptions; elements of solid-state chemistry
and physics including bonding, crystal structure and symmetry, origin of electronic band structure; synthesis
and characterization tools in materials chemistry; role of finite size effects

Course Prerequisites: PHY 208 (co-requisite) OR CHEM 102 (co-requisite)

Learning Outcomes: At the end of this course, students should be able to:
1. Have an understanding of common crystal structures and their representations
2. Recognize how symmetry and chemical bonding influence structures adopted by inorganic materials
3. Describe the role of valence electron structure in the resulting bonding present in solids.
4. Relate the origin of electronic band structure in materials.
5. Possess a basic understanding of analytical methods that can be applied to study materials and be
   able to devise testing plans
6. Appreciate the role of finite size in influencing the properties of materials

Press/Taylor and Francis, 2005

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional
material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1 Common structure types in solid-state chemistry
Week 2 Visualization and representation of crystal structures
Week 3 Rationalizing structure types
Week 4 Crystal field theory and lattice energetics
Week 5 Symmetry operations and point groups
Week 6 Space groups and Bravais lattices
Week 7 Elementary crystallography
Week 8 Chemical bonding and band structure: from bonds to bands
Week 9 Simple models of electronic structure
Week 10  Optical and electronic properties
Week 11  Quantum size effects
Week 12  Synthetic strategies in materials chemistry
Week 13  An introduction to defect chemistry
Week 14  Extended defects

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Understanding of the content will be assessed through graded problem sets, three in-class exams, a final exam, and a literature assignment.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Problem sets: 20% {Weekly}
Midterm exams: 45% {Weeks 4 & 8}
Literature assignment: 10%
Final exam: 25%

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studactinstances.tamu.edu/app/sponsauth/index
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
      b) Confirmation of visit to a healthcare professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justifiable cause for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**
Aggie Honor Code: "An Aggie does not lie, cheat, or steal or tolerate those who do." For additional information please visit: http://aggiehonor.tamu.edu.

**Americans with Disabilities Act (ADA) Policy Statement:**
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MSEN 240, Kinetics of Materials
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Raymundo Arroyave, Reed McDonald Bldg. 218, rarroyave@tamu.edu, 979-777-7116

Course (catalog) description: Application of physical principles that drive the evolution of materials as they approach thermodynamic equilibrium states; topics include: Gibbs free energy, driving forces, point defects, diffusion in solids, interface and grain boundary motion, nucleation, growth, transformation diagrams, precipitation, phase separation, ordering, solidification.

Course Prerequisites: MSEN 210

Learning Outcomes: At the end of this course, students should be able to:
1. Quantify driving forces for phase transformations by comparing Gibbs energies of phases taking part in transformation.
2. Apply physical principles to the quantification of rates of evolution in materials systems.
3. Use understanding of different kinds of solid-solid phase transformations (precipitation, segregation, ordering, martensitic transformation) and their influence on microstructure evolution in materials.
4. Interpret materials microstructures in terms of possible transformation paths
5. Interpret transformation diagrams and to use them to design materials processing parameters
6. Understand how cooling rates and thermal gradients affect microstructures observed during solidification processes.

Textbook: Phase Transformations in Metals and Alloys, Porter and Easterling, Second Edition,

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1 Thermodynamics in Phase Transformations
Week 2 Driving Forces for Materials Evolution
Week 3 Phenomenology of Diffusion Equation
Week 4 Strategies for the Solution to the Diffusion Equation: Steady State
Week 5 Strategies for the Solution to the Diffusion Equation: Non-steady State
Week 6 Atomistic Basis for Diffusion
Week 7 Diffusion in liquids, polymers and amorphous materials
Week 8  Interface and Grain Boundary Motion
Week 9  Nucleation and Growth
Week 10  Precipitation
Week 11  Phase Separation
Week 12  Ordering
Week 13  Martensitic Transformations
Week 14  Relationships between Phase Transformations and Microstructures

Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up
for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each
case, at least 1 week notice will be given.

Assessment and Evaluation:
The course will be evaluated through quizzes, homework, exams and a final paper.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Homework: 30% {Weekly}
Exam 1: 20% {Week 4}
Exam 2: 20% {Week 8}
Quizzes: 10%
Final paper: 20% {Week 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused
and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential
to complete the course successfully. University rules related to excused and unexcused absences are located
on-line at http://student-rules.tamu.edu/rule07 . Please come on time. Silence cell phones and other
electronic distractions.

Make-up Policy:
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exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed
upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are
expected to attend unless they have a university-approved excuse. The make-up work must be completed
in a timeframe not to exceed 30 calendar days from the last day of the initial absence.
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details at http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   iii. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   iv. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      c) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
      d) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN 250, Soft Matter  
Credits 3. 3 Lecture Hours  

Term: Fall 2017  

Meeting times and locations: TBD  
Office Hours: TBD  

Instructor Information:  
Dr. Svetlana Sukhishvili, Reed McDonald Bldg. 221, svetlana@tamu.edu, 979-458-9840  

Course (catalog) description: Structure, properties, and function of various classes of soft matter including colloids, polymers, amphiphils, liquid crystals, and biomacromolecules; basic concepts of viscoelasticity, glass transition, liquid-liquid and liquid-solid transitions and gelation; surface thermodynamics and surface tension; wetting and adhesion; forces acting between mesoscopic objects; supramolecular self-assembly in soft condensed matter.  

Course Prerequisites: PHYS 208, CHEM 102, CHEM 112  

Learning Outcomes: At the end of this course, students should be able to:  
1. Identify main distinctive features of soft matter, including wide spectra of length scales and relaxation times;  
2. Recognize how molecular structure and organization determine the properties of soft materials;  
3. Explain how molecular entanglements affect materials’ viscoelastic properties;  
4. Identify and quantify main forces acting between mesoscopic objects: Van der Waals and electrostatic interactions.  
5. Appreciate the role of self-assembly of biological macromolecules;  
6. Describe physical laws that define wetting and adhesion;  
7. Give a quantitative description of cooperativity as a driving force in self-assembly.  


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.  

Course Outline:  
Week 1  Introduction to organic molecules, functional groups  
Week 2-3  Chemical structures and bonding in organic molecules, surfactants, and biological molecules  
Week 4  Dynamics, phase transitions and viscoelasticity in soft materials  
Week 5  Polymer chain conformation and configuration polymer solutions and melts  
Week 6  Glass transition; rubbers and gels  
Week 7  Surfaces, interfaces and colloids: surface thermodynamics  
Week 8  Surface tension, van der Waals forces  
Week 9  Wetting and adhesion
Week 10  Electrostatic double layer, colloidal crystals
Week 11  Colloidal coagulation and stabilization, colloidal gels
Week 12  Micelles and liquid crystals
Week 13  Biological soft matter: electrostatics, hydration
Week 14  Biological soft matter: cooperativity and self-assembly

Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Progress towards achieving learning outcomes will be evaluated through graded problem sets, midterm and final exam, and a literature assignment.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Problem sets: 20% \{Weekly\}
Midterm exams: 30\% \{Weeks 4 & 8\}
Literature assignment: 20\%
Final exam: 30\% \{End of semester\}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor’s discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN 281, Materials Science and Engineering Seminar
Credits 1. 1 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Li Liu, Reed McDonald Bldg. 227, li.liu@tamu.edu, 979-458-1090

Course (catalog) description: Seminar series presenting technical advances in the field of materials science and engineering and applications of this field towards solving engineering challenges; presentations from visiting industry and academic speakers, as well as faculty; introduction to current research themes and focal points in industry.

Course Prerequisites: MSEN 201.

Learning Outcomes: At the end of this course, students should be able to:
1. Describe several recent technical breakthroughs, and the technologies they enable,
2. Describe fundamental and applied materials research and development,
3. Describe materials-focused activities pursued by industrial materials engineers,
4. Identify areas of personal interest in the field of materials science and engineering.

Textbook: None.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1-14 Technical Seminars (speakers TBD)
Week 5 First Reflection due
Week 10 Second Reflection due
Week 14 Final Reflection (personal interest statement) due

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Understanding of recent technological breakthroughs will be evaluated by a series of three reflective pieces. The first two reflective pieces focus on relating the motivation, context, and results of a recent breakthrough. The final piece focuses on identifying areas of interest to a student — this final piece will be utilized in pairing UG students with initial faculty advisors.
Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
First Reflection (30%)
Second Reflection (30%)
Final Reflection (20%)
Final Exam (20%)

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2. Death or major illness in a student’s immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student’s presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor’s discretion), within one week of the last date of the absence:
a) Texas A&M University Explanatory Statement for Absence from Class form
available at http://attendance.tamu.edu or
b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University
shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery
therefrom) and related conditions as a justification for an excused absence for so long a period
of time as is deemed medically necessary by the student’s physician. Requests for excused
absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper
documentation

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide
notification by the end of the second working day after the absence, including an explanation of why no
ice could not be sent prior to the class.

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please contact Disability Services, currently located in the Disability Services building at the Student
Services at White Creek complex on west campus or call 979-845-1637. For additional information visit
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MSEN 301, Unified Materials Lab I
writing intensive course
Credits 3. 2 Lecture Hours/ 3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Terry Creasy, Reed McDonald Bldg. 217, tcreasy@tamu.edu, 979-458-0118

Course (catalog) description: Unified materials lab integrating materials synthesis, structural characterization, and property evaluation; theory and practice of experimental and simulation techniques; emphasis on relationship between processing parameters and resulting materials structure.

Course Prerequisites: MSEN 240 or registration therein, MSEN 310 or registration therein.

Learning Outcomes: At the end of this course, students should be able to:
1. Demonstrate fundamental synthesis techniques of different classes of materials,
2. Demonstrate key materials characterization approaches,
3. Relate the strengths and weaknesses of experimental and simulation techniques,
4. Explain the theory of different synthesis, characterization, and simulation techniques,
5. Analyze and report experimental and simulation data, including basic statistical analysis and uncertainty quantification,
6. Effectively communicate technical results in formal lab report form.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1, 2 Evolution of Metal Microstructures:
    Heat Treatment, Optical Microscopy, Grain Coarsening Prediction
Week 3, 4 Polymer Coatings
    Coating process & film morphology, Scanning Electron Microscopy
Week 5, 6 Composite Layup
    Anisotropy & Failure in Composites, Optical & Scanning Electron Microscopy
Week 7, 8 Sintering and Diffusion in Solid State Ceramics
    Sintering Process, X-Ray Diffraction, Diffusion Simulation
Week 9, 10 Thin Metal films
    Deposition of thin films, X-Ray Diffraction/Atomic Force Microscopy
Week 11, 12 Hydrogels
    Gelation process, FTIR Spectroscopy
Week 13, 14 Electrochemical Deposition
    Solution-based Deposition of Coatings, Combined Microscopy/Diffraction Techniques
Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Analysis and interpretation of technical data will be assessed through technical content of lab reports. Emphasis on understanding of underlying theory through required description of ‘methods’; emphasis on data analysis through presentation of ‘results’ in data and figure form; emphasis on interpretation through ‘discussion’ of results. This course is a formal w course. Thus, 1 crh (33.3 % of grade) will be based on form, content, style and grammar of written lab reports. Submission of lab reports will follow an iterative process to impart technical editing and revision skills.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Analysis and interpretation of technical data (66.6 %)
Form, content, style and grammar of written lab reports (33.3 %)

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .

Attendance:
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    absence related to pregnancy should be directed to the instructor.

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documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide
notification by the end of the second working day after the absence, including an explanation of why notice
could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either
prior or after the absence, but not later than two working days after the absence.

Academic Integrity:
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information please visit: http://aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy Statement:
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requires that all students with disabilities be guaranteed a learning environment that provides for
reasonable accommodation of their disabilities. If you believe you have a disability requiring an
accommodation, please contact Disability Services, currently located in the Disability Services building at
the Student Services at White Creek complex on west campus or call 979-845-1637. For additional
information visit http://disability.tamu.edu.

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MSEN 302, Unified Materials Lab II
writing intensive course
Credits 3. 2 Lecture Hours/3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Terry Creasy, Reed McDonald Bldg. 217, terresy@tamu.edu, 979-458-0118

Course (catalog) description: Unified materials lab integrating materials synthesis, structural characterization, and property evaluation; theory and practice of experimental and simulation techniques; emphasis on relationship between materials structure and resulting materials physical properties.

Course Prerequisites: MSEN 301.

Learning Outcomes: At the end of this course, students should be able to:
1. Demonstrate fundamental synthesis techniques of different classes of materials,
2. Demonstrate key materials property characterization approaches,
3. Relate the strengths and weaknesses of experimental and simulation techniques,
4. Explain the theory of different synthesis, characterization, and simulation techniques,
5. Analyze and report experimental and simulation data, including basic statistical analysis and uncertainty quantification,
6. Effectively communicate technical results in formal lab report form.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1, 2 Hardening of Metals
Heat Treatment, Plastic Deformation, Strengthening Mechanisms
Week 3, 4 Viscoelastic solids
Viscoelastic and viscoplastic properties
Week 5, 6 Fracture and failure of composite materials
Anisotropy & Failure in Composites
Week 7, 8 Dielectric Oxides
Processing of capacitors, capacitor breakdown
Week 9, 10 Corrosion of Metals
Electrochemical testing
Week 11, 12 Thermal Insulators and Conductors
Characterization of thermal transport
Week 13, 14 Magnetic thin films
Electronic and magnetic properties of thin films
**Course Policies and Procedures:**

**Changes in schedule:**
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

**Assessment and Evaluation:**
Analysis and interpretation of technical data will be assessed through technical content of lab reports. Emphasis on understanding of underlying theory through required description of ‘methods’; emphasis on data analysis through presentation of ‘results’ in data and figure form; emphasis on interpretation through ‘discussion’ of results. This course is a formal w course. Thus, 1 crh (33.3 % of grade) will be based on form, content, style and grammar of written lab reports. Submission of lab reports will follow an iterative process to impart technical editing and revision skills.

**Grading Scale (Standard Letter Scale):**
A = 90-100  
B = 80-89.99  
C = 70-79.99  
D = 60-69.99  
F = <60

**Grading Policies:**
Analysis and interpretation of technical data (66.6 %)
Form, content, style and grammar of written lab reports (33.3 %)

**Late Work Policy:**
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07).

**Attendance:**
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07). Please come on time. Silence cell phones and other electronic distractions.

**Make-up Policy:**
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.f)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor’s discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
      b) Confirmation of visit to a health care professional affirming date and time of visit.

7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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MSEN 310, Structure of Materials
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Patrick Shamberger, Reed McDonald Bldg. 229, patrick.shamberger@tamu.edu, 979-458-1086

Course (catalog) description: Materials structure over many orders of scale; structure of non-crystalline materials; symmetry, unit cell, and the atomic structure of crystalline materials; liquid crystals; structural defects in ordered solids; microstructures and hierarchical structures.

Course Prerequisites: MSEN 201, MSEN 222, AERO 413, BMEN 343, CHEN 313, CVEN 306, ENTC 206, or NUEN 265, or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
1. Describe atomic structure in non-crystalline materials.
2. Use basic structural concepts to describe the crystal structure, including: the Bravais lattice; the unit cell; the crystal structure; planes and directions in a crystal.
3. Identify symmetry and symmetry operations. Symmetry operations and point groups
4. Describe the structure of liquid crystals and differentiate these materials from other crystalline materials.
5. Identify and describe structural defects in ordered solids.
6. Describe structural hierarchy in materials from atomic length-scales through macroscopic length-scales.
7. Describe techniques used to investigate materials structure at many different length scales.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1 Introduction to Structural Terms
Week 2-3 Noncrystalline Materials
Week 4-8 Crystalline State
Week 9 Liquid Crystals
Week 10-12 Defects
Week 13-14 Microstructures

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

**Assessment and Evaluation:**
Understanding of structure-property relationships will be evaluated through both conceptual questions and numerical problems in which relevant physical quantities will be calculated from fundamental relationships. Homework assignments and quizzes will play important roles in gaining a mastery of the course material.

**Grading Scale (Standard Letter Scale):**
- A = 90-100
- B = 80-89.99
- C = 70-79.99
- D = 60-69.99
- F = <60

**Grading Policies:**
- Midterm (40 %) {Week 8}
- Comprehensive Final (50 %) {End of semester}
- Homework (10%)

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

**Late Work Policy:**
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07).

**Attendance:**
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**Make-up Policy:**
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
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      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
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7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
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Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN 320, Deformation and Failure Mechanisms in Engineering Materials
Credits 3. 3 Lecture Hours

Term: Fall 2017
Meeting times and locations: TBD

Instructor Information:
Dr. Alan Needleman, Reed McDonald Bldg. 228, needle@tamu.edu, 979.862.2021

Course (catalog) description: Survey of deformation and failure mechanisms in different materials, including metals, ceramics, polymers, and composites; effect of atomistic structure, defects and microstructure on deformation and failure; deformation and failure mechanism maps and effects of temperature and deformation rate.

Course Prerequisites: MSEN 310, or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
1. Understand underlying atomistic mechanisms of deformation and failure in different materials, namely metals, ceramics, polymers and composites;
2. Identify deformation and failure mechanism in different materials;
3. Select appropriate strengthening and toughening strategies in different materials systems;
4. Predict a lifetime of structural components based on their dominant deformation and failure mechanisms;
5. Carry out failure analysis and determine origin of failure in structural components;

Textbook:

Additional Material:
N.E. Dowling, Mechanical Behavior of Materials, Prentice Hall, 1999

Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1  Introduction: Concept and mathematical description of stresses and strains;
Week 2  Overview of Macroscopic mechanical behavior of materials; Stress-strain curves and constitutive relationships;
Week 3  Elastic deformation - Atomistic aspects and constitutive models;
Week 4  Plastic deformation mechanisms: dislocation based mechanisms;
Week 5  Plastic deformation mechanisms: twinning and kinking, diffusion based mechanisms, grain boundary sliding;
Week 6  Mid-semester exam; Diffusionless phase transformations;
Week 7  Time dependent deformation mechanisms: visco-elastic, visco-plastic and creep deformation;
Week 8  Strengthening mechanisms; Ashby deformation maps and effect of temperature, strain rate and
         microstructure on deformation mechanisms and mechanical behavior;
Week 9  Introduction to fracture mechanics; Mechanisms of crack initiation and propagation;
Week 10 Brittle and Ductile failure mechanisms;
Week 11 Fatigue - Deformation and failure mechanisms in cyclic loading conditions
Week 12 Overview of experimental method for mechanical characterization of failure in engineering
         materials; Fractography;
Week 13 Toughening mechanisms; Fracture mechanisms maps and life prediction methods;
Week 14 Project presentations

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up
for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each
case, at least 1 week notice will be given.

Assessment and Evaluation:
Progress towards achieving learning outcomes will be evaluated through homework, exams, and final
project. Peer review will be incorporated into the evaluation of final project reports and presentations.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Mid-semester exam (25%) \{Week 6\}
Final Exam (25%) \{Week 15\}
Project presentation and report (20%) \{Week 14\}
Homework assignments (30%) \{Weekly\}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
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and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .

Attendance:
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Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz,
exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed
upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are
expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

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In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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MSEN 330, Numerical Methods for Materials Scientists and Engineers  
Credits 3. 2 Lecture Hours, 3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD  
Office Hours: TBD

Instructor Information:
Dr. Xiaofeng Qian, Reed McDonald Bldg. 226, feng@tamu.edu, 979-458-9843

Course (catalog) description: The purpose of this course is to introduce students to the use of computing platforms to address scientific/engineering problems related to materials science and engineering. Emphasis will be placed on the use of computer programming to: analyze data, implement mathematical models of materials behavior, the use of numerical methods to solve materials-related problems.

Course Prerequisites: MATH 307

Learning Outcomes: At the end of this course, students should be able to:
1. Use general scientific programming approaches to accelerate the analysis of materials data and to solve mathematical problems representing materials properties and phenomena.
2. Use numerical methods for the solution of non-linear equations associated with physical models of materials behavior.
3. Use numerical linear algebra to describe anisotropic properties of materials and to perform linear transformations.
4. Use least-squares methods for the parameterization of models with experimental data.
5. Use numerical differentiation and integration to quantify rates of change and cumulative changes in materials response.
6. Use numerical methods for the solution of ODEs/PDEs representing dynamic behavior in materials systems.
7. Use numerical optimization techniques for materials discovery and design.


Additional Material: Lecture notes, specific codes and subroutines, assignments, solutions, grades, project instructions, and additional material will be provided in the class or will be made available at http://ecampus.tamu.edu.

Course Outline:
Weeks 1-2 Introduction to Programming  
Weeks 3-4 Solution to Non-linear Equations: Application to Constitutive Models of Materials Behavior  
Weeks 5-6 Linear Algebra and Linear Transformations of Materials Anisotropic Properties  
Week 7 Building models from data through least squares approaches  
Weeks 8-9 Numerical integration and differentiation of materials response.  
Weeks 10-11 Numerical solution to ODEs: reaction kinetics, dynamics of atoms in a crystal  
Week 12 Numerical solution to PDEs: the diffusion equation in 1 D  
Weeks 13-14 Constrained Optimization: From Gibbs Energies to Phase Diagrams
Course Policies and Procedures:

Changes in schedule: The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation: Proper understanding of the Numerical Methods commonly used by Materials Scientists and Engineers will be evaluated through projects and exams. The focus will be on the ability to solve a given problem using computer programming.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
In-Class Participation and quizzes (10 %)
Weekly Projects (60%)
Exam #1 (15%) {Week 7}
Exam #2 (15%) {Week 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy: No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance: The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy: If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

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MSEN 340, Case Studies in Materials  
Credits 2. 2 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information: Dr. Patrick Shamberger  
Reed McDonald Bldg. 229, patrick.shamberger@tamu.edu, 979-458-1086

Course (catalog) description: Case studies illustrating materials science and engineering practice; systems analysis of repercussions for business and society; root causes of success and failure; design in the face of uncertainty; industry standards and regulatory frameworks; tradeoffs and cost-benefit analysis; ethical implications of engineering practice.

Course Prerequisites: MSEN 310

Learning Outcomes: At the end of this course, students should be able to:

6. Demonstrate critical thinking skills required in engineering practice through analysis of real-world examples
7. Illustrate trade-offs and system-level thinking with cases of both exemplary and poor materials selection or design
8. Show awareness of the role that materials scientists and engineers play in industry and the possible effect on society
9. Describe best practices in materials science and engineering in the face of uncertainty,
10. Introduce industry standards and regulatory frameworks,

Textbook:
- Engineering Ethics: Concepts and Cases, C. E. Harris, M. S. Pritchard, M. J. Rabins, R. James, E. Englehardt (Wadsworth, 2013)

Additional Material:  
Additional materials for specific cases will be distributed by the instructor. Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:  
Week 1 Case study 1: DH 106 Comet  
Week 2 Introduction to engineering ethics; business implications of engineering design  
Week 3 Case study 2: recycling and resource management

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Week 4: Introduction to systems engineering and uncertainty
Week 5-6: Exam 1; Teaming and assignment of final project topics
Week 7: Case 3: turbine disk failure in United Airlines Flight 232
Week 8: Introduction to engineering forensics
Week 9: Site visit and/or presentations by faculty of practice
Week 10: Case 4: the nuclear fuel cycle
Week 11: Introduction to regulatory frameworks
Week 12: Exam 2; special topic
Week 13-14: Final project presentations

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Effective communication techniques will be evaluated through exams, and a written term project.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Exam #1 (20 %) {Week 5}
Exam #2 (20 %) {Week 12}
Term Project (60%) {End of semester}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.
The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07]). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at [http://attendance.tamu.edu](http://attendance.tamu.edu)
      b) Confirmation of visit to a healthcare professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therewith) and related conditions as a justification for an excused absence for as long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**
Aggie Honor Code: "An Aggie does not lie, cheat, or steal or tolerate those who do." For additional information please visit: [http://aggiehonor.tamu.edu](http://aggiehonor.tamu.edu).

**Americans with Disabilities Act (ADA) Policy Statement:**
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MSEN 370, Computational Materials Science and Engineering Credits 3. 2
Lecture Hours, 3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD Office Hours: TBD

Instructor Information:
Dr. Ankit Srivastava, Reed McDonald Bldg. 223, ankit.sri@tamu.edu, 979.458.9841

Course (catalog) description: Studio course presenting methods to simulate materials behavior across multiple scales; topics include: electronic structure calculations, classical molecular dynamics, computational thermodynamics and kinetics of materials, microstructure evolution simulation, continuum models of materials behavior.

Course Prerequisites: MSEN 210, MSEN 330

Learning Outcomes: At the end of this course, students should be able to:
1. Recognize the strengths and limitations associated with different computational materials modeling methods
2. Understand the basic structure of most materials simulation codes in terms of input(s), problem representation, simulation parameters and output(s)
3. Use basic functionality of electronic structure codes to calculate physical properties of model materials systems
4. Use classical molecular dynamics to simulate dynamic behavior of collections of atoms
5. Use computational thermodynamics software to calculate phase stability in multi-component systems
6. Use computational kinetics software to quantify rates of transformation in materials
7. Use microstructure evolution software to simulate simple phase transformations


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1 Using Models to Represent Reality
Week 2 The basic Ingredients of Materials Simulation: Inputs, Problem Representation, Simulation Parameters and Outputs.
Week 3 Basics of Electronic Structure Simulations: Density Functional Theory in a Nutshell
Week 4 Using VASP/ABINIT to Calculate Equations of State of Simple Crystals
Week 5 Molecular Dynamics: Applying F=ma at the atomic scale
Week 6 Using LAMMPS to Simulate Melting of a Polymer
Week 7 Computational Thermodynamics: Minimizing Gibbs Energies
Week 8 Using Thermo-Calc to calculate the phase diagram in multi-component Ceramic System
Week 9 Computational Kinetics: Connecting Diffusion to Phase Transformations
Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
The course will be evaluated through quizzes and projects.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Quizzes: 20%
Project 1: 20% \{Week 4\}
Project 2: 25% \{Week 8\}
Project 3: 35% \{Week 14\}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
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Attendance:
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MSEN 400, Design and Analysis of Materials Experiments  
Credits 3. 2 Lecture Hours/3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:  
Dr. K. T. Hartwig, Reed McDonald Bldg. 220, thattwig@tamu.edu, 979-845-1585

Course (catalog) description: Systematic design of experimental investigations; student teams identify topics in consultation with the instructor and develop experiment designs including establishing the need, associated requirements and objective; conduct experiments; characterize materials; analyze and interpret results; documenting the procedures, analysis, results, and conclusions; present written and oral reports.

Course Prerequisites: MSEN 220, MSEN 302, and MSEN 320

Learning Outcomes: At the end of this course, students should be able to:

1. Establish the justification for an experiment, that is, why are the results needed or desired?
2. Establish specific objectives of an experiment.
3. Establish the budgetary, manpower and time requirements, including time sequencing of the project, and schedule for a project.
4. Establish the primary variables that must be controlled and measured by applying engineering fundamentals to determine the theory that describes the phenomena under investigation.
5. Identify clearly what the response variables (dependent variables) are and what the controlled variables (independent variables) are for a particular experiment.
6. Determine specific tasks (functions) that must be completed to conduct the experiment.
7. Determine if a Standard or Recommended Practice exists for conducting the experiment.
8. Determine the uncertainty (confidence intervals) which may be required for the primary measurements, and the number and spacing of such measurements required for proper data analysis and presentation of results.
9. Identify extraneous variables that might influence the results of an experiment and how they may be suppressed.
10. Determine whether measurements should be taken randomly or sequentially and design a test plan.
11. Determine if a factorial or fractional factorial experiment design can or should be used and design one if needed.
12. Set up data reduction calculations before conducting the experiment to be sure that adequate useful data will be collected to meet the objectives of the experiment.
13. Analyze the possible uncertainty in the anticipated results before an experiment is conducted so that modifications in uncertainty requirements on the various measurements may be changed if necessary.
14. Select instrumentation for the various material characterizations and measurements to match the anticipated uncertainty requirements. Modify the instrumentation to match budgetary, performance, and schedule limitations if necessary.
15. Conduct a preliminary analysis after collecting a few data points to make sure that the experiment is progressing as planned, and modify the experimental apparatus and/or procedure in accordance with the preliminary findings.
16. Conduct an experiment by doing materials characterizations and taking the experimental data, and presenting the results in a manner such that they can be analyzed and interpreted relevant to the objective of the experiment.
17. Test experimental results for consistency and rejection or outliers.
18. Apply statistical analysis to the results such as analysis of variance (ANOVA) or multiple regression analysis to aid in interpreting the results and determining their significance.
19. Discuss the results of an experiment relative to the objectives to: interpret the results; explain any discrepancies, scatter of data, or anomalies in the results; point out most important results; and provide a lead
in to the conclusions of the experiment.
20. Summarize findings of an experiment, draw conclusions, and make recommendations.
21. Organize and prepare a report describing the justification, objectives, experimental setup and procedures, findings, results, and conclusions of an experiment in writing and orally.

Textbook:

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1: Introduction to course and the general experimental design process, relationship to general design process.
Week 2: General planning of experimental investigations, establishing project objectives, application of systems engineering design process to experiments, identifying types of experiments, standards and recommended practices, identifying and organizing tasks, and preparing an experiment project proposal.
Week 3: Use of uncertainty analysis in the planning of experiments, statistical analysis for experiments, relationship of number of significant figures reported and uncertainty, confidence intervals, data acquisition and data checking.
Week 4: Preparing written reports of experiments, format for general report, difference between findings and conclusions.
Week 5: Continuation of interpretation, presentations and reporting of results, reports in industry.
Week 6: Detailed design of experimental investigations; determination of number and spacing of data points.
Week 7: Detailed design of experimental investigations; test sequences and experimental plans.
Week 8: Detailed design of experimental investigations; random designs, suppression of extraneous variables.
Week 9: Detailed design of experimental investigations; mathematical modeling of experimental results.
Week 10: Introduction to statistical Design of Experiments (DOE)-factorial design
Week 11: Fractional Factorial Design of Experiments, oral presentations.
Week 12: Analysis of variance (ANOVA) for single, two and three factor experiments.
Week 13: Multiple regression analysis.
Week 14: Student presentations

Class/laboratory Schedule: Two 50 minute lectures per week plus one 3 hour lab session per week where students work in teams of 3 or 4.

Relationships Between ABET and Course Program Outcomes:

<table>
<thead>
<tr>
<th>ABET Program Outcome</th>
<th>ABET Program Outcome</th>
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</thead>
<tbody>
<tr>
<td>x a. ability to apply knowledge of mathematics, science and engineering</td>
<td>f. understanding of professional and ethical responsibility</td>
</tr>
<tr>
<td>x b. ability to design and construct experiments, and analyze and interpret data</td>
<td>x g. ability to communicate effectively</td>
</tr>
<tr>
<td>x c. ability to design a system, component, or process to meet desired needs within realistic constraints</td>
<td>h. education to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
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<tr>
<td>x d. ability to function on multi-disciplinary teams</td>
<td>i. recognition of the need for, and an ability to engage in life-long learning</td>
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<tr>
<td>x e. ability to identify, formulate and solve engineering problems</td>
<td>j. a knowledge of contemporary issues</td>
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<tr>
<td>x k. ability to use the techniques, skills and modern engineering tools necessary for engineering practice</td>
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</tbody>
</table>
Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Understanding of fundamental concepts of Materials Science and Engineering will be evaluated through two in-class exams, and through a final group term paper relating design and engineering of material properties for specific technological applications.

Student understanding will be assessed throughout class in the form of quizzes, HWs, and in-class group activities, to ascertain that students are meeting desired learning outcomes.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
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D = 60-69.99
F = <60

Grade Components:

Two Written Proposals (team) 25%
Two Written Reports (team) 25%
Final Oral Report (team) 10%
Quizzes (individual) 10%
Lab Performance (individual) 10%
Final Exam (individual) 20%

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
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Attendance:
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MSEN 401 Materials Research and Design I
Credits 3. 2 Lecture Hours / 3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Ramesh Talreja, HRBB 736A, talreja@tamu.edu, 979.458.3256

Course (catalog) description: The research and design process; need definition, functional analysis, performance requirements, evaluation criteria, conceptual design evaluation; introduction to systems engineering; parametric and risk analysis, failure analysis, material selection, and manufacturability; cost and life cycle issues, project management; topics will come from sponsored research or an industry-sponsored design project.

Course Prerequisites: MSEN 281, MSEN 340, MSEN 400

Learning Outcomes: At the end of this course, students should be able to:
1. Recognize the stages of a generalized design process; explain what activities occur during each stage; distinguish among the products of each stage.
2. Apply the early stages of a generalized design process.
3. Analyze client/sponsor requests in order to identify quantitative design requirements.
4. Identify sources of information and differentiate among them to determine which are useful.
5. Develop a function structure by abstraction based on design requirements.
6. Apply innovation methods to generate conceptual design solutions.
7. Determine whether you have encountered fixation during concept generation and apply corrective action if necessary.
8. Describe the differences among concept sources such as database-driven, computational/modeling, or analytical-driven approaches
9. Evaluate concepts and select the most viable.
10. Recognize the triple constraint (cost, time, performance) and its effects on project management.
11. Produce a suitable work breakdown structure for accomplishing a design task.
12. Assess risk in a project and assign appropriate contingency.
13. Employ software tools to manage projects.
14. Develop a personal approach for successfully participating on a design team.
15. Record all project-related developments in a design project notebook.
16. Communicate the results of a design orally and in writing.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.
**Course Outline:**
Week 1: Introduction to design and project management
Week 2: Creating a Work Breakdown Structure, effective team participation
Week 3: Using project management software, functional representation of needs
Week 4: Methods of tracking project status, abstracting and producing a function structure
Week 5: Revising function structures and obtaining customer agreement
Week 6: Introduction of cognitive perspective of innovative behavior
Week 7: Using intuitive innovation methods
Week 8: Using logical innovation methods
Week 9: Applying innovation within an entrepreneurial activity, introduction of intellectual property
Week 10: Evaluating design concepts and selection methods
Week 11: Identifying information sources, making informed design decisions
Week 12: Embodying selected design concepts
Week 13: Communicating design information
Week 14: Presenting detailed conceptual designs to customers

**CLASS/LABORATORY SCHEDULE:** Two, 50 minute lecture sessions per week that overview engineering design principles. Studio sessions meet once per week outside of lecture to work on project teams focused on a specific research project, interdisciplinary senior design activity in coordination with another engineering department, or an industry-sponsored design project.

**Course Policies and Procedures:**
**Changes in schedule:**
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

**Assessment and Evaluation:**
Understanding of fundamental concepts of Materials Science and Engineering will be evaluated through two in-class exams, and through a final group term paper relating design and engineering of material properties for specific technological applications.

Student understanding will be assessed throughout class in the form of quizzes, HWs, and in-class group activities, to ascertain that students are meeting desired learning outcomes.

**Grading Scale (Standard Letter Scale):**
A = 90-100; B = 80-89.99; C = 70-79.99; D = 60-69.99; F = <60

**Grading Components:**
Home Work 10%
Quizzes 10%
Exam 20%
Final Presentation 20%
Final Design Report 30%
Performance on Team 10%

**Late Work Policy:**
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Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**
Aggie Honor Code: "An Aggie does not lie, cheat, or steal or tolerate those who do." For additional information please visit: [http://aggiehonor.tamu.edu](http://aggiehonor.tamu.edu).

**Americans with Disabilities Act (ADA) Policy Statement:**
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MSEN 402 Materials Research and Design II
Credits 3. 2 Lecture Hours/3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Ramesh Talreja, HRBB 736A, talreja@tamu.edu, 979.458.3256

Course (catalog) description: Continuation of MSEN 401; development of innovative solutions to research or industry-provided design challenges; structured framework and methodology for design activities; innovation, computational materials science, synthesis/processing, and analysis/characterization of material components; project definition, management, customer interaction and effective team participation; presentations and design reviews.

Extended description: In this second capstone design course, in which the engineering design and development process from need definition to embodiment, and the development of innovative solutions to real-world, and research or industry-provided design challenges will be addressed. A structured framework and methodology for design activities is emphasized and practiced through its application to challenging design tasks that are addressed by small design teams in complementary design studios. The design activity includes innovation, computational materials science, synthesis/processing, and analysis/characterization of material components, as well as project definition, management, customer interaction and effective team participation. Exposure to these topics occurs through participation in an intensive client-sponsored design project. Presentations and design reviews are conducted with technical staff from the partner-sponsor, and formal reports are prepared and submitted as evidence of participation and demonstration of hands-on design skills developed.

Course Prerequisites: MSEN 401

Learning Outcomes: Students who successfully complete this course should be able to design a material system, component or process to meet desired performance requirements within realistic constraints that include economic, social, political, environmental, ethical, health and safety, as well as manufacturability and sustainability. At the end of this course, you should be able to:
1. Comprehend the product design and development process, and the engineer’s role.
2. Define all environmental factors that may affect the material/component.
3. Select suitable material configurations and manufacturing processes.
4. Select theories of failure and failure modes from environmental conditions.
5. Select preliminary design margins by performing adequate risk analyses.
6. Develop final material requirements from design margins for each failure mode.
7. Define final material properties for all conceivable circumstances.
8. Perform computation based materials modeling and analyses.
9. Select developmental models, processes and procedures to evaluate material failure modes.
10. Define the new product (process) by converting functional properties into performance properties, and prepare final product (synthesis/processing) protocols.
11. Prepare final product design report and present final product presentation to sponsor.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Topics:
- Engineering Design Overview
- Design Principles
- Design Optimization
- Materials Selection and Processing
- Computation and Modeling
- Design for Manufacturing, for Assembly, and for Inspection
- Product Liability
- Failure Mode and Effects Analysis (FMEA)
- Risk Assessment, Risk Analysis, and Risk Management
- Total Quality Management
- Life-Cycle Cost Analysis and sustainability
- Patents and Intellectual Property

CLASS/LABORATORY SCHEDULE: Two lecture sessions per week that overview engineering design principles, plus a studio session that meets once per week for work on project teams devoted to a specific research or industry-sponsored design project.

RELATIONSHIP OF MSEN 402 COURSE TO ABET PROGRAM OUTCOMES:

<table>
<thead>
<tr>
<th>ABET Program Outcome</th>
<th>ABET Program Outcome</th>
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</thead>
<tbody>
<tr>
<td>x a. ability to apply knowledge of mathematics, science and engineering</td>
<td>x f. understanding of professional and ethical responsibility</td>
</tr>
<tr>
<td>b. ability to design and construct experiments, and analyze and</td>
<td>x g. ability to communicate effectively</td>
</tr>
<tr>
<td>c. ability to design a system, component, or process to meet desired needs within</td>
<td>x h. education to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
</tr>
<tr>
<td>d. ability to function on multi-disciplinary teams</td>
<td>x i. recognition of the need for, and an ability to engage in lifelong learning</td>
</tr>
<tr>
<td>e. ability to identify, formulate and solve engineering problems</td>
<td>x j. a knowledge of contemporary issues</td>
</tr>
<tr>
<td></td>
<td>x k. ability to use the techniques, skills and modern engineering tools necessary for engineering practice</td>
</tr>
</tbody>
</table>

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.
Assessment and Evaluation:
Understanding of fundamental concepts of Materials Science and Engineering will be evaluated through two in-class exams, and through a final group term paper relating design and engineering of material properties for specific technological applications.

Student understanding will be assessed throughout class in the form of quizzes, HWs, and in-class group activities, to ascertain that students are meeting desired learning outcomes.

Grading Scale (Standard Letter Scale):
A = 90-100; B = 80-89.99; C = 70-79.99; D = 60-69.99; F = <60

Grading Components:
- Home Work 10%
- Quizzes 10%
- Exam 20%
- Final Presentation 20%
- Final Design Report 30%
- Performance on Team 10%

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused
and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07).

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential
to complete the course successfully. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07). Please come on time. Silence cell phones and other
electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz,
exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed
upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are
expected to attend unless they have a university-approved excuse. The make-up work must be completed
in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for
the absence. Among the reasons absences are considered excused by the university are the following (see
Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university
-excused absences does not relieve the student of responsibility for prior notification and documentation.
Failure to notify and/or document properly may result in an unexcused absence. Falsification of
documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized
   activity list at [https://studentactivities.tamu.edu/app/sponsauth/index](https://studentactivities.tamu.edu/app/sponsauth/index)
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)

ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
   a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
   b) Confirmation of visit to a health care professional affirming date and time of visit.

7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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MSEN 410, Materials Processing,
Credits 3. 2 Lecture Hours, 3 Lab Hours
Term: Fall 2017
Meeting times and locations: TBD
Instructor Information:
Dr. Miladin Radovic, Reed McDonald Bldg. 216, mradovic@tamu.edu, 979-865-5114
Course (catalog) description: The course will provide an introduction to synthesis, properties and processing of technologically important inorganic materials (metals and ceramics). Topics covered will include thermodynamics and kinetics of different materials processing methods, casting, deformation processing, heat treatments, powder processing and sintering, coating and thin films processing, etc.
Course Prerequisites: MSEN 201 MSEN 222, AERO 413, BMEN 343, CHEN 313, CVEN 306, ENTC 206, or NUEN 265, or approval of instructor; junior or senior classification.
Course Learning Outcomes:
By the end of the course, students should be able to:

1. Understand basic thermodynamics and kinetics of phase transformations and chemical reactions in materials processing.
2. Describe in details different available conventional methods for processing materials (metals & ceramics) properties and understand their advantages and limitations in terms of final microstructure, cost, energy and power requirements, shape limitations and dimensional tolerances, and time to manufacture components.
3. Select conventional processing method and determine optimal processing parameters to achieve specified microstructure and properties of materials;
4. Understand principles of advanced processing methods and their advantages and limitations.
Required Textbook:
The Production and Processing of Inorganic Materials, James W. Evans and Lutgard C. De Jonghe
Related Textbooks:
There are several good textbooks available in the Library covering related course material. In these books, the information covered in the course is approached in different ways and with different perspectives than in required textbook, which may make the principles described easier to understand. In addition, some of the figures and tables in other textbooks may make it easier to understand the topics covered. The following books are recommended, but are not required reading for this course:
The Science and Engineering of Materials, Donald R. Askeland, Pradeep P. Fulay, and Wendelin J. Wright
Materials Processing, James H. Swisher
Materials Science in Manufacturing, Rajiv Asthana, Ashok Kumar and Narendra Dahotre

Engineering Materials 2, Michael F. Ashby and David R.H. Jones

Ceramic Processing, Mohamed N. Rahaman

Additional Material:

Lecture notes (including topics that are not covered in the required textbook), assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu. Library resources (including supplementary reading material, materials reference handbooks, standards databases and video links) will be available at: http://guides.library.tamu.edu/MSEN410.

Assessment and Evaluation:

Understanding of course material will be evaluated through both conceptual questions and numerical problems in which relevant physical quantities will be calculated from fundamental relationships. Assigned practice problems and Tests will play important roles in gaining a mastery of the course material.

Course Policies and Procedures:

Changes in schedule:

The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Grading Scale (Standard Letter Scale):

A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:

Test#1 (20 %) {Week 5}
Test#2 (20 %) {Week 10}
Test#3 (20 %) {Week 13}
Comprehensive Final (30 %) {End of semester}
Project (10 %)

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:

No late work will be accepted, except in the case of an excused absence.

Attendance:

The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located

**Make-up Policy:**

If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence. The reasons absences are considered excused by the university are listed below. See Student Rule 7 for details ([http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1) Participation in an activity that is required for a class and appears on the university authorized activity list at [https://studentactivities.tamu.edu/app/sponsauth/index](https://studentactivities.tamu.edu/app/sponsauth/index)
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7) Required participation in military duties.
8) Mandatory admission interviews for professional or graduate school that cannot be rescheduled. Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

**Course Outline* (subject to change):**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Chapter(s)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Course Introduction:</td>
<td>1</td>
</tr>
<tr>
<td>1/2</td>
<td>Thermodynamics of chemical reactions and phase transformations in metals and ceramics.</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Diffusion and Kinetics of chemical reactions and phase transformations in metals and ceramics processing;</td>
<td>3, 6</td>
</tr>
<tr>
<td>4</td>
<td>Production of metals and glasses</td>
<td>8, 9</td>
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<tr>
<td>5</td>
<td>Casting and solidification of metals and glasses;</td>
<td>10</td>
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<tr>
<td>5</td>
<td>Test 1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Powders and particles; Productions of powders;</td>
<td>4, 11</td>
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<tr>
<td>7</td>
<td>Powder compaction;</td>
<td>12</td>
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<tr>
<td>8</td>
<td>Sintering and densification technologies;</td>
<td>13, 14, 15</td>
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<tr>
<td>9</td>
<td>Heat treatment and deformation processing of metals;</td>
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</tr>
<tr>
<td>10</td>
<td><strong>Test 2</strong></td>
<td></td>
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<tr>
<td>10</td>
<td>Coating and Surface Engineering</td>
<td>**</td>
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<tr>
<td>11</td>
<td>Nanomaterial and Nonmanufacturing</td>
<td>**</td>
</tr>
<tr>
<td>12</td>
<td>Overview of advanced materials processing</td>
<td>16</td>
</tr>
<tr>
<td>13</td>
<td>Process Engineering</td>
<td>7</td>
</tr>
<tr>
<td>13</td>
<td><strong>Test 3</strong></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Project presentations</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Comprehensive Final Exam</td>
<td></td>
</tr>
</tbody>
</table>

*Subject to changes. Changes will be posted on [http://ecampus.tamu.edu](http://ecampus.tamu.edu)*

** Topic is not covered in the required textbook. Students will be provided with lecture notes and recommendations for additional readings.

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MSEN 415, Defects in Solids  
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:  
Michael J. Demkowicz, Reed McDonald Bldg. 231, 979.845.0750

Course (catalog) description: Overview of point, line, and surface defects in solids; relates defect properties to diffusion, deformation, phase transformations; focuses on atomic defects in crystals, with additional examples from liquid crystals, superconductors, and ferromagnets; incorporates atomistic modeling to examine defect structure.

Course Prerequisites: MSEN 310 or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
- Define and explain the structures and properties of point and electronic, line, and planar defects
- Describe mathematically the mutual interactions between defects
- Explain how the structure and properties of defects give rise to macroscale materials behaviors, such as diffusion, plastic deformation, and electrical/magnetic/optical properties.
- Construct atomistic models of defects, visualize the defects in these models, and use the models to compute defect properties

Textbooks:  
D. Hull and D. J. Bacon, Introduction to Dislocations (Butterworth Heinemann, 2006)

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:  
Point defects:  
Week 1 Vacancies and interstitials  
Week 2 1st atomistic modeling tutorial; multipole expansion  
Week 3 Defect reactions; 2nd atomistic modeling tutorial  
Week 4 Defects in multicomponent systems; defects in amorphous solids

Line defects:  
Week 5 Ideal shear strength; Topology of dislocations  
Week 6 Dislocation-point defect interactions; configurational forces on dislocations  
Week 7 Midterm; Plastic deformation through dislocation glide  
Week 8 Dislocation climb; Dislocation-obstacle interactions  
Week 9 Strengthening mechanisms; stacking faults; dislocation reactions  
Week 10 Hardening; dislocations in 2-D materials; line defects in liquid crystals, superfluids, and superconductors

Planar defects:
Week 11  Free surfaces; terrace-ledge-kink model  
Week 12  Grain boundaries; coincident site lattices  
Week 13  Heterophase interfaces; O-lattice theory; magnetic domain walls  
Week 14  Final project presentations  

Course Policies and Procedures:  
Changes in schedule:  
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.  

Assessment and Evaluation:  
Progress towards achieving learning outcomes will be evaluated through homework, exams, and final project. Peer review will be incorporated into the evaluation of homework assignments.  

Grading Scale (Standard Letter Scale):  
A = 90-100  
B = 80-89.99  
C = 70-79.99  
D = 60-69.99  
F = <60  

Grading Policies:  
Midterm (25 %) {Week 5}  
Final comprehensive exam: (25 %)  
Final project presentation (25 %) {Week 14}  
Homework (25 %) {Weekly}  

Course will not be graded on a curve.  

Late Work Policy:  
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .  

Attendance:  
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 . Please come on time. Silence cell phones and other electronic distractions.  

Make-up Policy:  
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.  

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3. Illness of a dependent family member.
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7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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MSEN 420, Polymer Science
Credits 3, 3 Lecture Hours
Term: Fall 2017
Meeting times and locations: TDD
Instructor Information:
Dr. Svetlana Sukhishvili, RDMC 221, svtlana@tamu.edu, 979-458-9840

Course (catalog) description: Types of polymerization and molecular characteristics of polymer chains; single chain statistics and rubber elasticity; phase transitions, glass transition, viscoelasticity and time-temperature superposition; polymer structure at the molecular, microscopic and macroscopic levels; polymer thermosets, thermoplastics, elastomers, fibers, and advanced nanoparticle-filled composites.

Course Prerequisites: PHYS 208, CHEM 102, CHEM 112, or approval of instructor

Learning Outcomes: At the end of this course, students should be able to:
1. Recognize main types of polymerization reactions, and relate type of polymerization to polymer properties.
2. Define and differentiate between polymer conformations and configurations.
3. Give a quantitative description of single chain conformations in polymer melts and solutions, and relate the single polymer chain statistics with rubber elasticity.
4. Differentiate between thermodynamic and kinetic phase transitions in polymers.
5. Recognize main features of viscoelastic behavior in polymers.
6. Explain and apply the concept of time-temperature superposition to a polymer material.
7. Differentiate between and identify distinct properties of thermosets and thermoplastics.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1  Introduction to polymers. Classification of polymers based upon molecular structure
Week 2  Polymerization mechanisms
Week 3  Chain conformation and configuration
Week 4  Molecular weight and molecular weight distributions
Week 5  Polymer solutions, amorphous polymers
Week 6  Phase transitions and glass transition in polymers
Week 7  Amorphous state of polymers
Week 8  Crystalline state in polymers
Week 9  Thermal transitions in polymers
Week 10  Mechanical properties of polymers
Week 11  Time-temperature superposition
Week 12  Viscoelasticity of polymer solution and melts
Week 13  Rubbers and gels
Week 14  Thermoplastics and thermosets. Polymer composites.
Course Policies and Procedures:

**Changes in schedule:**
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

**Assessment and Evaluation:**
Progress towards achieving learning outcomes will be evaluated through graded problem sets, midterm and final exam, and a literature assignment.

**Grading Scale (Standard Letter Scale):**
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

**Grading Policies:**
Problem sets: 20% \( \{ \text{Weekly} \} \)
Midterm exams: 30% \( \{ \text{Weeks 4 \\& 8} \} \)
Literature assignment: 10%
Final exam: 30%

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

**Late Work Policy:**
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rules07](http://student-rules.tamu.edu/rules07).

**Attendance:**
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rules07](http://student-rules.tamu.edu/rules07). Please come on time. Silence cell phones and other electronic distractions.

**Make-up Policy:**
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rules07](http://student-rules.tamu.edu/rules07)). The fact that these are university -excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.
1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor’s discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

_**Academic Integrity:**_
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MSEN 426, Polymer Laboratories
Credits 3. 2 Lecture Hours, 3 Lab Hours.

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. H.-J. Sue, Reed McDonald Bldg. 222, hjsue@tamu.edu, 979-845-5024

Course (catalog) description: Laboratory class to prepare students who are interested in polymer research with necessary experimental and analytical skills to conduct and analyze experimental work.

Course Prerequisites: MSEN 250; or approval of instructor

Learning Outcomes: At the end of this course, students should be able to:
1. Demonstrate practical knowledge of polymer experimental techniques,
2. Describe the theory behind different experimental techniques,
3. Accurately and succinctly describe laboratory results.

Textbook: None.

Additional Material:
Experiments in Polymer Science, by E.A. Collins, J. Bares, and P.W. Billmeyer, JR. (Wiley)
Polymer: Polymer Characterization and Analysis, Jacqueline L. Kroschwitz
Instrumental Methods of Analysis, Hobart H. Willard
Physical Properties of Polymers Handbook, James E. Mark

Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1 Course Introduction
Week 2 Polymerization of Styrene
Week 3 Curing of Epoxy
Week 4 Rubber Swelling
Week 5 Thermal Gravitational Analyzer
Week 6 Density Measurements
Week 7 Surface Roughness Measurements
Week 8 Fracture Toughness
Week 9 Fourier Transform Infrared Spectroscopy
Week 10 Scratch Test
Week 11 Tensile Test
Week 12 DSC
Week 13-14 Summary and Data Analysis
Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Evaluation of knowledge regarding experimental techniques will be evaluated through a combination of Lab results, Lab reports, Presentations, and a Final Exam.

Grading Scale (Standard Letter Scale):
A = 90-100  
B = 80-89.99  
C = 70-79.99  
D = 60-69.99  
F = <60

Grading Policies:
Lab Performance 15%
Lab Reports 45% (Weekly)
Presentation 15% (Week 14)
Final Exam 25%

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 . Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07 ). The fact that these are university excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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4. Participation in legal proceedings or administrative procedures that require a student's presence.
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      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

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Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN 430, Nanomaterials Science  
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:  
Dr. Ibrahim Karaman, Reed McDonald Bldg. 235, ikaraman@tamu.edu, 979-862-3923

Course (catalog) description: Nanotechnology and nanomaterials; types, fabrication, characterization methods, and applications; their current roles in technology, and the likely future impact of such systems on industry targeting.

Course Prerequisites: MSEN 310, junior or senior classification; or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
1. define nanotechnology and nanoscience
2. explain the effects of size scales on materials behavior
3. perform analysis using scaling laws to show why size scales affect certain materials response.
4. explain the new phenomena observed on the nanoscale
5. describe types of nanomaterials.
6. explain the basic principles and types of nanomaterials fabrication.
7. select appropriate techniques for fabricating nanostructures from different types of materials.
8. comprehend the limitation of conventional characterization techniques and learn about major characterization tools for the nanostructured materials
9. design experiments to characterize and determine properties of a given nanomaterial.
10. provide multiple examples of current and predicted applications of nanomaterials

Textbook: None.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ccampus.tamu.edu.

Course Outline:
Week 1  Public Awareness of Nanotechnology
Week 2  Effect of Size Scaling: Thermal Properties
Week 3  Effect of Size Scaling: Mechanical Properties
Week 4  Effect of Size Scaling: Electrical Properties
Week 5  Effect of Size Scaling: Magnetic Properties
Week 6  Effect of Size Scaling: Optical Properties
Week 7  New Behavior: surfaces
Week 8  New Behavior: Sticky/Shaky/Bumpy
Week 9  Nanostructured materials: shapes
Week 10  Nanostructured materials: applications
Week 11  Fabrication of Nanomaterials: Top-down approaches
Week 12  Fabrication of Nanomaterials: Bottom-up approaches
Week 13-14  Introduction to Nanomaterials Characterization methods
Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
The student progress will be evaluated through a combination of homework, a final exam, two laboratory experiments and reports, a term project and class presentation.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Homework (25%) {Weekly}
Laboratory Reports (20%) {Weeks 4 & 8}
Final Exam (35%) {End of semester}
Term Project (20%) {Week 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.
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2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
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9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN 440, Materials Electrochemistry and Corrosion
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Li Liu, Reed McDonald Bldg. 227, li.liu@tamu.edu, 979-458-1090

Course (catalog) description: Survey of thermodynamic and kinetic fundamentals of electrochemistry; multiscale materials corrosion mechanisms; details of interfacial aqueous electrochemical mechanisms and the environmental effects when materials are exposed to different conditions.

Course Prerequisites: MSEN 220; or approval of instructor

Learning Outcomes: At the end of this course, students should be able to:
- Describe fundamental corrosion mechanisms,
- Demonstrate the use of modern engineering tools necessary for understanding basic principles in materials electrochemistry and corrosion,
- Apply math, chemistry, and physics, to problems in corrosion.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:

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<td>Charged Interfaces (Electrolytes, Electrical double layer, potentials)</td>
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<td>Thermodynamics review (State functions, Chemical potential, Nernst expression)</td>
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<td>Thermodynamics of materials electrochemistry (Electrochemical cells)</td>
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<td>Electrochemical Thermodynamics (E-pH diagrams at different conditions)</td>
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<td>7</td>
<td>Kinetics of materials electrochemistry (Methods of determining corrosion rates by electrochemical testing)</td>
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Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Effective knowledge of fundamental electrochemistry and corrosion mechanisms will be evaluated through homework, course projects, and exams.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Homework (30%) {Weekly}
Projects (40%) {Weeks 4 & 8}
Exams (30%) {Weeks 6 & 11}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
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Make-up Policy:
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-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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4. Participation in legal proceedings or administrative procedures that require a student’s presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
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7. Required participation in military duties.
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Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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MSEN 444, CORROSION AND ELECTROCHEMISTRY LABORATORY
Credits 3. 2 Lecture Hours, 3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information: Dr. Homero Castaneda
Reed McDonald Bldg. 230, hcastaneda@tamu.edu, 979-458-9844

Course (catalog) description: Laboratory practice and principles for corrosion and electrochemistry methods; students will design, carry out, and analyze a series of labs illustrating the most important techniques in the field; course builds to an open-ended corrosion engineering problem resulting in preparation of a technical report for a hypothetical client.

Course Prerequisites: MSEN 440

Learning Outcomes: At the end of this course, students should be able to:
1. Demonstrate ability to use reference electrodes.
2. Demonstrate ability to conduct electrochemical and weight loss measurements of corrosion rate.
3. Demonstrate ability to generate potentiodynamic polarization curves to study passivity and localized corrosion.
4. Demonstrate ability to conduct measurements of polarization resistance
5. Demonstrate ability to use metallographic methods for sample preparation and analysis.
6. Demonstrate ability to design experiments to characterize and study electrochemical/corrosion systems.

Textbook: Electrochemical Techniques in Corrosion Testing and Research, John Scully Editor, 1983

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
1 Introduction, laboratory safety
2 Lab 1: Materials sample and preparation (Metallography)
3 Lab 2. Materials Characterization (Microscopy)
4 Lab 3: Corrosion Rate, Weight Loss vs. Potentiostatic measurements
5 Lab 4: Tafel Slopes and Linear Polarization Resistance
6 Lab 5: Potentiodynamic Polarization, Active to Passive Transitions
7 Lab 6: Pitting Corrosion
8 Pitting corrosion (cont.)
9 Lab 7: Coatings
10 Lab 8: Cathodic Protection (galvanic anodes, impressed current)
11 Lab 9: Cathodic protection (coatings)
12 Lab 9: Batteries Characterization
13 Lab 10: Supercapacitors characterization
14 Final Exam
**Course Policies and Procedures:**

*Changes in schedule:*
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

*Assessment and Evaluation:*
There will be ten laboratory assignments during the semester. For each laboratory assignment students are expected to produce a short individual technical report, which will be used to grade the assignment.

One final objective is to solve an open-ended corrosion engineering question for a hypothetical client. The student will design, carry out and analyze several corrosion experiments. The culmination of this analysis will be a report detailing the work and experimental approach as well as recommendations to the client.

*Grading Scale (Standard Letter Scale):*
- A = 90-100
- B = 80-89.99
- C = 70-79.99
- D = 60-69.99
- F = <60

*Grading Policies:*
Homework (30%) *{Weekly}*
Term Project (40%) *{Week 13}*
Exams (30%) *{Weeks 8 & 14}*

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

*Late Work Policy:*
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07).

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2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**
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MSEN 446, CORROSION PREVENTION AND CONTROL METHODS  
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD  
Office Hours: TBD

Instructor Information: Dr. Homero Castaneda  
Reed McDonald Bldg. 230, hcastaneda@tamu.edu, 979-458-9844

Course (catalog) description: Cathodic protection and coatings as corrosion prevention and control methods for different applications; functional engineering approach to controlling and preventing aqueous corrosion based on engineering methodologies; impressed current, galvanic anodes, organic, inorganic and hybrid coatings; case of studies in the oil and gas, energy, automotive and different industries are included to illustrate the application of each method.

Course Prerequisites: MSEN 444; MEEN 360

Learning Outcomes: At the end of this course, students should be able to:
- Demonstrate ability to use fundamentals and basics for cathodic protection design for different metallic structures.
- Demonstrate ability to select the most suitable action and solution for corrosion control and mitigation (coatings and cathodic protection) based on the system conditions.

Textbook: Morgan, Cathodic Protection, NACE.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
1. Overview of Corrosion Science and Engineering
2. Concept of Cathodic Protection
3. Cathodic Protection Systems
4. Field Measurements
5. CP design fundamentals and applications
6. Stray Currents
7. Evaluation of CP System Performance
8. Coating Fundamentals
9. Coatings types and curing mechanisms
10. Coatings types and curing mechanisms
11. Coatings surface preparation
12. Surface preparation instrumentation
13. Subsea case of studies in prevention and corrosion control
14. Oil and gas cases of study for cathodic protection design and coatings application
Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Knowledge of corrosion prevention and control methods will be evaluated through homework, exams, and completion of class projects.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Homework (30%) {Weekly}
Project (30%) {Week 13}
Participation (Quizzes) (10%)
Exams (30%) {Weeks 8 & 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/spons auth/index
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
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      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
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7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN 458, Fundamentals of Ceramics
Credits 3. 3 Lecture Hours

Stacked with MSEN 658
Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Miladin Radovic, Reed McDonald Bldg. 216, mradovic@tamu.edu, 979-845-5114

Course (catalog) description: Structure-property relationships of ceramics and ceramic composites; atomic bonding in ceramics; crystalline and glassy structures; phase equilibria and ceramic reactions; mechanical, electrical, thermal, dielectric, magnetic, and optical properties; and ceramic processing; different properties of ceramics will be related to their underlying structure.

Course Prerequisites: MSEN 310; or approval of instructor

Learning Outcomes: At the end of this course, students should be able to:
- Recognize basic structures of ceramics and glass;
- Correlate processing conditions to the structure of ceramics and glasses;
- Correlate properties of ceramics and glasses to their structure;
- Select ceramic materials for different applications;
- Design components from ceramics and glasses.


Additional Material:

Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:

Week 1  Bonding in Ceramics
Week 2  Structure of Ceramics
Week 3  Thermodynamic and Kinetic Considerations
Week 4  Phase Equilibria
Week 5  Effects of Chemical Forces on Physical Properties
Week 6  Defects in Ceramics
Week 7  Diffusion and Electrical Conductivity
Week 8  Mechanical Properties: Fast Fracture
Week 9  Thermal Properties
Week 10 Magnetic and Dielectric Properties
Week 11 Optical Properties
Week 12 Processing of Ceramics
Week 13 Structure of Glass
Week 14 Properties of Glass

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Knowledge of ceramic structures and properties will be evaluated through four tests and an optional final exam.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Test 1 (18%) {Week 3}
Test 2 (18%) {Week 6}
Test 3 (18%) {Week 9}
Test 4 (18%) {Week 12}
Final Exam (28%)

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 . Please come on time. Silence cell phones and other electronic distractions,
**Make-up Policy:**

If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make-up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at [https://studentactivities.tamu.edu/app/spnsauth/index](https://studentactivities.tamu.edu/app/spnsauth/index)
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
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      c) Texas A&M University Explanatory Statement for Absence from Class form available at [http://attendance.tamu.edu](http://attendance.tamu.edu) or
      d) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**

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MSEN 460, Properties of Functional Materials  
Credits 3. 3 Lecture Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:  
Dr. Pao-Tai Lin; WEB 214F, paolin@tamu.edu, 979-458-8223

Course (catalog) description: Origins of functional materials properties from their electronic and molecular structure; electron theory in solids; electronic transport and dielectric behavior; optical and magnetic properties; current applications of functional materials.

Course Prerequisites: MSEN 220, MSEN 310; MSEN 222, AERO 413, BMEN 343, CHEN 313, CVEN 306, ENTC 206, or NUEN 265, or approval of instructor

Learning Outcomes: At the end of this course, students should be able to:
1. Describe the origins of electronic bands in crystalline solids. Compare and contrast linear combination of atomic orbitals and nearly free electron models of attaining electronic bands.
2. Predict electronic transport properties of semiconductors and metals from their band diagrams. Relate effective mass of holes and electrons to band curvature. Calculate density of states and occupation near the Fermi energy. Apply knowledge of band diagrams to design materials with desired transport properties.
3. Relate ferroelectric and piezoelectric properties in crystals to their crystal structure. Calculate electric dipoles from crystal structures. State symmetry conditions which allow for piezoelectric and ferroelectric behavior.
4. Predict optical properties of semiconductors and metals from their band diagrams. Calculate the optical bandgap and optical absorption in a material. Differentiate direct and indirect bandgap semiconductors. Using the principles of bandgap engineering, design a material with desired optical properties.
5. Describe the magnetic behavior of atoms and electrons. Differentiate the different types of magnetic behavior (diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic, ferromagnetic) and the origin of each. Calculate atomic magnetic moments.
6. Describe the origin of ferromagnetic behavior and the processes that occur during magnetization of a material. Relate magnetic hysteresis to domain growth and rotation.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1 Classical electronic transport (metals)
Week 2 Quantum picture of electronic solids
Week 3 Quantum applications in materials
Week 4 Electronic bands (LCAO/Bloch functions)
Week 5  Phonons: Thermal Conductivity & heat capacity
Week 6  Semiconductors and Interfaces
Week 7  Dielectrics and Insulators
Week 8  Piezoelectrics, Ferroelectrics, Pyroelectrics
Week 9  Atomic and Macroscopic Magnetization
Week 10  Collective Magnetic behavior of Materials
Week 11  Ferromagnetic Domains, Magnetic Hysteresis
Week 12  Optical: Transmission, reflection, absorption, scattering
Week 13  Optical materials & devices
Week 14  Superconductors

Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Understanding of structure-property relationships will be evaluated through both conceptual questions and numerical problems in which relevant physical quantities will be calculated from fundamental relationships. Homework assignments and quizzes will play important roles in gaining a mastery of the course material.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Exam#1 (20 %) {Week 4}
Exam#2 (20 %) {Week 8}
Exam#3 (20 %) {Week 15}
Quizzes (5 %)
In-Class Participation (5%)
Homework (30 %) {Weekly}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.
Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
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       b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student’s physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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MSEN 462, Advanced Materials Characterization
Credits 3. 2 Lecture Hours, 3 Laboratory Hours.

Term: Fall 2017
Meeting times and locations: TBD

Instructor Information:
Dr. Patrick Shamberger, Reed McDonald Bldg. 229, patrick.shamberger@tamu.edu, 979-458-1086

Course (catalog) description: Principles and techniques used in characterization of different materials, including metals, ceramics, polymers, composites, and semiconductor systems; microstructural, chemical/compositional, and surface analysis methods; interpretation and analysis of the characterization results.

Course Prerequisites: MSEN 220, MSEN 250, MSEN 310; or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
1. Grasp the principles and theory behind advanced materials characterization techniques;
2. Understand the instrumentation requirement, set-up, and performance capabilities and limitations of these materials characterization techniques;
3. Select appropriate method for structural, microstructural, chemical and surface analysis of different materials;
4. Interpret and analyze results from advanced materials characterization techniques;
5. Present and effectively communicate results of materials characterization.

Textbook:

Additional Material:
Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2nd Ed., Willey, 2013

Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1  X-Ray Diffraction and Scattering and Neutron Diffraction and Scattering with lab demonstrations;
Week 2  Optical Microscopy (OM) and Scanning Electron Microscopy (SEM)
Week 3  Transmission Electron Microscopy (TEM)
Week 4  Atomic Force Microscopy (AFM)/Scanning Probe Microscopy (SPM)
Week 5  Microanalysis in Electron Microscopy: Energy/Wavelength Dispersive Spectroscopy (EDS/WDS); Electron Backscatter Diffraction (EBSD); Electron Energy Loss Spectroscopy (EELS)
Week 6  OM, SEM, TEM, AFM, EDS, EBSD, and EELS lab demonstrations;
Week 7  Mid-term exam
        Chemical Analysis of Surface Composition: X-Ray Fluorescence (XRF); X-Ray and
        Ultraviolet Photoelectron Spectroscopy (XPS/UPS)
Week 8  Auger Electron Spectroscopy (AES); Secondary Ion Mass Spectrometry (SIMS)
Week 9  Photoluminescence (PL), Absorption/Transmission Spectroscopies; Visible and Near-IR
        Spectroscopy
Week 10 Fourier Transform Infrared Spectroscopy (FTIR); Raman Spectroscopy
Week 11 Lab demonstration of spectroscopy methods
Week 12 Mass Spectrometry (MS) with lab demonstration
Week 13 Nuclear Magnetic Resonance Spectroscopy (NMR) with lab demonstration
Week 14 Project presentations

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up
for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each
case, at least 1 week notice will be given.

Assessment and Evaluation:
Progress towards achieving learning outcomes will be evaluated through homework, exams, and final
project. Peer review will be incorporated into the evaluation of final project reports and presentations.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Mid-semester exam (25%) \{Week 7\}
Final Exam (25%) \{Week 15\}
Project presentation and report (20%) \{Week 14\}
Homework assignments (30%) \{Weekly\}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused
and unexcused absences are located on-line at \texttt{http://student-rules.tamu.edu/rule07}.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential
to complete the course successfully. University rules related to excused and unexcused absences are located
on-line at \texttt{http://student-rules.tamu.edu/rule07}. Please come on time. Silence cell phones and other
electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz,
exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed

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upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
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8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
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10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student’s physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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Americans with Disabilities Act (ADA) Policy Statement:
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MSEN 472, Atomistic Simulation of Materials  
Credits 3. 3 Lecture Hours

Stacked with MSEN 670
Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Xiaofeng Qian, Reed McDonald Bldg. 226, feng@ tamu.edu, 979-458-9843

Course (catalog) description: Modern methods of computational modeling and simulation of materials properties and phenomena at the atomistic scale; quantum, classical, and statistical mechanical methods, including semi-empirical atomic and molecular-scale simulations, and other modeling techniques using macroscopic input.

Course Prerequisites: MSEN 370; or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
1. Differentiate the fidelity and assumptions of different scales of atomistic simulations,
2. Apply quantum mechanical methods, classical methods based on empirical potentials, and continuum methods to describe different fundamental materials problems,
3. Describe weaknesses and strengths of different scale simulation methods.

Textbook: None.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1  Introduction to Modeling in Materials
Week 2-4  Quantum Mechanical Methods
Week 5-8  Interaction Potentials for Materials
Week 9-12  Classical Simulation Methods
Week 13-14  Continuum Methods

Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Knowledge of application and theory of atomistic simulation will be demonstrated through homework sets, and through a final term project.
Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Class Participation (10%)
Homework sets (40%) {Weekly}
Term Project (50%) {Week 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponsauth/index
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student’s presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor’s discretion), within one week of the last date of the absence:
a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
b) Confirmation of visit to a health care professional affirming date and time of visit.

7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**
Aggie Honor Code: "An Aggie does not lie, cheat, or steal or tolerate those who do." For additional information please visit: http://aggiehonor.tamu.edu.

**Americans with Disabilities Act (ADA) Policy Statement:**
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MSEN 474, Materials Modeling of Phase Transformation and Microstructural Evolution  
Credits 3. 2 Lecture Hours, 3 Lab Hours

Stacked with MSEN 619  
Term: Fall 2017  

Meeting times and locations: TBD

Instructor Information:  
Dr. Amine Benzerga, HRBB 736C, benzerga@tamu.edu, 979.845.1602

Course (catalog) description: Computer modeling and simulation of microstructural evolution during various phase transformation processes in solid materials, including spinodal decomposition, ordering, martensitic transformation, ferroelectric and ferromagnetic domain evolution, nucleation, growth, solidification.

Course Prerequisites: MSEN 370, or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
1. Apply basic concepts of thermodynamics and kinetics of heterogeneous systems to the understanding of microstructure evolution of materials
2. Understand the basic principles behind diffuse interface modeling framework
3. Apply variational principles to arrive at kinetic evolution equations from functional thermodynamic descriptions
4. Use FiPy as the computational framework to implement phase field modeling of microstructures
5. Use basic numerical methods to implement solutions to the Cahn-Hilliard and Allen-Cahn equations

Textbook: Course Notes by Instructors

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
Week 1 Thermodynamics of Microstructures
Week 2 Functions and functionals and Variational Calculus
Week 3 Sharp vs Diffuse Interface
Week 4 The Cahn-Hilliard Equation
Week 5 The Allen-Cahn Equation
Week 6 Phase-field Models
Week 7 Phase-field Models: the structure of interfaces
Week 8-9 Application of Phase Field Modeling to Solidification
Week 10-12 Application of Phase Field Modeling to Solid-Solid Phase Transformations
Week 13 The problem of nucleation
Week 14 Multi-physics Phase Field Modeling
Course Policies and Procedures:
Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
The course will be evaluated through quizzes and projects.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Quizzes: 20% {Weekly}
Project 1: 20% {Week 5}
Project 2: 25% {Week 9}
Project 3: 35% {Week 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07).

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07). Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university -excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

1. Participation in an activity that is required for a class and appears on the university authorized activity list at [https://studentactivities.tamu.edu/app/sponsauth/index](https://studentactivities.tamu.edu/app/sponsauth/index)
2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor’s discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at http://attendance.tamu.edu or
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

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MSEN 476, Multi-Scale Computational Materials Science  
Credits 3. 2 Lecture Hours, 3 Lab Hours

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:  
Dr. Dimitris Lagoudas, HRBB 109C, d-lagoudas@tamu.edu, 979.845.1604

Course (catalog) description: This is a problem-based advanced course illustrating elements of the challenges associated with multi-scale simulations in materials science. As an example, the course will examine the multi-scale modeling of elastic response of a multi-phase microstructure. Elements of uncertainty quantification and propagation will be central to the course.

Course Prerequisites: MSEN 370, or approval of instructor.

Learning Outcomes: At the end of this course, students should be able to:
1. Recognize the strengths and limitations associated with different computational materials modeling techniques
2. Recognize the challenges associated with simulation of materials systems across multiple scales in space and time
3. Understand basic concepts of model uncertainty
4. Apply of simple methods for uncertainty quantification and propagation to multi-scale materials problems
5. Implement practical schemes for information passing across two simulation scales

Textbook: None.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:  
Week 1  The problem: Elastic Response of a Multi-phase Microstructure  
Week 2  Models, Reality and Uncertainty  
Week 3  Model Sensitivity and Model Validation  
Week 4  Elements of Quantification of Uncertainty  
Week 5  The Problem: From Electronic Structure to Elastic Properties of Materials  
Week 6  Sampling Methods – Monte Carlo Methods  
Week 7  The Problem: Using Molecular Dynamics to Predict Elastic Properties of Materials  
Week 8  Elements of Parameter Estimation  
Week 9  The Problem: Predicting Elastic Response of Multi-phase Microstructure  
Week 10  Micromechanics  
Week 11  Homogenization methods  
Week 12  Multi-scale Models and Loss of Information  
Week 13  Uncertainty Quantification in Multi-scale Computational Materials Science  
Week 14  Uncertainty Propagation in Multi-scale Computational Materials Science
Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
The course will be evaluated through quizzes and projects.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Quizzes: 20% {Weekly}
Project 1: 20% {Week 4}
Project 2: 25% {Week 9}
Project 3: 35% {Week 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer’s discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.
1. Participation in an activity that is required for a class and appears on the university authorized activity list at https://studentactivities.tamu.edu/app/sponauth/index
2. Death or major illness in a student’s immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student’s presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (instructor’s discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at https://attendance.tamu.edu or
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student’s physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation.

In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

Academic Integrity:
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MSEN 480, Communicating Materials Science and Engineering
1 Credit, c Course

Term: Fall 2017

Meeting times and locations: TBD

Instructor Information:
Dr. Ted Hartwig, Reed McDonald Bldg. 220, thatwig@tamu.edu, 979-845-1585

Course (catalog) description: Effective communication of technical topics in materials science and engineering to technical and non-technical audiences; emphasis on oral and visual presentations.

Course Prerequisites: MSEN 401 or registration therein.

Learning Outcomes: At the end of this course, students should be able to:
1. Prepare a technical abstract describing a short seminar.
2. Communicate technical results in report form in either a letter or e-mail.
3. Develop a clear and informative figure visually displaying quantitative information
4. Present a brief, no visual-aids technology ‘pitch’.
5. Effectively communicate an important concept in the field of materials science to a non-technical audience.
6. Deliver a 10-minute technical presentation to an audience of your peers.
7. Assemble and present a technical poster to an audience of your peers.


Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://evampus.tamu.edu.

Course Outline:
Week 1  Course Introduction/Communication Mechanics
Week 2  The ‘Pitch’: pt 1
Week 3  The ‘Pitch’: pt 2
Week 4  The Abstract
Week 5  Non-technical Presentations: Grabbing Attention
Week 6  Non-technical Presentations: Explaining Complicated Ideas Simply
Week 7  Technical Oral Presentations: Intro/Background
Week 8  Technical Oral Presentations: Data/Results
Week 9  Technical Oral Presentations: Takeaway Points
Week 10  Posters: Layout
Week 11  Posters: The Figure
Week 12  Posters: Content
Week 13  Presenting Technical Posters
Week 14  Presenting through video
Course Policies and Procedures:

Changes in schedule:
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:
Effective communication techniques will be evaluated through oral, written, and visual presentations. Peer evaluation, and continued revision and improvement of first draft materials will play important roles in gaining a mastery of the course material. This course is a formal c (communication) course. Thus, 1 crh (100 % of grade) will be based on form, content, and style of student presentations.

Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Technology 'pitch' (10%) {Week 3}
Abstract (10%) {Week 5}
Non-technical Presentations (20%) {Week 6}
Technical Presentations (20%) {Week 9}
Figure (10%) {Week 12}
Poster Presentations (20%) {Week 13}
Video Presentations (10%) {Week 14}

Course will not be graded on a curve. Extra credit opportunities may be provided at the lecturer's discretion.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 .

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07 . Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07 ). The fact that these are university
-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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2. Death or major illness in a student's immediate family.
3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor's discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at [http://attendance.tamu.edu](http://attendance.tamu.edu) or
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefore) and related conditions as a justification for an excused absence for so long a period of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

Other absences may be excused at the discretion of the instructor with prior notification and proper documentation. In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

Accommodations sought for absences due to the observance of a religious holiday can be sought either prior or after the absence, but not later than two working days after the absence.

**Academic Integrity:**
Aggie Honor Code: "An Aggie does not lie, cheat, or steal or tolerate those who do." For additional information please visit: [http://aggiehonor.tamu.edu](http://aggiehonor.tamu.edu).

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MSEN 484, Internship
Credits 0-4.

Term: Fall 2017

Meeting times and locations: TBD      Office Hours: TBD

Instructor Information:
Dr. Michael J. Demkowicz, Reed McDonald Bldg. 231, 979.845.0750

Course (catalog) description: Practical experience working in a professional materials science and engineering setting offered on an individual basis.

Course Prerequisites: Junior or Senior classification, approval of instructor

Learning Outcomes: At the end of this course, students should be able to:
1. Formulate and solve engineering problems,
2. Function on multi-disciplinary teams,
3. Act in a professional and ethical manner,
4. Communicate effectively, and
5. Apply synthesis, characterization, or simulation methods towards solving complex materials-related challenges.

Textbook: none.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:
None.

Course Policies and Procedures:
Assessment and Evaluation:
Internships will be completed on a Satisfactory/Unsatisfactory basis only. Satisfactory grade requires completion of reflection assignment at the internship midpoint and at the conclusion of the internship, as well as favorable employer feedback at the end of the internship. The student is responsible for soliciting a letter of evaluation at the end of the internship.

Grading Scale (Standard Letter Scale):
S = Satisfactory
U = Unsatisfactory

Grading Policies:
Satisfactory grade requires completion of reflection assignment at the beginning, midpoint and at the conclusion of the internship, as well as a favorable letter from supervisor at the completion of the internship.
Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07).

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07). Please come on time. Silence cell phones and other electronic distractions.

Internships: Please contact Disability Services in order to assure any accommodations are in place prior to the internship commencing. Disability Services is currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit [http://disability.tamu.edu](http://disability.tamu.edu).

Make-up Policy:
If an absence is excused, the instructor will either provide the student an opportunity to make up any quiz, exam or other work that contributes to the final grade or provide a satisfactory alternative by a date agreed upon by the student and instructor. If the instructor has a regularly scheduled make up exam, students are expected to attend unless they have a university-approved excuse. The make-up work must be completed in a timeframe not to exceed 30 calendar days from the last day of the initial absence.

The student is responsible for providing satisfactory evidence to the instructor to substantiate the reason for the absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details [http://student-rules.tamu.edu/rule07](http://student-rules.tamu.edu/rule07)). The fact that these are university-excused absences does not relieve the student of responsibility for prior notification and documentation. Failure to notify and/or document properly may result in an unexcused absence. Falsification of documentation is a violation of the Honor Code.

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3. Illness of a dependent family member.
4. Participation in legal proceedings or administrative procedures that require a student's presence.
5. Religious holy day. NOTE: Prior notification is NOT required.
6. Injury or illness that is too severe or contagious for the student to attend class.
   i. Injury or illness of three or more class days: Student will provide a medical confirmation note from his or her medical provider within one week of the last date of the absence (see Student Rules 7.1.6.1)
   ii. Injury or illness of less than three class days: Student will provide one or both of these (at instructor’s discretion), within one week of the last date of the absence:
      a) Texas A&M University Explanatory Statement for Absence from Class form available at [http://attendance.tamu.edu](http://attendance.tamu.edu)
      b) Confirmation of visit to a health care professional affirming date and time of visit.
7. Required participation in military duties.
8. Mandatory admission interviews for professional or graduate school that cannot be rescheduled.
9. Mandatory participation as a student-athlete in NCAA-sanctioned competition.
10. In accordance with Title IX of the Educational Amendments of 1972, Texas A&M University shall treat pregnancy (childbirth, false pregnancy, termination of pregnancy and recovery therefrom) and related conditions as a justification for an excused absence for so long a period
of time as is deemed medically necessary by the student's physician. Requests for excused absence related to pregnancy should be directed to the instructor.

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In cases where prior notification is not feasible (e.g., accident or emergency) the student must provide notification by the end of the second working day after the absence, including an explanation of why notice could not be sent prior to the class.

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The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information visit [http://disability.tamu.edu](http://disability.tamu.edu).
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MSEN 485, Directed Studies  
Credits 0-4.

Term: Fall 2017

Meeting times and locations: TBD  
Office Hours: TBD

Instructor Information:  
Dr. Patrick Shamberger, Reed McDonald Bldg. 229, patrick.shamberger@tamu.edu, 979-458-1086

Course (catalog) description: Directed study of selected problems in the area of materials science and engineering not covered in other courses. May be taken four times for credit.

Course Prerequisites: Junior or Senior classification, approval of instructor

Learning Outcomes: At the end of this course, students should be able to demonstrate conceptual understanding in the topic area of directed study, as defined by the instructor. Learning outcomes are identified on an individual basis at the outset of the semester.

Textbook: Textbook identified on an individual basis at the outset of the semester.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline:  
Course outline identified on an individual basis at the outset of the semester.

Course Policies and Procedures:  
Changes in schedule:  
The instructor reserves the right to change the order and content of lectures as necessary (and to make up for holidays and unscheduled class cancellations). Exam dates may be changed by the instructor, but in each case, at least 1 week notice will be given.

Assessment and Evaluation:  
The course is evaluated based on submission of directed-study related products, as agreed upon by the student and the faculty instructor at the beginning of the semester. The student is responsible for preparing, and getting instructor approval for the course plan of study, including: 1) Objective of the Directed Studies course, 2) Approach, 3) Expected Outcomes/Deliverables, 4) Weekly Schedule, 5) Grading scheme, and 6) Credit Hour justification.

The complexity of assignments will reflect the number of credit hours of the course.

An example for a course might be:

Submission of Proposed Plan of Study: 10%  
2 Page Weekly Reading Reports: 40%  
Final Written Summary paper: 30%  
Final 10-minute Presentation Video: 20%
Grading Scale (Standard Letter Scale):
A = 90-100
B = 80-89.99
C = 70-79.99
D = 60-69.99
F = <60

Grading Policies:
Grading scheme is agreed upon by the student and faculty instructor at the onset of the semester.

Late Work Policy:
No late work will be accepted, unless in the case of excused attendance. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07.

Attendance:
The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at http://student-rules.tamu.edu/rule07. Please come on time. Silence cell phones and other electronic distractions.

Make-up Policy:
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MSEN 491, Research
Credits 0-4.

Term: Fall 2017

Meeting times and locations: TBD
Office Hours: TBD

Instructor Information:
Dr. Patrick Shamberger; Reed McDonald Bldg. 229, patrick.shamberger@tamu.edu, 979-458-1086

Course (catalog) description: Research conducted under the direction of faculty members in materials science and engineering. May be taken four times for credit.

Course Prerequisites: Approval of instructor

Learning Outcomes: At the end of this course, students should have made significant research progress in the agreed upon area of research, as defined by the instructor. Learning outcomes are identified on an individual basis at the outset of the semester.

Textbook: Textbook identified on an individual basis at the outset of the semester.

Additional Material: Lecture notes, assignments, solutions, grades, project instructions, and additional material will be available at http://ecampus.tamu.edu.

Course Outline: Course outline identified on an individual basis at the outset of the semester.

Course Policies and Procedures:
Changes in schedule:
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Assessment and Evaluation:
The course is evaluated based on submission of research-related products, as agreed upon by the student and the faculty instructor at the beginning of the semester. The student is responsible for preparing, and getting instructor approval for the course plan of study, including: 1) Objective of the Research, 2) Approach, 3) Expected Outcomes/Deliverables, 4) Weekly Schedule, 5) Grading scheme, and 6) Credit Hour justification.

The complexity of assignments will reflect the number of credit hours of the course.

An example for a course might be:
Submission of Proposed Plan of Study: 10%
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Undergraduate Required Areas: 128 hours*

Major Coursework: Total 53

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>ENGR 111</td>
<td>Foundations of Engr I.</td>
<td>2</td>
</tr>
<tr>
<td>ENGR 112</td>
<td>Foundations of Engr. II.</td>
<td>2</td>
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<tr>
<td>MSEN 201</td>
<td>Fundamentals of Materials Science and Engineering.</td>
<td>3</td>
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<tr>
<td>MSEN 210</td>
<td>Thermodynamics of Materials.</td>
<td>3</td>
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<tr>
<td>MSEN 220</td>
<td>Chemistry and Physics of Inorganic Materials.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(To be cross listed as CHEM/MSEN 220 in the future)</td>
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<tr>
<td>MSEN 240</td>
<td>Kinetics of Materials.</td>
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<tr>
<td>MSEN 250</td>
<td>Soft Matter.</td>
<td>3</td>
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<td>MSEN 281</td>
<td>Materials Seminar.</td>
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<tr>
<td>MSEN 301</td>
<td>Unified Materials Lab I.</td>
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<tr>
<td>MSEN 302</td>
<td>Unified Materials Lab II.</td>
<td>2</td>
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<tr>
<td>MSEN 310</td>
<td>Structure of Materials.</td>
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<tr>
<td>MSEN 320</td>
<td>Deformation and Failure Mechanisms in Engineering Materials.</td>
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</tr>
<tr>
<td>MSEN 330</td>
<td>Numerical Methods for Materials Scientists and Engineers.</td>
<td>2</td>
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<tr>
<td>MSEN 340</td>
<td>Case Studies in Materials.</td>
<td>2</td>
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<tr>
<td>MSEN 370</td>
<td>Introduction to Computational Materials Science and Engineering.</td>
<td>2</td>
</tr>
<tr>
<td>MSEN 400</td>
<td>Design and Analysis of Materials Experiments.</td>
<td>2</td>
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<tr>
<td>MSEN 401</td>
<td>Materials Research and Design I.</td>
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<tr>
<td>MSEN 402</td>
<td>Materials Research and Design II.</td>
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</tr>
<tr>
<td>MSEN 460</td>
<td>Properties of Functional Materials.</td>
<td>3</td>
</tr>
<tr>
<td>MSEN 480</td>
<td>Communicating Materials Science and Engineering.</td>
<td>1</td>
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</tbody>
</table>

Concentration Coursework: Total 18 hrs

Technical Electives 9: MSEN 300-499

Specialty Electives 9: MSEN 300-499; AERO 300-499; BAEN 300-499; BMEN 300-499; CHEN 300-499; CVEN 300-499;
CSCE 300-499; ECEN 300-499; ISEN 300-499; MEEN 300-499; NUEN 300-499; ENGR 300-499;
BIOL 300-499; CHEM 300-499; MATH 300-499; PHYS 300-499; STAT 300-499

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Communication: Minimum 6 hrs
Must take:
  ENGL 104
Choose one:
  COMM 205
  ENGL 210

Mathematics: Minimum 6hrs. Total 14
  MATH 151 Eng Math I
  MATH 152 Eng Math II
  MATH 251 Eng Math III
  MATH 307 Analytical Mthds for Materials Engineering

Life and Physical Sciences**: Minimum 9hrs. Total 16
  PHYS 218 Mechanics
  PHYS 208 Elect and Optics
  CHEM 101/111 Fund Chem I
  CHEM 102/112 Fund Chem II

Language, Philosophy and Culture**: Minimum 3hrs
Select one from list:
  ANTH 210 Introduction to Social and Cultural Anthropology
  ANTH 316 Nautical Archaeology
  ENGL 204 Introduction to African American Literature
  ENGL 222 World Literature
  ENGL 330 Arthurian Literature
  ENGL 334 Science Fiction Present and Past
  ENGL 336 American Ethnic Literature
  ENGL 374 Women Writers
  GEOG 202 Geography of the Global Village
  GEOG 301 Geography of the United States
  SPAN 201 Intermediate Spanish I
  SPAN 202 Intermediate Spanish II
  AFST 204 Introduction to African American Literature
  AFST 345 Modern Africa
  ANTH 204 Peoples and Cultures of the Ancient World
  ANTH 205 Peoples and Cultures of the World
  ANTH 317 Introduction to Biblical Archaeology
  ARAB 201 Intermediate Arabic I
  ARAB 202 Intermediate Arabic II
  ARCH 213 Sustainable Architecture
  CARC 331 Field Studies in Design Philosophy
  CHIN 201 Intermediate Chinese I
  CHIN 202 Intermediate Chinese II
  CLAS 220 History of Christianity: Organs to the Reformation
  CLAS 221 Intermediate Latin I
  CLAS 222 Intermediate Latin II
  CLAS 250 Greek and Roman Civilization
  CLAS 251 Classical Mythology
  CLAS 429 The Roman Empire
  COMM 301 Rhetoric in Western Thought
  COMM 327 American Oratory
  ENGL 202 Environmental Literature
  ENGL 206 21st Century Literature and Culture
  ENGL 221 World Literature
  ENGL 227 American Literature: Beginnings to Civil War
  ENGL 228 American Literature: Civil War to Present
  ENGL 231 Survey of English Lit I
  ENGL 232 Survey of British Literature II
  ENGL 333 Gay and Lesbian Literature
  ENGL 360 Literature for Children
  ENGL 362 Latino/a Literature of the U.S.
  ENGL 365 Bible as Literature
  ENGL 376 American Novel Since 1900
  ENGR 482 Ethics and Engineering
  FREN 201 Intermediate French I
  FREN 202 Intermediate French II
  FSTC 300 Religious and Ethnic Foods
  GEOG 305 Geography of Texas
  GERM 201 Intermediate German I
  GERM 202 Intermediate German II
  HISP 206 Food in the Hispanic World
  HISP 362 Latino/a Literature of the U.S.
  HIST 101 Western Civilization to 1660
  HIST 102 Western Civilization Since 1660
  HIST 103 World History to 1500
  HIST 104 World History Since 1500
  HIST 210 Russian Civilization
  HIST 213 History of England
  HIST 214 History of England
  HIST 220 History of Christianity: Origins to the Reformation
  HIST 221 History of Islam
  HIST 234 European Military History, 1630-1900
  HIST 345 Modern Africa
  HIST 347 Rise of Islam, 600-1258
  HIST 429 The Roman Empire
  INTS 251 Contemporary Issues in the Middle East
  ITAL 201 Intermediate Italian I
  ITAL 202 Intermediate Italian II
  JAPN 201 Intermediate Japanese I
  JAPN 202 Intermediate Japanese II
  LAND 240 History of Landscape Architecture
  MODL 221 World Literature

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<tr>
<td>MODL 222</td>
<td>World Literature</td>
<td>RELS 347</td>
<td>Rise of Islam, 600-1258</td>
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<tr>
<td>MUSC 201</td>
<td>Music &amp; The Human Experience</td>
<td>RELS 360</td>
<td>Bible as Literature</td>
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<td>MUSC 227</td>
<td>Popular Music of India</td>
<td>RUSS 201</td>
<td>Intermediate Russian I</td>
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<td>MUSC 325</td>
<td>Dance in World Cultures</td>
<td>RUSS 202</td>
<td>Intermediate Russian II</td>
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<td>MUSC 326</td>
<td>Dance and Identity in the United States</td>
<td>SPMT 220</td>
<td>Olympic Studies</td>
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<td>NUTR 300</td>
<td>Religious and Ethnic Foods</td>
<td>THAR 155</td>
<td>History of Western Dress</td>
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<td>PERF 325</td>
<td>Dance in World Cultures</td>
<td>THAR 156</td>
<td>Dress, Culture, and Society</td>
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<td>PERF 326</td>
<td>Dance and Identity in the United States</td>
<td>THAR 280</td>
<td>History of Theatre I</td>
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<td>PHIL 111</td>
<td>Contemporary Moral Issues</td>
<td>THAR 281</td>
<td>History of the Theatre II</td>
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<tr>
<td>PHIL 251</td>
<td>Introduction to Philosophy</td>
<td>WGST 200</td>
<td>Introduction to Women's and Gender Studies</td>
</tr>
<tr>
<td>PHIL 482</td>
<td>Ethics and Engineering</td>
<td>WGST 333</td>
<td>Gay and Lesbian Literature</td>
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<td>RELS 221</td>
<td>History of Islam</td>
<td>ENGL 253</td>
<td>Introduction to Cultural Studies &amp; Popular Culture</td>
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<td>RELS 251</td>
<td>Classical Mythology</td>
<td>ENGL 335</td>
<td>Literature of the Sea</td>
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<td>RELS 312</td>
<td>Contemplative Practices in the Modern World</td>
<td>HIST 242</td>
<td>United States Maritime History</td>
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<td>RELS 317</td>
<td>Introduction to Biblical Archaeology</td>
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**Creative Arts**: Minimum 3hrs

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<td>Music in World Cultures</td>
</tr>
<tr>
<td>ARCH 249</td>
<td>Survey of World Architecture History 1</td>
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<td>Survey of World Architecture History II</td>
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<tr>
<td>ARCH 350</td>
<td>History and Theory of Modern and Contemp Arch</td>
</tr>
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<td>ARTS 149</td>
<td>Art History Survey I</td>
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<td>CARC 311</td>
<td>Field Studies in Design Communication</td>
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<tr>
<td>DCED 202</td>
<td>Dance Appreciation</td>
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<tr>
<td>ENDS 101</td>
<td>Design Process</td>
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<td>ENDS 115</td>
<td>Design Communication Foundations</td>
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<tr>
<td>ENGL 219</td>
<td>Literature and the Other Arts</td>
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<td>FILM 251</td>
<td>Introduction to Film Analysis</td>
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<td>FILM 425</td>
<td>French Film</td>
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<tr>
<td>HISP 204</td>
<td>Spanish &amp; Spanish American Lit in Translation</td>
</tr>
<tr>
<td>HISP 205</td>
<td>Don Quijote and the other Arts</td>
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<tr>
<td>HORT 203</td>
<td>Floral Design</td>
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<tr>
<td>KINE 311</td>
<td>Fundamental Rhythms and Dance</td>
</tr>
<tr>
<td>MUSC 221</td>
<td>Guitar Heroes</td>
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<tr>
<td>MUSC 222</td>
<td>Music of the Americas</td>
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<tr>
<td>MUSC 225</td>
<td>History of Jazz</td>
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<tr>
<td>MUSC 228</td>
<td>History of Electronic Music</td>
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<tr>
<td>MUSC 301</td>
<td>Performance in World Cultures</td>
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<tr>
<td>MUSC 324</td>
<td>Music in World Cultures</td>
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<tr>
<td>MUSC 327</td>
<td>Popular Music in the African Diaspora</td>
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<td>MUSC 328</td>
<td>Japanese Traditional Performing Arts</td>
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<tr>
<td>MUSC 386</td>
<td>Evolution of the American Musical</td>
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<tr>
<td>MUSC 396</td>
<td>Performance in World Cultures</td>
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<tr>
<td>PERF 301</td>
<td>Philosophy of Art</td>
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<tr>
<td>PERF 327</td>
<td>Popular Music in the African Diaspora</td>
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<tr>
<td>PHIL 330</td>
<td>Philosophy of Art</td>
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<tr>
<td>PHIL 375</td>
<td>Philosophy of Visual Media</td>
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<tr>
<td>THAR 101</td>
<td>Introduction to Western Theatre and Drama</td>
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<tr>
<td>THAR 201</td>
<td>Introduction to World Theater</td>
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<td>THAR 301</td>
<td>Performance in World Cultures</td>
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<td>THAR 328</td>
<td>Japanese Traditional Performing Arts</td>
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<tr>
<td>THAR 386</td>
<td>Evolution of the American Musical</td>
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<tr>
<td>KINE 210</td>
<td>Dance Appreciation and the Art of Movement</td>
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**Social and Behavioral Science**: Minimum 3hrs

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ENGR 482</td>
<td>Ethics and Engineering (w)</td>
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**Citizenship**: This is a university area and will be added automatically. Total 12

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ENGR 482</td>
<td>Ethics and Engineering (w)</td>
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</tbody>
</table>

**Work Not Applied**: This is a university area and will be added automatically

** These courses come from [http://core.tamu.edu/](http://core.tamu.edu/) and may be updated or changed upon University discretion.
University Writing Req.: 2 courses min. (List the departments approved writing or communication courses – or you may use the university approved: Must have two courses with the UWRT or UCRT attributed)

MSEN 301 – Unified Materials Lab (w)
MSEN 302 – Unified Materials Lab II (w)
ENGR 482 – Ethics and Engineering (w)
MSEN 480 – Communication Materials Science & Engineering (c)

Int‘l & Cult Diversity: This is a university area and will be added automatically

Foreign Language: For programs that do not require a foreign language, area this is the university approved foreign language area

Residence Requirement – 36 hrs of 300-400 level coursework must be completed at TAMU. 12 hrs must be in major field: List the range for the 12hr major field of study (example: COMM 300-499)

MSEN 300-499

GPR – Major: Specific courses required: Provide a list or range of courses for this area: (example – MUSC 100-499; ARTS 149; ENGL 227)

74 hours *this includes the 53 hours of major coursework, 18 hours of technical/specialty electives and 3 hours of MATH 307

MATH 307; MEEN 300-499; MSEN 100-499; AERO 300-499; BAEN 300-499; BMEN 300-499; CHEN 300-499; CVEN 300-499; CSCE 300-499; ECEN 300-499; ISEN 300-499; MEEN 300-499; NUEN 300-499; ENGR 300-499; BIOL 300-499; CHEM 300-499; MATH 300-499; PHYS 300-499; STAT 300-499

** These courses come from http://core.tamu.edu/ and may be updated or changed upon University discretion.
MEMORANDUM

TO: Dr. Ibrahim Karaman, Department Head  
Department of Materials Sciences and Engineering

THROUGH: Dr. François Gabbaï, Department Head  
Department of Chemistry

Dr. Simon North, Associate Head and Chair, Academic Operations Committee  
Department of Chemistry

Dr. Holly Gaede, Undergraduate Advisor and Chair, Undergraduate Curriculum Committee  
Department of Chemistry

Dr. Sarbajit Banerjee, ad hoc Committee Member, MSEN Undergraduate Curriculum Committee, Departments of Chemistry and Materials Science and Engineering

FROM: Dr. James Batteas, ad hoc Committee Member, MSEN Undergraduate Curriculum Committee, Departments of Chemistry and Materials Science and Engineering

SUBJECT: Chemistry related coursework for the BS degree in Materials Science and Engineering

This memo serves as a summary of the comments and input from the Chemistry Department to MSEN on their proposed BS degree program. Having received a copy of their degree plans, the Chemistry Department has engaged in active discussion among representative faculty in the department with regards to their planned curriculum and how the Department of Chemistry can best assist in this degree. The input, as presented to the department head from our Undergraduate Curriculum Committee, our Academic Operations Committee, with further input from Drs. Sarbajit Banerjee and James Batteas, who have been participating as ad hoc members of the MSEN Undergraduate Curriculum Committee, is described below.

We want to start by thanking the MSEN Department for visiting with us and discussing their degree program with us. There is a natural synergy between CHEM and MSEN that this degree will facilitate, and we support the formation of a BS degree in MSEN, and look forward to ongoing curricula and research development with MSEN.

A. Concerns raised by the department

Here we present an itemized list of concerns brought forward. While these concerns do not prevent our support for the degree plan, they are noted here simply for informational purposes for MSEN as they were raised by faculty in our department.

1. Since the material covered in the proposed Physics and Chemistry of Materials was largely chemistry, it was felt that the course should be offered by chemistry faculty through the chemistry department. This proposal has been revised to reflect this new plan in the form of the CHEM 220/MSEN 220 course (See below).
2. A concern was raised with regards to the lack of organic chemistry, coverage of which was included only in a few weeks as part of the MSEN Soft Matter course. We strongly believe that some organic chemistry should be included as a prerequisite for this course. To this end, we are evaluating the development of a one semester terminal organic course to serve this purpose, or if additional chemistry courses absolutely cannot be included in the curriculum, develop an alternative first year sequence that includes sufficient organic chemistry. Those discussions are planned. (See below).

3. We hope that some of the MSEN courses will be readily available to our Chemistry majors (for example, the course dealing with electrochemistry would be especially beneficial) and we hope that the level and number of prerequisites to access these courses will not be prohibitive for students outside of engineering.

B. Resolutions of support

As it does for all majors, the Chemistry Department will teach introductory chemistry (CHEM 101 and CHEM 102, along with the corresponding laboratory courses, CHEM 111 and CHEM 112) in support of students in MSEN. These are foundational courses in chemistry needed for any student seeking to be involved in careers associated with materials science. These courses are offered every semester and taught by chemistry faculty.

Following consultation with MSEN, the Chemistry Department will also develop and teach (out of an existing special topics course on Materials Chemistry, CHEM 489), a new course - CHEM 220 – Physics and Chemistry of Inorganic Materials, which will be cross-listed with MSEN as MSEN 220. This course will provide students with the fundamental concepts of solid-state chemistry which impacts a wide a range of materials and give students and appreciation for the structure, properties, and function of materials developed from an atomistic and molecular perspective emphasizing quantum chemical descriptions; elements of solid-state chemistry and physics including bonding, crystal structure and symmetry, origin of electronic band structure; synthesis and characterization tools in materials chemistry. This course will be offered by the Chemistry Department at least once per year and up to every semester as needed, based on enrollment demand. This course will be staffed by chemistry faculty. To optimize the experience for, as available, faculty with joint appointments between CHEM and MSEN will be utilized to teach this course.

C. Ongoing development

There are still ongoing discussions with regards to the optimal way of providing students in MSEN with foundational chemistry. Given the needs for both a strong introductory chemistry experience as well as exposure to organic chemistry, which the Chemistry Department views as critical for students with interests in soft matter, the department is engaged in ongoing discussions on developing a new freshman sequence that would involve a combination of CHEM 107 in conjunction with a new course, CHEM 108, in which students would receive a solid introduction to organic chemistry, aimed at students with an interest in materials both in the Chemistry Department and MSEN.

In order to bring this concept to fruition however, additional discussions and development are required. Elements that must be considered include: 1) what concepts are missing from CHEM 107 that should be added to CHEM 108 that would be of benefit to MSEN students (e.g. electrochemistry, descriptive inorganic chemistry)? and 2) what is the optimal combination of topics from organic chemistry that should be included?
Our Organic Chemistry division will be meeting on December 21, 2015 to discuss this. Until such time as this is resolved however, it is the position of the Chemistry Department that students in MSEN take the CHEM 101/102 sequence as described in the original degree plans from MSEN.