

Minor Curriculum Changes in the MMAE Department:

The MMAE department made the following minor changes in the curriculums of Mechanical Engineering (ME), Aerospace Engineering (AE) and Materials Science & Engineering (MSE) degree programs. These minor curriculum changes have been approved by full faculty vote in the MMAE department and is now being submitted to IIT UGSC for information. Motivation for these changes are presented at the end of this document along with the other changes that have been made over the last 2 years.

ME Curriculum Changes:

OLD	NEW
<p>MMAE 200 Statics (3-0-3)</p> <p>Equilibrium concepts. Free body diagrams. Statics of particles and rigid bodies. Distributed forces, centroids, center of gravity, hydrostatic loads, and moments of inertia. Analysis of trusses and frames. Friction including wedges, screws, and belts. Internal loads in beams.</p> <p>PREREQUISITE(S): (CS 104* or CS 105* or CS 115*) and MATH 152* and PHYS 123, An asterisk (*) designates a course which may be taken concurrently.</p>	<p>MMAE 200 has been removed from the curriculum, and a TECHNICAL ELECTIVE is added to the curriculum.</p>
<p>MMAE 202 Mechanics of Solids (3-0-3)</p> <p>Stress and strain relations, mechanical properties. Axially loaded members. Torsion of circular shafts. Elementary bending theory, unsymmetric bending, normal and shear stresses in beams, beam deflection. Combined loading. Plane stress and strain, Mohr's circle, stress transformation.</p> <p>PREREQUISITE(S): MMAE 200</p>	<p>MMAE 202 Mechanics of Solids (3-0-3)</p> <p>Newton's law. Force and moment balance in vector form. Free body diagrams. Trusses. Distributed loads including fluid statics. Loads on a beam, shear force and bending moment diagrams. Stress, strain, and Hooke's law. Thermal stresses. Internal shear and normal stresses in a beam. Shear stress and torsion. Friction (screws, belts). Computational methods in mechanics.</p> <p>PREREQUISITE(S): (CS 104* or CS 105* or CS 115*) and MATH 152* and PHYS 123, An asterisk (*) designates a course which may be taken concurrently.</p>
<p>MMAE 302 Advanced Mechanics of Solids (3-0-3)</p> <p>Analysis of stress and strain. Singularity functions. Plasticity under torsional and bending loads. Energy methods and Castigliano's theorems. Curved beams and springs. Pressure vessels. Stability of columns. Stress concentration and stress intensity factors. Theories of failure, yield, and fracture. Fatigue.</p> <p>PREREQUISITE(S): MMAE 202 and MATH 252 and MATH 251</p>	<p>MMAE 302 Advanced Mechanics of Solids (3-0-3)</p> <p>Singularity functions in bending. Moment and deflection of beams. Stress-transformation in 2 and 3D (from the perspective of matrix rotation, eigenvalues) and Mohr circle. Thin walled pressure vessels. Yield theories. Effective stress concept. Strain components and Hooke's law in 3D. Energy methods for trusses, beams and frames. Stability of columns. Stress concentration factors and stress intensity factors. Cracks in 3 modes. computational methods in mechanics.</p> <p>PREREQUISITE(S): MMAE 202 and MATH 252 and MATH 251</p>
<p>MMAE 445 Computer-Aided Design (3-0-3)</p> <p>Principles of geometric modeling, finite element analysis and design optimization. Curve, surface, and solid modeling. Mesh generation, Galerkin method, and Isoparametric elements. Optimum design concepts. Numerical methods for constrained and unconstrained optimization. Applications of CAD/CAE software for mechanical design problems.</p> <p>PREREQUISITE(S): MMAE 350 and (MMAE 304 or MMAE 332)</p>	<p>MMAE 445 has been removed from the curriculum, and a TECHNICAL ELECTIVE is added to the curriculum. However, MMAE 445 will be offered as a technical elective.</p>

AE Curriculum Changes:

OLD	NEW
<p>MMAE 200 Statics (3-0-3) Equilibrium concepts. Free body diagrams. Statics of particles and rigid bodies. Distributed forces, centroids, center of gravity, hydrostatic loads, and moments of inertia. Analysis of trusses and frames. Friction including wedges, screws, and belts. Internal loads in beams.</p> <p>PREREQUISITE(S): (CS 104* or CS 105* or CS 115*) and MATH 152* and PHYS 123, An asterisk (*) designates a course which may be taken concurrently.</p>	<p>MMAE 200 has been removed from the curriculum, and a TECHNICAL ELECTIVE is added to the curriculum.</p>
<p>MMAE 202 Mechanics of Solids (3-0-3) Stress and strain relations, mechanical properties. Axially loaded members. Torsion of circular shafts. Elementary bending theory, unsymmetric bending, normal and shear stresses in beams, beam deflection. Combined loading. Plane stress and strain, Mohr's circle, stress transformation.</p> <p>PREREQUISITE(S): MMAE 200</p>	<p>MMAE 202 Mechanics of Solids (3-0-3) Newton's law. Force and moment balance in vector form. Free body diagrams. Trusses. Distributed loads including fluid statics. Loads on a beam, shear force and bending moment diagrams. Stress, strain, and Hooke's law. Thermal stresses. Internal shear and normal stresses in a beam. Shear stress and torsion. Friction (screws, belts). Computational methods in mechanics.</p> <p>PREREQUISITE(S): (CS 104* or CS 105* or CS 115*) and MATH 152* and PHYS 123, An asterisk (*) designates a course which may be taken concurrently.</p>
<p>MMAE 304 Mechanics of Aerostructures (3-0-3) Loads on aircraft, and flight envelope. Stress, strain and constitutive relations. Torsion of open, closed and multi-cell tubes. Energy methods. Castigliano's theorems. Structural instability.</p> <p>PREREQUISITE(S): MMAE 202 and MATH 252 and MATH 251</p>	<p>MMAE 304 Mechanics of Aerostructures (3-0-3) Loads on aircraft and flight envelopes. Singularity functions in bending moment and deflection of beams. Stress, strain and constitutive relations. Stress-transformation in 2 and 3D (from the perspective of matrix rotation, eigenvalues) and Mohr circle. Energy methods. Castigliano's theorems. Torsion of open, closed and multi-cell tubes. Structural instability. Stress concentration factors and stress intensity factors. Cracks in 3 modes. Fatigue and cumulative damage.</p> <p>PREREQUISITE(S): MMAE 202 and MATH 252 and MATH 251</p>

MSE Curriculum Changes:

OLD	NEW
<p>MMAE 200 Statics (3-0-3) Equilibrium concepts. Free body diagrams. Statics of particles and rigid bodies. Distributed forces, centroids, center of gravity, hydrostatic loads, and moments of inertia. Analysis of trusses and frames. Friction including wedges, screws, and belts. Internal loads in beams.</p> <p>PREREQUISITE(S): (CS 104* or CS 105* or CS 115*) and MATH 152* and PHYS 123, An asterisk (*) designates a course which may be taken concurrently.</p>	<p>MMAE 200 has been removed from the curriculum and MMAE 350 is added to the curriculum. Note that MMAE 350 is an existing course offered by the department on a regular basis, and is required by ME and AE curriculums.</p> <p>MMAE 350 Computational Mechanics (3-0-3) Explores the use of numerical methods to solve engineering problems in solid mechanics, fluid mechanics and heat transfer. Topics include matrix algebra, nonlinear equations of one variable, systems of linear algebraic equations, nonlinear equations of several variables, classification of partial differential equations in engineering, the finite difference method, and the finite element method. Same as MATH 350.</p> <p>PREREQUISITE(S): MATH 251 and CS 104-201 and MMAE 202* and MATH 252*, An asterisk (*) designates a course which may be taken concurrently.</p>
<p>MMAE 202 Mechanics of Solids (3-0-3) Stress and strain relations, mechanical properties. Axially loaded members. Torsion of circular shafts. Elementary bending theory, unsymmetric bending, normal and shear stresses in beams, beam deflection. Combined loading. Plane stress and strain, Mohr's circle, stress transformation.</p> <p>PREREQUISITE(S): MMAE 200</p>	<p>MMAE 202 Mechanics of Solids (3-0-3) Newton's law. Force and moment balance in vector form. Free body diagrams. Trusses. Distributed loads including fluid statics. Loads on a beam, shear force and bending moment diagrams. Stress, strain, and Hooke's law. Thermal stresses. Internal shear and normal stresses in a beam. Shear stress and torsion. Friction (screws, belts). Computational methods in mechanics.</p> <p>PREREQUISITE(S): (CS 104* or CS 105* or CS 115*) and MATH 152* and PHYS 123, An asterisk (*) designates a course which may be taken concurrently.</p>

Motivation for these curriculum changes:

In an attempt to improve the curriculums of UG degree programs, MMAE department looked into the curriculums of similar programs nationwide and discussed the findings in its last Faculty Retreat in May 2021 and later in subcommittees, where MMAE faculty agreed to consolidate three courses in the mechanics sequence (MMAE 200, 202, 302/304) into two courses (which is in line with many other ME and AE programs nationwide) and use the 3 credit hours created towards a technical elective to bring more flexibility to ME and AE curriculums. The MSE program used these 3 credit hours created to introduce a Computational Mechanics course (MMAE 350) into its curriculum due to its increasing role in materials science and also because MSE program already had total of five technical/free/engineering electives in its curriculum.

The impact of these changes on the number of technical/free/engineering electives is as follows:

	OLD	NEW
ME program	1 Tech, 2 Free electives	3 Tech, 2 Free electives
AE program	2 Free electives	1 Tech, 2 Free electives
MSE program	2 Tech, 2 Free, 1 Engineering electives	2 Tech, 2 Free, 1 Engineering electives

Changes that have been made over the last 2 years:

Over the last 2 years, there have been 3 changes related to degree programs in the MMAE department. Two of these changes are related to the creation of new minors, while one is about converting one technical elective in AE and MSE curriculums into a free elective.

These changes are summarized in the minutes of IIT UGSC meetings as follows:

2019, Oct 8th

Information item: new minor in Manufacturing Engineering (Wark).

C. Wark described the requirements of a new minor in Manufacturing Engineering as part of the offerings from the MMAE department. A discussion followed with some concerns and questions:

- The minor will require students to take several courses at the 500 level.
- The minor will primarily be completed by students within the MMAE department --- should this instead be offered as a specialization?

C. Wark addressed these concerns: there is precedent for minors requiring 500 level classes, Civil Engineering students would also be in a position to complete this minor, the MMAE department wants to offer this as a minor not as a specialization.

2019, Oct 22nd

Information item: minor changes to BS in Aerospace Engineering and BS in Materials Science and Engineering (C. Wark).

C. Wark described the following changes by the MMAE department and explained that the changes were made to increase to number of free electives credits for students in these programs.

- Aerospace Engineering: The 1 technical elective in the BS Aerospace engineering program is now a free elective. *The Aerospace Engineering program now has 2 free electives instead of 1 free and 1 technical.*
- Materials Science and Engineering: One of the three technical electives is converted to a free elective. *The MSE program now has 2 free electives, 2 technical electives and 1 engineering elective instead of 1 free, 3 technical and 1 engineering.*

A short discussed followed.

2021, April 27th

Information item: [elimination of minor in Electromechanical Design and Manufacturing \(for AE majors\), and addition of minor in Electromechanical Systems \(for AE and ME majors\)](#) (Vural).