UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Report No. 3639 Revised

MEMORANDUM

To: Executive Committee of Faculty Council (November 21, 2019)
Faculty Council (December 13, 2019)

From: Prof. Evan Bentz
Chair, Undergraduate Curriculum Committee

Date: November 29, 2019

Re: **Major Curriculum Changes for the 2020-2021 Academic Year**

REPORT CLASSIFICATION

This is a major policy matter that will be considered by the Executive Committee for endorsing and forwarding to Faculty Council for vote as a regular motion (requiring a simple majority of members present and voting to carry).

BACKGROUND

The Undergraduate Curriculum Committee is tasked with managing the curriculum change process for the Faculty. This report summarizes course changes proposed for the 2020-2021 academic year.

PROGRAMS AFFECTED

The proposed curriculum changes affect cross-disciplinary minors and certificates, and undergraduate programs in Civil & Mineral Engineering, the Cross Disciplinary Programs Office, Electrical & Computer Engineering, Engineering Science, First Year Core 8, the Institute for Studies in Transdisciplinary Engineering Education & Practice, Institute of Biomaterials & Biomedical Engineering, Materials Science & Engineering, and Mechanical & Industrial Engineering.

CONSULTATION

These changes have been reviewed and approved by the Undergraduate Curriculum Committee, which is comprised of representatives from each undergraduate program; the Vice-Dean, Undergraduate Studies; the Vice-Dean, First Year; the Associate Dean, Cross-Disciplinary Programs; the Director, First Year Curriculum; the Registrar's Office; undergraduate students; the Faculty's Teaching and Learning Specialist; the Faculty's

Scheduling Officer; and representatives from IBBME, UTIAS, the Institute for Studies in Transdisciplinary Engineering & Practice, and the Engineering and Computer Science Library. The Committee meets regularly, and reviews changes to the curriculum. The impact of these changes on students in the relevant programs has been considered.

RECOMMENDATION FOR FACULTY COUNCIL

THAT the proposed curriculum changes for the 2020-2021 academic year, as described in Report 3639 Revised, be approved.

PROPOSED CURRICULUM CHANGES

1. **CIVIL & MINERAL ENGINEERING**

1.1. **CIV576H1** Sustainable Buildings, 0.5 credit weight, **3/0/1**
- Change course hours to: **3/0/0**

1.2. **Remove ESS221H1 Minerals and Rocks and ESS222H1 Petrology from Lassonde Mineral Engineering Year 2 Curriculum and replace with ESS262H1 Earth Systems Processes and ESS224H1 Rocks and Minerals**
- Rationale: Both ESS221H1 and ESS222H1 are hosted by the Earth Sciences department, and the courses will be withdrawn at the end of the current academic year. As alternatives, ES will off ESS262H1 and ESS224H1 in their place starting in Fall 2020.

1.3. **NEW COURSE: MIN1XX Insight into Mineral Engineering, 0.5 credit weight, 3/2/1, 50% Engineering Science, 50% Complementary Studies**
- Description: A comprehensive introduction into the global minerals industry using international regulatory requirements as a thematic structure. Engineering applications together with current and emerging issues are emphasized throughout. Principal topics include: mineral resources in the economy; land and mineral ownership; legal and environmental issues; mineral exploration; surface and sub-surface mine development and management; fundamentals of mineral processing; mineral industry finance. Graphics communication skills are developed in the associated laboratory sessions, and a visit to an operating mine is used to place the course material in context.
- Rationale: The content of ESS262H1 significantly duplicates that of the existing CME185H1, and as a result it is proposed that a new 1S course MIN1xx Insight into Mineral Engineering is introduced in 2020-2021. For LME

this will replace both of the existing 1S CME185H1 Earth Systems Science and 2F MIN225H1 Introduction to the Resource Industries courses.

1.4. **MIN429H1F** Engineering Rock Mechanics, 0.5 credit weight, 3/1/1

- Change course code to: MIN329H1F
- Change course description to:
  An introduction to fundamental concepts of rock mechanics and their application to rock engineering. Rock mechanics topics include: stress and strain; in situ stress; intact rock strength; discontinuity geometry, strength and stiffness; rock mass behaviour; anisotropy, heterogeneity and the size effect; rock mass classification schemes. Rock engineering topics include: rock excavation; rock stabilization; instability mechanisms in foundations and slopes; rock slope design methods; underground openings in discontinuous and continuous rocks; rock-support interaction; synopsis of numerical methods. Associated laboratory sessions involve stress measurement, core logging, compressive strength determination and index testing.
- Rationale: MIN429 moved from 4S to 3F of the MIN program in 2012; changing the course code is overdue. The opportunity is being taken to correct spelling and typographical errors in the course description.

1.5. **Remove course: CME185H1S Earth Systems Science in MIN Program**

- Rationale: this course slot is being replaced by the proposed MIN1XX course in the MIN program. See section 1.3 for other discussion of this course.

2. **<u>CROSS DISCIPLINARY PROGRAMS OFFICE</u>**

2.1. **Add MSE415H1F** Environmental Degradation of Materials as *Advanced Elective - Environmental Engineering Minor*

2.2. **Add APS360H1 F/S** Artificial Intelligence Fundamentals as *Introductory Elective - Robotics and Mechatronics Minor*

2.3. **Add MIE36XH1S** Introduction to Artificial Intelligence to *Category 3 - AI Engineering Minor*

2.4. **Move CHE507H1S** Data-based Modelling for Prediction and Control to *category 5 - AI Engineering Minor*

2.5. **Add ECE516H1 S** Intelligent Image Processing and to *Category 6 - AI Engineering Minor*

2.6. **Add CHE322H1 S** Process Control to *Category 6 - AI Engineering Minor*

2.7. **Add CSC412H1 S** Probabilistic Learning and Reasoning to *Category 6 - AI Engineering Minor* – Subject to CSC Approval

2.8. **Add CSC413H1 S** Neural Networks and Deep Learning to *Category 6 - AI Engineering Minor* – Subject to CSC Approval

2.9. **Add APS500H1 F** Negotiations in an Engineering Context as *Elective - Engineering Business Minor*

2.10. **Add MSE4XXH1 S** Materials Manufacturing and Design Laboratory II as *Advanced Elective - Advanced Manufacturing Minor*

2.11. **Add MIE304H1 S** – Introduction to Quality Control as *Introductory Elective - Advanced Manufacturing Minor*

2.12. **Remove MIE364H1 S** – Methods of Quality Control and Improvement from *Introductory Electives - Advanced Manufacturing Minor*

2.13. **Music Performance and Minor Certificate – Add note**

- Note for electives: The Faculty of Music updates the list of MUS courses offered each year. A final list of MUS electives eligible for 2020-2021 will be posted on the Minors web site in May 2020.
- Rationale: The Faculty of Music rotates its elective course offerings each academic year.

2.14. **Add ECE313H1 F** Energy Systems and Distributed Energy as *Introductory Elective - Sustainable Energy Minor*

2.15. **Add ECE520H1 F** Power Electronics as *Advanced Elective - Sustainable Energy Minor*

2.16. **Add ECE526H1 S** Power System Protection and Automation as *Advanced Elective - Sustainable Energy Minor*

2.17. **Remove ECE413H1** from *Sustainable Energy Minor*

- Response to ECE changes

2.18. **Remove ECE514H1** from *Sustainable Energy Minor*

- Response to ECE changes

2.19. **Remove ECE533H1** from **Sustainable Energy Minor**

- Response to ECE changes

2.20. **Add APS322H1 S** Language and Power to the *Leadership Certificate*

2.21. **Add STE448H1 S** System Mapping Complex Problems to the *Leadership Certificate*

2.22. **AI Engineering Certificate – Add note**

- Students in the Engineering Science Robotics Major are not eligible for the AI Engineering Certificate due to overlapping core course requirements.

2.23. **Add APS326H1 F** Special Topics in Creative Writing to the *Creative Writing Certificate*

2.24. **Remove APS310H0 F** Defining Energy Futures in India and Canada from calendar

- Rationale: This course was created a number of years ago in India, and was offered for two years but has not been available since. There is no plan to offer the course again.

2.25. **CHE566H1 F** Elements of Nuclear Engineering

- Change hours to **3/0/2, to be offered as 2LEC, 1LEC + 1TUT, 1TUT.**
- Rational: The instructor has requested more tutorial time. The second tutorial hour would be with the Teaching Assistant.

3. ELECTRICAL AND COMPUTER ENGINEERING

3.1. **ECE297H1 S** Software Design and Implementation

- **Add prerequisite: ECE244H1 Programming Fundamentals**
  - Rationale: Previously this prerequisite had been implicit, but this change makes the requirement explicit, and ensures that students who fail ECE244 cannot proceed to ECE297 without the required knowledge.

3.2. **ECE244H1 F** Programming Fundamentals

- **Add prerequisite: APS105H1 Computer Fundamentals**
  - Rationale: Previously this prerequisite had been implicit, but this change makes the requirement explicit, and ensures that students who transfer programs have a background in C based programming.

3.3. **ECE421H1 F/S** Introduction to Machine Learning

- **Change prerequisite to:** ECE302H1 Probability and Applications / ECE286H1 Probability and Statistics / MIE231H1 Probability and Statistics with Engineering Applications / CHE223H1 Statistics/ MSE238H1 Engineering Statistics and Numerical Methods/ MIE236H1 Probability

3.4. **APS3601H1 F/S** Artificial Intelligence Fundamentals

- **Add as Technical Elective**, Area 6 (Software) for ECE undergraduate program

3.5. **ECE368H1 S** Probabilistic Reasoning
- **Add as Technical Elective**, Area 4 (Control, Communications, and Signal Processing)

3.6. **ECE410H1 F** Linear Control Systems, 0.5 credit weight, **3/1.5m/1m**
- Change hours to: 3/1.5m/1

3.7. **ECE446H1 F** Sensory Communication. 0.5 credit weight, **3/1.5m/1m**
- Change hours to: 3/1.5m/0
  - Rationale: Instructor has not found tutorial time necessary

3.8. **NEW COURSE: ECE499H1 F/S Research Thesis, 0.5 credit weight, 100% Engineering Science**
- Description: The course consists of a research project conducted under the supervision of an ECE faculty member. Research projects must be arranged individually between the student and a supervising faculty member, subject to the approval of the Associate Chair, Undergraduate. The thesis should have a research focus. The student's work must culminate in a final thesis document. The student is also required to submit a set of deliverables, including a proposal. The course may be undertaken only once, either in the Fall (F) or Winter (S) Session (0.5 weight), or as a full year (Y) course (1.0 weight).

3.9. **NEW COURSE: ECE499Y1Y Research Thesis, 1.0 credit weight, 100% Engineering Science**
- Description: The course consists of a research project conducted under the supervision of an ECE faculty member. Research projects must be arranged individually between the student and a supervising faculty member, subject to the approval of the Associate Chair, Undergraduate. The thesis should have a research focus. The student's work must culminate in a final thesis document. The student is also required to submit a set of deliverables, including a proposal. The course may be undertaken only once, either in the Fall (F) or Winter (S) Session (0.5 weight), or as a full year (Y) course (1.0 weight).

3.10. **ECE413H1S** Energy Systems and Distributed Generation, 0.5 credit weight, 3/1.5/1, 100% Engineering Science
- **Change course code to: ECE313H1**
- This course will now be a kernel course in Area 2

3.11. **Remove course: ECE514H1**

- Rationale: there are currently two 500-level courses focused on power electronics being offered. These will be replaced by a single 500-level power electronics course offered in the Fall (ECE520H1F).

3.12. **Remove course: ECE533H1**

- Rationale: there are currently two 500-level courses focused on power electronics being offered. These will be replaced by a single 500-level power electronics course offered in the Fall (ECE520H1F).

3.13. **NEW COURSE: ECE520H1 F Power Electronics, 0.5 credit weight, 3/1.5/1, 50% Engineering Science, 50% Engineering Design**

- Description: The course focuses on power electronic converters utilized in applications ranging from low-power mobile devices to higher power applications such as electric vehicles, server farms, microgrids, and renewable energy systems. Concepts covered include the principles of efficient electrical energy processing (dc-dc, dc/ac, and ac/ac) through switch-mode energy conversion, converter loss analysis, large- and small-signal modeling of power electronic circuits and controller design.

3.14. **NEW COURSE: ECE526H1 S Power System Protection and Automation, 0.5 credit weight, 3/1.5/1, 100% Engineering Design**

- Description: This course presents the concepts of short-circuit fault analysis, protective relaying, and automation in power systems. The course starts by discussing the causes and types of short-circuit faults using real-world examples. The consequences of faults for different power system components will be reviewed using event reports from field data. The method of symmetrical components for analyzing unbalanced three-phase systems will be introduced. Analytical methods and computer-based approaches for deriving fault voltages and currents will be discussed and the effect of system grounding during transient conditions, including faults, will be introduced. Students will also learn the concept of power system automation and its role in monitoring, protection, and control of modern power systems. Critical devices used in an automation system, such as breakers, relays, reclosers, capacitor bank controllers, and tap changer controllers will be presented.

3.15. **ECE463H1 S** Electric Drives, 0.5 credit weight, 3/1.5/1

- **Add corequisites: ECE311 or ECE365 or AER372**.
    - Rationale: Control content is needed for this course but the information can be learned in tandem and is not necessary as a prerequisite.

4. **ENGINEERING SCIENCE**

4.1. **Move PHY180H1 to S Session and move MSE160H1 to F Session (Foundation Curriculum change)**

- Rationale: This swap has been proposed to accommodate math requirements for PHY180H1 course. Both departments support this change.

4.2. **BME395H1** Biomedical Systems Engineering II: Cells and Tissues

- Change course description to: Tissue engineering is largely based on concepts that emerged from developmental biology. This course provides an introduction to the study of animal development, both at the cellular and molecular levels. Topics include developmental patterning, differential gene expression, morphogenesis, stem cells, repair and regeneration.

4.3. Major (Option) Curriculum Change – Electrical and Computer Engineering – **ECE368H1** Probabilistic Reasoning

- Add to Technical Elective List

4.4. Major (Option) Curriculum Change – Engineering Mathematics, Statistics and Finance – **Add 1 course to technical elective list**

- **MIE424H1** Optimization in Machine Learning

4.5. Major (Option) Curriculum Change – Engineering Physics – **Add 3 courses to technical elective list**

- **JGA305H1** Environmental and Archaeological Geophysics (List A)
- **ESS445H1** Global Tectonics (List B)
- **ESS450H1** Geophysical Field Techniques (List B)

4.6. Major (Option) Curriculum Change – Machine Intelligence - **Add 3 courses as technical electives**

- **STA314H1** Statistical Methods for Machine Learning I (Mathematics and Modelling list)
- **STA414H1** Statistical Methods for Machine Learning II (Mathematics and Modelling list)
- **MIE424H1F** Optimization in Machine Learning (Artificial Intelligence list)

5. **FIRST YEAR CORE 8 AND TRACK ONE CURRICULUM**

5.1. **Move to a common fall term for all Core 8 and TrackOne programs**

- This change would have all first year students register for APS110 in the first term. The intention is to promote a coherent experience for all students in their first term. A key principle that underlays this proposal is that students

should have the ability to transfer programs at the end of the first year and have the foundational knowledge they need to be successful.

Proposed Core 8 and TrackOne Fall Term (Common to all Programs)

Course Title	Lecture	Lab	Tutorial	Weight
APS100: Orientation to Engineering	0.5		1	0.25
APS111: Engineering Strategies & Practice I	3		2	0.5
APS110: Engineering Chemistry and Materials Science	3	1	1	0.5
MAT188: Linear Algebra	3	1	1	0.5
MAT186: Calculus I	3		1	0.5
CIV100: Mechanics	3		2	0.5
	Total Contact:		25.5 hours	

Proposed Core 8 Winter Term (Three Program Specific Courses)

Course Title	Program(s)	Lecture	Lab	Tutorial	Weight
APS112: Engineering Strategies & Practice II	All	2	2		0.5
APS105/106: Computer Programming*	All	3	2	1	0.5
MAT187: Calculus II	All	3		1	0.5
ECE110: Electrical Fundamentals	ECE, MIE, MSE T1	3	1	2	0.5
MIE100: Dynamics	ECE, MIE, T1	3		2	0.5
CHE112: Physical Chemistry	CHE, CIV/MIN	3	1	1	0.5
CHE113: Concepts in Chemical Eng.	CHE	3	1	1	0.5
CME185: Earth Systems Science	CIV	3	2	1	0.5
MIN1XX: Mineral Engineering (new course)	MIN	3	2	1	0.5
MSE1XX: Materials Engineering, Processing and Application (new course)	MSE	3	1	1	0.5
APS191: Introduction to Engineering	T1	1			0.15
???101: Introduction to CHE/CIV/ECE/MIE/MIN/MSE (new courses)	CHE, CIV, ECE, MIE, MIN, MSE	1			0.15
		Total Contact:		25 to 26 hours	

* Two programming courses are offered, one based on C (APS105), one based on Python (APS106) with students being automatically enrolled in the most appropriate course, but given the chance of making their own informed choice in November.

5.2. **Create program-specific seminar courses for first year CHE, CIV, MIN, and MSE students in the winter term**

- This initiative is meant to address an existing inequity in curriculum. CHE, CIV, MIN and MSE have not had a course that introduces students to opportunities in their upper years of study and what kinds of research they can pursue. These courses will be offered in the second term of the first year.

6. **INSTITUTE FOR STUDIES IN TRANSDISCIPLINARY ENGINEERING EDUCATION & PRACTICE (ISTEP)**

6.1. **NEW COURSE: STE448H1 Using System Mapping to Tackle Complex Problems, 0.5 credit weight, 2/0/2, 75% Complementary Studies, 25% Engineering Design**

- Description: System mapping is a system thinking tool that is frequently used in fields such as public health and environmental policy to describe complex, multi-stakeholder problems. Students will apply system mapping techniques to describe complex problems with technical, social and environmental aspects. Students will explore fields outside of engineering that are critical to these challenges, including public policy, sociology, and law. Students will complete a team project to develop a system map of a complex problem. The emphasis will be on problem definition not problem solution, though it is expected that maps will point to potential paths for solution.

7. **INSTITUTE OF BIOMATERIALS & BIOMEDICAL ENGINEERING**

7.1. **BME435H1 S** Biostatistics, 0.5 credit weight, 3/-/1

- Change course description to: This is intended to provide students interested in biomedical research with an introduction to core statistical concepts and methods, including experimental design. The course also provides a good foundation in the use of discovery tools provided by a data analysis and visualization software. The topics covered will include: i) Importance of being uncertain; ii) Error bars; iii) Significance, p-values and t-tests; iv) Power and sample size; v) Visualizing samples with box plots; vi) Comparing samples; vii) Non parametric tests; viii) Designing comparative experiments; ix) Analysis of variance and blocking; x) Replication; xi) Two-factor designs; xii) Association, correlation and causation; xiii) Simple linear regression; xiv) Regression diagnostics. The concepts will be illustrated with realistic examples that are commonly encountered by biomedical researchers (as opposed to the simpler examples described in entry-level textbooks). The statistical software used in this course are JMP and R Studio.

- **Remove prerequisites:** BME225H1, CHE223H1, MIE231H1, or MSE238H1, (or equivalent)
  - Rationale: Explicit prerequisites are unnecessary as students have been picking up the required knowledge organically over the course of their studies.

7.2. **BME445H1 F** Neural Bioelectricity, 0.5 credit weight, 3/1.5/1.5

- Change course description to: Generation, transmission and the significance of bioelectricity in neural networks of the brain. Topics covered include: (i) Basic features of neural systems. (ii) Ionic transport mechanisms in cellular membranes. (iii) Propagation of electricity in neural cables. (iv) Extracellular

electric fields. (v) Neural networks, neuroplasticity and biological clocks. (vi) Learning and memory in artificial neural networks. Laboratory experiences include: (a) Biological measurements of body surface potentials (EEG and EMG). (b) Experiments on computer models of generation and propagation of neuronal electrical activities. (c) Investigation of learning in artificial neural networks. This course was previously offered as ECE445H1.

- **Add prerequisites:** ECE159H1 Fundamentals of Electric Circuits or ECE110H1 Electrical Fundamentals, (or equivalent).
    - Rationale: students are required to have an understanding of the fundamentals of circuits in order to be successful in the course.

8. MATERIALS SCIENCE & ENGINEERING

8.1. NEW COURSE: MSE1XXH1S Materials Engineering, Processing and Application, 0.5 credit weight, 3/1a/1, 50% Engineering Science, 50% Engineering Design

- Description: This course covers an introduction to the field of materials science and engineering following a design-led approach. Application areas such as stiffness-limited design, fracture-limited design, strength-limited design will be used to guide further investigations into elements of the processing-structure-properties-performance paradigm. Topics covered will include material property charts, computer-aided design and materials selection, crystallographic planes and directions, crystal structures, stiffness, strength, plasticity, yielding, ductility, fracture and fracture toughness, cyclic loading and fatigue, friction and wear, thermal properties of materials, electrical properties, optical properties, materials corrosion, and materials processing.

8.2. NEW COURSE: MSE296H1F Materials Paradigm at a Glance, 0.15 credit weight, 1a/0/0

- Description: Materials come in all sorts of forms and exhibit a wide range of behaviors, yet there is more in common to their explanation than there is difference. MSE296 will put the threads from the second year curriculum into a common informational framework more reflective of the emerging state-space based materials paradigm. This course will meet on a biweekly basis. Credit is obtained by participating in in-class exercises.
- Rationale: This course is an initiative of the department's chair. It will emphasize the connection between different courses and class material and will be CR/NCR.

8.3. NEW COURSE: MSE297H1S Materials Paradigm at a Glance, 0.15 credit weight, 1a/0/0

- Description: Materials come in all sorts of forms and exhibit a wide range of behaviors, yet there is more in common to their explanation than there is difference. MSE297 will put the threads from the second year curriculum into a common informational framework more reflective of the emerging state-space

based materials paradigm. This course will meet on a biweekly basis. Credit is obtained by participating in in-class exercises.

- Rationale: This course is an initiative of the department's chair. It will emphasize the connection between different courses and class material and will be CR/NCR.

8.4. **MSE352H1S** Biomaterials and Biocompatibility, 0.5 credit weight, 3/0/2

- Change course code to: **BME352H1**
- Rational: IBBME is assuming course administration.

8.5. **MSE438H1F** Computational Materials Design, 0.5 credit weight, 3/1/0

- **Prerequisite added: one of MSE335, PHY356, PHY452, ECE330**
- Rationale: The instructor felt that some students didn't have the necessary background knowledge to succeed in the course. These prerequisites can satisfy that need for students from different programs.

8.6. **MSE498Y1Y, Capstone Team Design Project, 1.0 credit weight, 0/6/2**

- Change course name to: **Capstone Project: Design of Materials Processes**
- Change course description to: The students, working in small groups complete a project involving design of a materials processing plant, leading to a design report delivered at the conclusion of the course. The topics covered in the lectures and design process include basic materials processing flowsheet for primary processing and recycling of materials, materials and energy balance of individual units and of overall process flowsheets, use of computer software for flowsheet evaluation, translating process flowsheets to resource and utility requirements, energy analysis, capital/operating cost, basics of equipment sizing, operation scheduling, safety and HAZOP, plant layout, and design for sustainability.

- Change course hours from: 0/6/2 to **2a/1/2**
  - Note: the two hours of alternating lecture will be concentrated to the first half of the course. This will ensure the correct number of contact hours is met.

8.7. **NEW COURSE: MSE4XXH1F/S Research Thesis, 0.5 credit weight, -/4/1**

- Description: The course offers an opportunity to carry out an independent research under the supervision of an academic staff for the students interested in expanding their research capabilities. The students will submit a proposal in the beginning of the course that describes the problem and work plan together with an estimate of the level of effort (hours of work). The grading will be based on a final report and presentation, assessed by a minimum of two faculty members. Students may take either a half-credit (F/S), or a full-year credit (Y) in consultation with the supervising faulty. The course may be completed only

once; the half-credit option may be taken either in the Fall (F) or Winter (S) session.

8.8. **NEW COURSE: MSE4XXY1Y Research Thesis, 1.0 credit weight, -/4/1**

- Description: The course offers an opportunity to carry out an independent research under the supervision of an academic staff for the students interested in expanding their research capabilities. The students will submit a proposal in the beginning of the course that describes the problem and work plan together with an estimate of the level of effort (hours of work). The grading will be based on a final report and presentation, assessed by a minimum of two faculty members. Students may take either a half-credit (F/S), or a full-year credit (Y) in consultation with the supervising faulty. The course may be completed only once; the half-credit option may be taken either in the Fall (F) or Winter (S) session.

8.9. **NEW COURSE: MSE4XXH1S Materials Manufacturing and Design Laboratory II, 0.5 credit weight, 1/4/-**

- Description: This half year design course focusses on the simulation informed design and execution of a product and continues on the concepts learned in MSE398. Working in small groups, students will use the principles of materials selection and computer simulation to design and build a product of their own choosing. This design focused course will guide students through several iterations of their product design, each iteration further informed by computer simulation. Materials selection will include selection for mechanical design, process, and shape and will also be used to inform each iteration of the design process. Finally, computer simulation results will be experimentally validated in parts of, or the entire the final product. This course will involve significant time involved in hands-on manufacturing. The course is accepted as one of the Advanced Electives for the Advanced Manufacturing Minor.

8.10. **Remove course: MSE450H1F Process and Plant Design**

8.11. **MSE432H1 F Polymer and Composite Materials, 0.5 credit weight, 3/0/0**

- Change course code to: **MSE443H1 F**
- Change course name from: **Composite Materials Engineering**
- Change course description to: This course is designed to provide an integrated approach to composite materials design, and provide a strong foundation for further studies and research on these materials. Topics include: structure, processing, and properties of composite materials; design of fillers reinforcements and matrices reinforcements, reinforcement forms, nanocomposites systems, manufacturing processes, testing and properties, micro and macromechanics modeling of composite systems; and new applications of composites in various sectors.

- Rationale: The course code change matches the graduate component course, MSE1043. Other changes more closely reflect the course material.

9. **MECHANICAL & INDUSTRIAL ENGINEERING**

9.1. **MIE331H1** Physiological Control Systems, 0.5 credit weight, 3/1/1

- Change course code to: BME331H1 S
- Change course description to: This course introduces physiological concepts and selected physiological control systems present in the human body to undergraduate students. The course is organized into four parts: (1) introduce physiology and give an overview of the main physiological systems, (2) introduce endocrine system and its subsystems, including glucose regulation, thyroid metabolic hormones, and the menstrual cycle, (3) introduce cardiovascular system and related aspects such as cardiac output, venous return, control of blood flow by the tissues, and nervous regulation of circulation, and (4) introduce central nervous system, the musculoskeletal system, proprioception, kinaesthetic, and control of voluntary motion. These topics allows us to combine linear control theory, physiology, and neuroscience with the objective of explaining how these complex systems operate in a healthy human body.
- Rationale: IBBME have been administering this course.

9.2. **MIE368H1** Analytics in Action, 0.5 credit weight, **3/2/-**

- Change hours to: **2/3/1**
- Add prerequisite: **MIE237 or equivalent, MIE262 and MIE263 or permission of instructor.**
  - Rationale: the instructor wants to ensure that students taking the course from other programs have the requisite statistics and research background.

9.3. **NEW COURSE: MIE36X Introduction to Artificial Intelligence, 0.5 credit weight, 3/2/1**

- Description: Introduction to Artificial Intelligence. Search. Constraint Satisfaction. Propositional and First-order Logic Knowledge Representation. Representing Uncertainty (Bayesian networks). Rationality and (Sequential) Decision Making under Uncertainty. Reinforcement Learning. Weak and Strong AI, AI as Engineering, Ethics and Safety in AI.