

March 11, 2019

MEMO

Subject: 2022 Robotics and Mechatronics Major

From: C. L. Dancey

Please find attached the 2022 checksheet for a new undergraduate major, Robotics and Mechatronics, within the Bachelor of Science in Mechanical Engineering degree program.

Educational value and the need for the program

Robotics impact our lives in many different ways. There are the headlines capturing autonomous cars and humanoid companions, but far subtler applications are, for example, the manufacturing systems that wind electric motors or assemble laptop computers. The need to automate, doing the dirty, dull and dangerous tasks humans would prefer not to do will dominate the manufacturing sector. Our role as educators is to meet the workforce requirements this technology demands. Coupled closely to robotics is mechatronics, the overlap of mechanical engineering, electrical engineering and computer science. The average 2018 automobile contains more than 100 micro-controllers, managing engine performance, antiskid braking, steering control, and climate control among others. This requires our engineers to have a working knowledge of digital systems. In addition, interfacing smart technologies that will connect the autonomous automobile with other vehicles, highway signal systems and the digital cloud will also require our mechanical engineers to be schooled in these emerging technologies. The ability to navigate in these complex environments, sense and perceive to adapt performance to changing conditions, and accommodate a broad spectrum of operating requirements places pressure on our curriculum to offer course content that meets the needs of our students.

It is proposed to create a Major in Robotics and Mechatronics to provide the educational content necessary to meet the demands of industry as well as our students. The digital revolution that has formed the foundations of our communications and complex mechanical systems needs to be addressed in our course offerings.

Whom Will it Serve

A Major in Robotics and Mechatronics will principally serve the undergraduate population of Mechanical Engineering. However, students from Electrical and Computer Engineering, Computer Science, Aerospace and Ocean Engineering and Civil Engineering could also take advantage of courses within this major. Students outside the College of Engineering, meeting the basic requirements of dynamics, physics and mathematics, could also benefit. The required courses coupled with the selection of electives will give the student an in-depth knowledge of the interface between electrical engineering, computer science and mechanical engineering.

For the initial offering of the major it is anticipated that approximately 100 students may enroll in the major from the general population within the ME undergraduate degree program. As mentioned previously, the rapid growth of robotic systems, autonomous devices and the need for

mechatronic systems requires engineers and engineering expertise in these fields. The employment of mechanical engineers is expected to continue to be healthy and the need for specialists within robotics and mechatronics (which the major addresses) will likely keep pace with this or even exceed the general growth of MEs for some time to come.

Resources Needed

Faculty: Currently, the Mechanical Engineering Department has sufficient faculty to support the Major course content. No additional faculty resources are requested.

Financial: No additional resources are requested to support this Major.

Courses: Most of the required courses in the attached curriculum are active and already being offered by faculty. One new course is proposed, the Robotics and Mechatronics Seminar, and two other existing courses are in revision, but no additional resources are requested to support these courses.

Administration

The major will be administered by the Department of Mechanical Engineering within the College of Engineering. Fall semester 2020 will be the first term to enroll in the major and Spring 2022 will be the first term to graduate with the major.

Students will be notified of the addition of this major through email and by posted documents in the hallway and on-line. The Department of Mechanical Engineering supports the proposed 2022 Robotics and Mechatronics Major, checksheet and list of technical electives.

Sincerely,



Clinton L. Dancey

Associate Department Head, Department of Mechanical Engineering

COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING
DEGREE: BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING
MAJOR: ROBOTICS AND MECHATRONICS

FOR STUDENTS GRADUATING IN CALENDAR YEAR 2022 AND DATE OF ENTRY UNDER UG CATALOG 2020-2021

CREDITS REQUIRED FOR GRADUATION: 129

FALL 2018		Credits	SPRING 2019		Credits
CHEM 1035 General Chemistry Co: MATH 1025 or MATH 1225		3	ENGL 1106 First-Year Writing Pre: 1105		3
CHEM 1045 General Chemistry Lab Co: 1035		1	MATH 1226 Calculus of a Single Variable Pre: 1225 (C-)		4
ENGL 1105 First-Year Writing		3	MATH 2114 Introduction to Linear Algebra Pre: 1226 or 1225 (B)		3
Math 1225 Calculus of a Single Variable (C-) Pre: Math ready		4	ENGE 1216 Foundations of Engineering (C-) Pre: 1215(C-)		2
ENGE 1215 Foundations of Engineering Exploration (C-)		2	PHYS 2305 Foundations of Physics w/lab **Pre: MATH 1225 Co: MATH 1226		4
Pathways 2, 3, 6a, or 7		3			
TOTAL		16	TOTAL		16
FALL 2019		Credits	SPRING 2020		Credits
ESM 2104 Statics Pre: MATH 1226; Co: MATH 2204 or MATH 2204H or MATH 2224 or MATH 2406H		3	ECE 2054 Applied Electrical Theory Co: MATH 2214; (or ECE 3054+2074, ECE 2004+2074)		3 ^[F,S]
ISE 2214 Manufacturing Processes Laboratory		1	ESM 2204 Mechanics of Deformable Bodies #Pre: MATH 2114, MATH 2204		3
MATH 2204 Introduction to Multivariable Calculus Pre: 1226		3	ESM 2304 Dynamics #Pre: MATH 2114, MATH 2204 Co: MATH 2214		3
PHYS 2306 Foundations of Physics w/lab Pre: MATH 1206 or MATH 1206H or MATH 1226, 2305		4	MATH 2214 Introduction to Differential Equations Pre: (1114 or 2114 or 2114H or 2405H), 1226		3
MSE 2034 Elements of Materials Engineering Pre: CHEM 1035; Co: PHYS 2305		3	ME 2134 (C-) Thermodynamics ***Pre: PHYS 2306, MATH 2204, CHEM 1035 Co: MATH 2214		4 ^[F,S]
ME 2004 ⁽¹⁾ (C-) Engineering Analysis using Numerical Methods Pre: (ENGE 1216 or ENGE 1414), MATH 1226, (MATH 2114 or MATH 2114H or MATH 2405H or MATH 2214)		3 ^[F,S,SI]			
TOTAL		17	TOTAL		16
FALL 2020		Credits	SPRING 2021		Credits
STAT 3704 Statistics for Engineering Applications Pre: MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H or MATH 2406H; (or 4604, 4714, or 4705)		2	ECE 3254 ^[2] Industrial Electronics Pre: 2054		3
ME 3024 Engineering Design and Economics Pre: 2004, MSE 2034, ESM 2204, ENGL 1106; Co: ME 3624		3 ^[F,S]	ME 3304 ⁽¹⁾ Heat & Mass Transfer Pre: (2124 or 2134), (MATH 2214 or MaTH 2214H or MATH 2306H), (MATH 2204 or MATH 2204H or MATH 2406H)		3 ^[S,SI]
ME 3414 ⁽¹⁾ Fluid Dynamics (w lab) Pre: MATH 2114, MATH 2204, MATH 2214, ME 2004(C-); Co: ME 2134		4 ^[F,S]	ME 3534 ⁽¹⁾ Controls Engineering I (w lab) Pre: 2004, MATH 2114, MATH 2204, ESM 2104, ESM 2304		4 ^[S,SI]
ME 3524 Mechanical Vibrations Pre: 2004, ESM 2304, (MATH 2114 or MATH 2114H or MATH 2405H), (MATH 2214 or MATH 2214H or MATH 2406H)		4 ^[F,S]	ME 4005 ⁽¹⁾ Mechanical Engineering Lab Pre: (3514 or 3524), (STAT 3704 or STAT 4604 or STAT 4705 or STAT 4714), (ECE 2054 or ECE 3054) or (ECE 2004, ECE 2074)		3 ^[S,SI]
ME 3624 ⁽¹⁾ Mechanical Design (w lab) Pre: 2004(C-), ESM 2204, MATH 2214		4 ^[F,S]	CS 1044 ^[2] Introduction to Programming in C		3
			ME 3034 Mechanical Engineering Discourse Pre: 3024; Co: 4005		1 ^[S,SI]
TOTAL		17	TOTAL		17
FALL 2021		Credits	SPRING 2022		Credits
ME 4015 ^[4] Engineering Design and Project # Pre: 4005, 3024, 3304, 3524, 3534, 3624, ECE 3254		3 ^[F]	ME 4016 ^[4] Engineering Design and Project Pre: 4015		3 ^[S]
ME 4524 ^[2] Robotics and Automation Pre: (ECE 2574, STAT 4714) or (3534, STAT 3704). Co: 4584		3 ^[F]	Technical Elective from list		3
ME 4744 ^[2] Mechatronics: Theory and Application Pre: (ECE 3254, 3534) or (ECE 2004, ECE 2704)		4 ^[F]	Pathways 2, 3, 6a or 7		3
Pathways 2, 3, 6a or 7		3	Pathways 2, 3, 6a or 7		3
ME 4584 ^[2] Robotics Laboratory Co: 4524 or ECE 4704		1	Pathways ^[3] 2, 3, 6a and 7		3
ME 4734 ^[2] Robotics and Mechatronics Seminar Pre: (3534, ECE 3254) or (ECE 2004, ECE 2704)		1			
TOTAL		15	TOTAL		15

General Information about Checksheet: Superscripted annotation after the course number [1] indicates core courses of the degree (and shaded light blue) while [2] indicates courses associated with the major (and shaded yellow). Pathways courses are shaded green. [3] Indicates Pathways Core Concept 7 must be doubled-counted with another Pathways Core Concept course. [4] Senior Capstone Design must be approved for credit towards the Robotics and Mechatronics major. Additionally [F,S,SI,III] in credits column indicates terms when a course is expected to be offered. Course offerings are subject to change and the availability of sufficient resources. Students should confirm course offerings in advance with their department. Grade requirements in specific courses are indicated in parenthesis. For example, a minimum grade of (C-) must be earned in MATH 1225. This is also shown in the prerequisite list for MATH 1226 where (C-) is indicated next to the MATH 1225 prerequisite.

**** Pre:** (MATH 1205 or MATH 1205H or MATH 1225) or (MATH 1206 or MATH 1206H or MATH 1226). **Co:** 2325 or MATH 1206 or MATH 1206H or MATH 1226)

***** Pre:** PHYS 2306, (MATH 2204, or MATH 2204H or MATH 2406H), CHEM 1035. **Co:** MATH 2214

‡ Pre: (2104 or 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)

† Pre: (2104 or 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). **Co:** MATH 2214

‡‡ Pre: 4005, (2024 or 3024), ECE 3254, (3614 or 3624), 3304, (3504 or 4504) or (3524, 3534).

Pathways

Consult the Pathways Alphabetical Listing at: <https://www.pathways.prov.vt.edu/about/course-catalog.html>, Pathways courses need to be completed prior to graduation

Pathway 1: Discourse (6hs foundational, 3 hrs advanced)	Foundational: ENGL 1105	(3)	Foundational: ENGL 1106	(3)
	Advanced: ME 3024, 3034, 4015-4016			(3)
Pathway 2: Critical Thinking in the Humanities (6 hrs)		(3)		(3)
Pathway 3: Reasoning in the Social Sciences (6 hrs)		(3)		(3)
Pathway 4: Reasoning in the Natural Sciences (8 hrs)	PHYS 2305	(4)	PHYS 2306	(4)
Pathway 5: Quantitative and Computational Thinking (11 hrs)	Foundational: MATH 1225	(4)	Foundational: MATH 1226	(4)
	Advanced: MATH 2214			(3)
Pathway 6: Critique and Practice in Design and the Arts (7 hrs)	Arts:			(3)
	Design: ENGE 1215 & 1216			(4)
Pathway 7*: Critical Analysis of Identity and Equity in the United States (3 hrs)				(3)

*Pathways 7 should be double-counted with Pathway 2, 3, or 6a to avoid taking additional credits.

Electives: The Robotics and Mechatronics major requires 3 credits of approved technical electives from list. Please see attached list for technical elective choices.

Change of Major Requirements: Please see <http://www.enge.vt.edu/undergraduate-changing-major.html>

Foreign Language Requirements: Students must have had 2 years of a foreign language in high school or one year at the college level (6 credit hours) of the same language. College-level credits used to meet this requirement do not count towards the degree.

Satisfactory Progress Towards Degree: University Policy 91 outlines university-wide minimum criteria to determine if students are making satisfactory progress towards the completion of their degrees. The ME Department fully supports this policy. Specific expectations for satisfactory progress for Mechanical Engineering majors are as follows:

- Each student must meet the minimum University-wide criteria as described in Policy 91 and summarized in the Undergraduate Catalog (<http://www.undergradcatalog.registrar.vt.edu/>)
- Once a student is in the ME major, a student must:
 - Complete a minimum of 12 credits that apply toward the ME degree during each 12 month period
 - Maintain an in-major GPA (in-major is calculated using all courses taught under the ME and NSEG designators) of at least 2.00;
 - Maintain an extended in-major GPA (extended in-major is calculated using all courses taught under the ME and NSEG designators plus ESM 2104, 2204 and 2304) of at least 2.00
 - Complete ESM 2104, MATH 2114 and MATH 2204 within 45 attempted required course credits (not to include Pathways courses, technical electives or free electives)
 - Complete ESM 2304, ME 2004 and MATH 2214 within 60 attempted required course credits (not to include Pathways courses, technical electives or free electives)
 - Complete ME 2134 (C-), 3524, and 3624 with 72 attempted required course credits (not to include Pathways courses, technical electives or free electives)
 - Complete ME 4015 and ME 4524 within 90 attempted required course credits (not to include Pathways courses, technical electives or free electives)

Statement of Hidden Prerequisites: Prerequisites may change. Students are responsible for pre-requisites and pre-requisites of pre-requisites whether specifically spelled out or not on this checksheet. Be sure to consult the University TimeTable or check with your advisor for the most current requirements. There are no hidden pre-requisites in this program of study.

Graduation Requirements: Each student must complete at least 129 semester credit hours with a minimum overall GPA of 2.00 and a minimum in-major GPA of 2.00. In-major GPA is determined from all courses with ME and NSEG (nuclear) designators.

Robotics and Mechatronics Major Technical Elective List
for Students Graduating in 2022

ELECTIVE COURSES (select one):

Course No.	Title	Credits
ME 3604	Kinematics and Dynamics of Machinery	3
ME 4754	Mechatronics: Advanced Topics and Applications	3
ME 4974	Independent Study*	3
ME 4994	Undergraduate Research*	3
	Any non-duplicating ME/ECE/CS 4000-5000 level Controls course*	3
*	Requires departmental/major approval	



English Department

181 Turner St. NW
323 Shanks Hall (MC 0112)
Blacksburg, Virginia 24061
P: (540) 231-6501
F: (540) 231-5692

7 January 2020

Professor Clint Dancey,
Associate Head,
Department of Mechanical Engineering,
Virginia Tech.

Hello Professor Dancey,

The Department of English is glad to allow the Department of Mechanical Engineering to list ENGL 1105–1106 First-Year Writing to be listed on the checksheet as a requirement for its new major in Robotics & Mechatronics.

All good wishes,

Joseph F. Eska,
Professor & Interim Chair.



Clinton Dancey <cdancey@vt.edu>

Re: New major need STAT approval

1 message

Dave Higdon <dhigdon@vt.edu>

To: Clinton Dancey <cld@vt.edu>

Cc: Dave Higdon <dhigdon@vt.edu>

Wed, Jan 29, 2020 at 7:45 AM

Dear Professor Dancey,
The Statistics Department supports the creation of new major in Mechanical Engineering. Since the majors are already required to take STAT 3704, we feel this won't require any additional resources for Statistics.

Feel free to contact me if you need additional information.

Regards,
Dave Higdon
Department Head, Statistics

On Tue, Jan 28, 2020 at 10:40 AM Clinton Dancey <cld@vt.edu> wrote:
Professor Higdon,

A week or two ago I sent you an email (I had originally sent to Ron Fricker) about the Statistics Department supporting a new Major in Mechanical Engineering. The Registrar is asking for us to get this proposal completed, or I wouldn't be bothering you again. Briefly, to get the new Major in ME approved the Registrar requires an email from all affected departments. Since STAT 3704 is already required for all ME students, there will be no additional impact due to the creation of the Major (Robotics and Mechatronics) within the ME degree. Would you provide a letter or email supporting the approval of this major? I will answer any questions you might have, if needed.

Thanks
Sincerely,

Clint Dancey
Associate Dept. Head
Department of Mechanical Engineering



Department of Chemistry
1040 Drillfield Drive
Davidson Hall 480
Blacksburg, Virginia 24061
P: (540) 231-8251
F: (540) 231-3255
Email: aesker@vt.edu

January 7, 2020

Resource Letter for Adding Chem 1035/1045 – General Chemistry Lecture/Lab as a Required Course for a New Major, Robotics and Mechatronics, under the Bachelor of Science in Mechanical Engineering Degree

To the Appropriate Curriculum Committees:

Clinton Dancey, Associate Department Head of the Department of Mechanical Engineering, has requested that Chem 1035 – General Chemistry and Chem 1045 – General Chemistry Lab be added as required courses for a new major, Robotics and Mechatronics, under their Bachelor of Science in Mechanical Engineering degree. Chem 1035 and Chem 1045 are already required courses for the Bachelor of Science in Mechanical Engineering degree. As the new major is expected to redistribute students among majors rather than grow the Mechanical Engineering degree, I do not believe this will require additional resources.

Sincerely,

A handwritten signature in black ink that reads 'Alan Esker'. The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Alan Esker
Chair and Professor of Chemistry



Dr. Mark L. Pitt
Professor and Chair
Department of Physics (0435)
850 West Campus Drive
Blacksburg, Virginia 24061
540-231-3015 Fax: 540-231-7511
E-mail: pitt@vt.edu

January 28, 2020

Dear Colleagues,

This letter is in support of the new major, Robotics and Mechatronics, within the Mechanical Engineering BS degree. PHYS 2305 and PHYS 2306 will be required for this new major. The Physics Department agrees with including these courses as requirements. We will be able to accommodate this request with existing resources.

Sincerely,

A handwritten signature in black ink that reads 'Mark L. Pitt'.

Mark L. Pitt
Professor and Chair
Department of Physics



Mathematics Department
225 Stanger Street
460 McBryde Hall
Blacksburg, VA 24061
Ph: (540) 231-6536
Fax: (540) 231-5960

January 6, 2020

Clint Dancey
Associate Department Head
Department of Mechanical Engineering
Virginia Tech

Professor Dancey:

The Department of Mathematics supports the proposed new Major within the BSME degree: Robotics and Mechatronics. Math 1225, 1226, 2114, 2204 and 2214 are required courses within the BSME curriculum (and have been for many years). Requiring these for the new major should not cause problems.

We expect to be able to teach these courses with no new recourses.

Best regards,

A handwritten signature in black ink, appearing to read 'R.C. Rogers'.

Robert C. Rogers
Professor and Associate Chair