

Welcome to Materials Science & Engineering!

In this Curriculum Guide, you will find:

- MSE Major Curriculum by Requirement
- Sample Schedules for 4 Year Majors
- Sample Schedule for Transfer Majors
- Definitions of MSE Major Requirements
- MSE Course Pre- and Co- Requisite Guide
- Suggested Course Sequence
- Guidance on how to create schedules
- MSE Minor Requirements



November 2023

MSE Major Curriculum by Requirement

MSE Core Courses

- MSE 2090: Intro to MSE
- MSE 2101: Properties Lab
- MSE 3050: Thermodynamics
- MSE 3060: Structures & Defects
- MSE 3070: Kinetics
- MSE 3101: Investigations Lab
- MSE 3670: EMOP
- MSE 4320: Mechanical Behavior
- MSE Capstone 1
- MSE Capstone 2

MSE Electives (choose 5)

- MSE 2200: 3D Printing
- MSE 2300: Science of Cooking
- MSE 3080: Corrosion
- MSE 3610: Aerospace Materials
- MSE 4030: X-ray Scattering
- MSE 4055: Nanoscale Sci & Tech
- MSE 4200: Additive Manufacturing
- MSE 4210: Materials Processing
- MSE 4220: Polymer Physics
- MSE 4270: Atomistic Simulations
- MSE 4960: Research for Credit
- MSE 4592: Special Topics

Applied Math

- APMA 1110: Calc 2
- APMA 2120: Multivariate Calc
- APMA 2130: Differential Equations
- APMA 3110: Prob Stats

STS and ENGR

- ENGR 1010: Engineering Foundations 1
- ENGR 1020: Engineering Foundations 2
- STS 2600: Engineering Ethics
- STS 4500: Engineering Practice
- STS 4600: Ethics and Responsibility

Science & Electives

- CHEM 1410 & 1411: Chem 1 & Lab
- PHYS 1425 & 1429: Phys 1 & Lab
- PHYS 2415 & 2419: Phys 2 & Lab (or ECE 2200)
- Math/Science Elective 1
- Math/Science Elective 2
- CS 111x: Intro to Programming

Additional Requirements

- Engineering Elective 1
- Engineering Elective 2
- Technical Elective 1
- Technical Elective 2

Humanities & Social Science Electives

- HSS 1
- HSS 2
- HSS 3

Unrestricted Electives

- UNRE 1
- UNRE 2
- UNRE 3

Official major guidelines and more details can be found at:

http://records.ureg.virginia.edu/preview_program.php?catoid=58&poid=8079



MSE Major Requirements by Semester – Sample Schedule

For Students who didn't take MSE 2090 in their first year

Fall/1st semester (15 credits)

- APMA 1110: Calc 2
- CHEM 1410 & 1411: Chem 1 & Lab
- ENGR 1010: Engr Foundations 1
- CS 111x: Intro to Programming

Spring/2nd semester (17 credits)

- APMA 2120: Multivariate Calc
- PHYS 1425 & 1429: Phys 1 & Lab
- ENGR 1020: Engr Foundations 2
- Math/Science Elective 1
- HSS Elective 1

Fall/3rd semester (17 credits)

- APMA 2130: Differential Equations
- PHYS 2415 & 2419: Phys 2 & Lab
- MSE 2090: Intro to MSE
- MSE 2101: Properties Lab
- MSE 3050: Thermodynamics

Spring/4th semester (15 credits)

- APMA 3110: Prob Stats
- MSE 3101: Investigations Lab
- MSE 3070: Kinetics
- Engineering Elective 1
- STS 2600: Engineering Ethics

Fall/5th semester (18 credits)

- MSE 3060: Structures & Defects
- MSE 3670: EMOP
- Engineering Elective 2
- Math/Science Elective 2
- HSS Elective 2
- Unrestricted Elective 1

Spring/6th semester (15 credits)

- MSE 4320: Mechanical Behavior
- MSE Elective 1
- MSE Elective 2
- Technical Elective 1
- HSS Elective 3

Fall/7th semester (15 credits)

- STS 4500: Engineering Practice
- MSE Capstone 1
- MSE Elective 3
- MSE Elective 4
- Unrestricted Elective 2

Spring/8th semester (15 credits)

- STS 4600: Engr Ethics & Profession
- MSE Capstone 2
- MSE Elective 5
- Technical Elective 2
- Unrestricted Elective 3

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MSE Major Requirements by Semester – Sample Schedule

For Students who took MSE 2090 in their First Year

Fall/1st semester (15 credits)

- APMA 1110: Calc 2
- CHEM 1410 & 1411: Chem 1 & Lab
- ENGR 1010: Engr Foundations 1
- CS 111x: Intro to Programming

Spring/2nd semester (17 credits)

- APMA 2120: Multivariate Calc
- PHYS 1425 & 1429: Phys 1 & Lab
- ENGR 1020: Engr Foundations 2
- MSE 2090: Intro to MSE
- Math/Science Elective 1

Fall/3rd semester (17 credits)

- APMA 2130: Differential Equations
- PHYS 2415 & 2419: Phys 2 & Lab
- MSE 3050: Thermodynamics
- MSE 2101: Properties Lab
- HSS Elective 1

Spring/4th semester (15 credits)

- APMA 3110: Prob Stats
- MSE 3101: Investigations Lab
- MSE 3070: Kinetics
- Engineering Elective 1
- STS 2600: Engineering Ethics

Fall/5th semester (18 credits)

- MSE 3060: Structures & Defects
- MSE 3670: EMOP
- Engineering Elective 2
- Math/Science Elective 2
- HSS Elective 2
- Unrestricted Elective 1

Spring/6th semester (15 credits)

- MSE 4320: Mechanical Behavior
- MSE Elective 1
- MSE Elective 2
- Technical Elective 1
- HSS Elective 3

Fall/7th semester (15 credits)

- STS 4500: Engineering Practice
- MSE Capstone 1
- MSE Elective 3
- MSE Elective 4
- Unrestricted Elective 2

Spring/8th semester (15 credits)

- STS 4600: Engr Ethics & Profession
- MSE Capstone 2
- MSE Elective 5
- Technical Elective 2
- Unrestricted Elective 3

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MSE Major Sample Schedule: *For Transfer Majors*

Fall/5th semester (12 credits)

- MSE 2090: Intro to MSE
- MSE 3050: Thermodynamics
- MSE 2101: Properties Lab
- MSE Elective 1 (or do this in 7th semester)

Spring/6th semester (12 credits)

- MSE 3101: Investigations Lab
- MSE 3070: Kinetics
- MSE Elective 2
- MSE Elective 3 (or do this in 8th semester)

Fall/7th semester (18 credits)

- MSE Capstone 1
- MSE 3060: Structures & Defects
- MSE 3670: EMOP
- MSE Elective 4
- MSE Elective (unless taken in 5th semester)
- STS 4500 (Engineering Practice)

Spring/8th semester (15 credits)

- MSE Capstone 2
- MSE 4320: Mechanical Behavior
- MSE Elective 5
- MSE Elective (unless taken in 6th semester)
- STS 4600 (Ethics and Professional Responsibility)

Other required courses:

- CHEM 1410 & 1411 (Chemistry 1 and lab)
- PHYS 1425 & 1429 (Physics 1 and lab)
- PHYS 2415 & 2419 (Physics 2 and lab) or ECE 2200
- Math/Science Elective 1 (PHYS 2620, CHEM 1420, BIOL 2100, BIOL 2200, EVSC 2800, EVSC 3200, EVSC 3300 or any APMA course over 2000)
- Math/Science Elective 2: CHEM 3410 or 3610 or any 3000 or higher APMA course
- APMA 1110 (Calc 2)
- APMA 2120 (Multivariable Calc)

- APMA 2130 (Ordinary Differential Equations)
- APMA 3110 (Statistics and Probability)
- HSS 1, 2 & 3 (3 courses in Humanities & Social Sciences)
- Unrestrictive Electives 1, 2 & 3 (Any 3 courses)
- STS 2600 (Engineering Ethics)
- ENGR 1010 (Engineering Foundations 1)
- ENGR 1020 (Engineering Foundations 2)
- CS 111x (Intro to Programming)
- Engineering Electives 1 & 2 (most 2000 or above engineering courses)
- Technical Electives 1 & 2 (most 2000 or higher math, science or engineering courses)

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Definitions of MSE Major Requirements:

See <https://engineering.virginia.edu/current-students/current-undergraduate-students/degree-information/elective-information> for details on electives.

Math/Science Electives - For the **first one**, choose from PHYS 2620, CHEM 1420, BIOL 2100, BIOL 2200, EVSC 2800, EVSC 3200, EVSC 3300 or any APMA course over 2000 (APMA 3080 Linear Algebra recommended). For the **second one**, CHEM 3410 or 3610 (Pchem) or any 3000 or higher APMA course (APMA 3140 Partial Differential Equations recommended).

HHS electives - 9 credits from chosen list in dean's office - see link above.

MSE Electives - choose 5 additional (non-core) MSE courses, only two of which may be below the 3000-level. One MSE 4960 Research for credit may count as an MSE elective.

Engineering Electives - Chosen from any 2000-level or higher engineering course, with the following exceptions: no course in APMA, STS, or ENGR may be used as engineering electives; no course that counts as a Science Elective may be used as an engineering elective; and no course that fulfills the Engineering Business Minor may be used as an engineering elective.

Technical Electives - Any 2000 or higher math, science or engineering courses, unless courses for non-science majors, duplicates required MSE course work, or duplicates another previously taken course. Only up to 2 research-for-credit courses permitted - if one has been used as an MSE elective, then only one research for credit may count as a tech elective. ECE 3103 Solid State Devices (note pre-req ECE 2630) is recommended for students interested in EMOPS; CHEM 2410 Orgo 1 plus 2311 1cr Lab, CHEM 2420 Orgo 2 plus 2321 1cr lab, ChE Polymers 4449 (note pre-req CHE 3321 Transport, which also has pre-reqs), and BME 4414 Intro to Biomaterials (note pre-reqs: BME 2014 Cell/Molecular Bio and BME 2220 Biomechanics) recommended for students interested in soft materials; MAE/CE 2310 Statics & MAE/CE 2320 Strength of Materials recommended for students interested in structural materials. No STS or ENGR courses may count as Technical Electives.

Unrestricted Electives - Chosen from any graded course in the University except mathematics courses below MATH 1310; courses that substantially duplicate any others offered for the degree, including PHYS 2010, PHYS 2020, CS 1010, CS 1020; any introductory programming course. APMA 1090 counts as a three-credit unrestricted elective for students.

Research for Credit – Students may take up to 6 credits (2 courses) of MSE 4960, Research for Credit. 3 of these credits may count as one MSE Elective course. The other 3 credits may count as one Technical Elective course or all 6 credits may count as two Technical Elective courses.

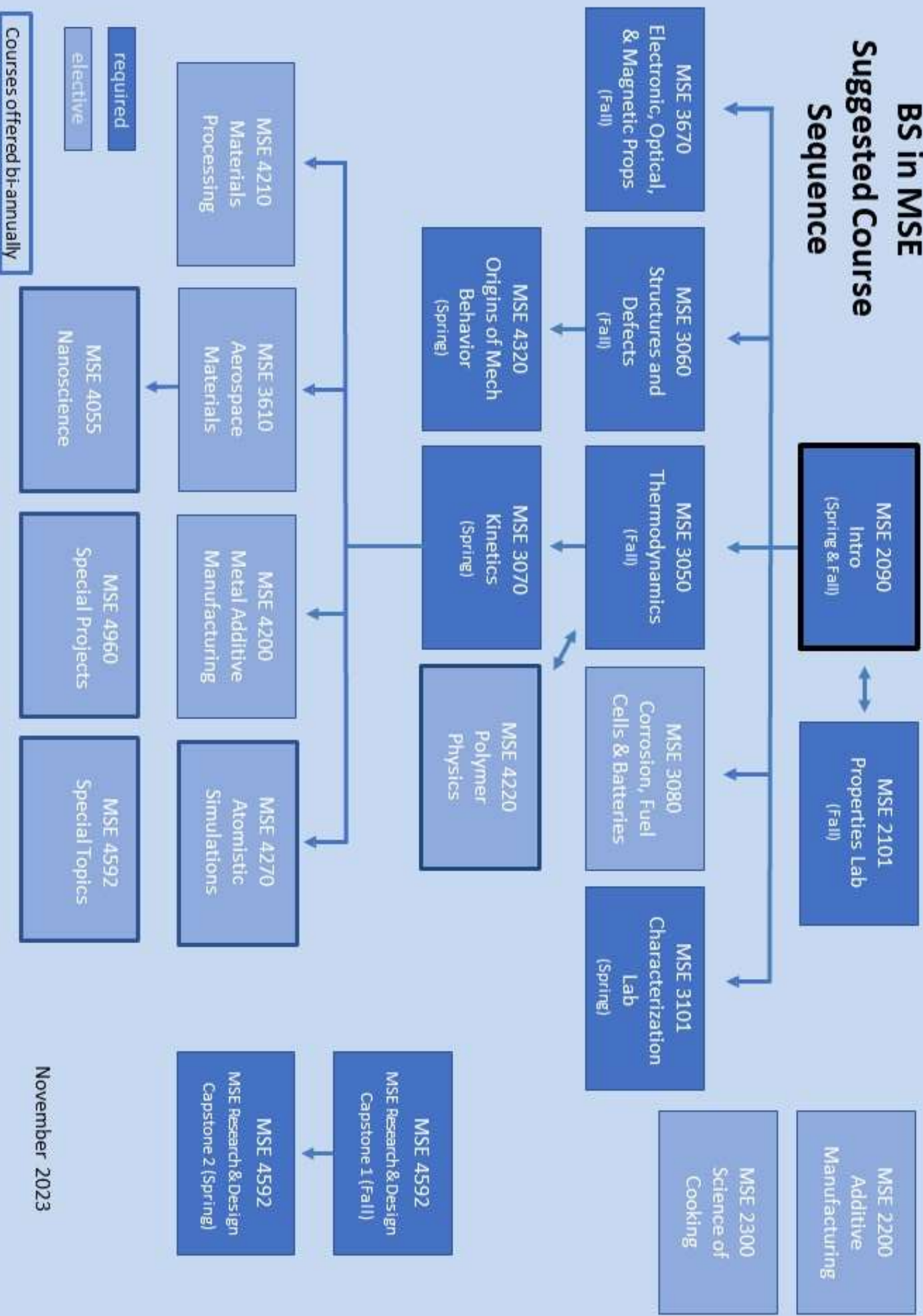
MSE 3050 – Students should take MSE 3050 in the first Fall Semester they can as this course is foundational to the major. MSE 3050 may be taken concurrently with MSE 2090.

MSE Course Pre- and Co-Requisites

Course	Title	Semester	Pre- or Co-Requisite
MSE 2090	Intro to MSE	Fall & Spring	none
MSE 2101	MSE Investigations: Properties	Fall	MSE 2090 pre- or co-requisite
MSE 2200	AM & 3-D Printing	Spring	None
MSE 2300	Science of Cooking	Fall	None
MSE 2500	Special Topics: MSE	Fall	none
MSE 3050	Thermodynamics of Materials	Fall	APMA 2120 (Multivariable Calc) or equivalent
MSE 3060	Structures/Defects of Materials	Fall	APMA 2120 (Multivariable Calc) or equivalent
MSE 3070	Kinetics of Materials	Spring	MSE 3050 or instructor permission
MSE 3080	Corrosion	Fall	CHEM 1410 (Chem 1) or equivalent
MSE 3081	Corrosion Lab	Fall	MSE 3080 co-requisite
MSE 3101	MSE Investigations	Spring	MSE 2090
MSE 3610	Aerospace Materials	Fall	CHEM 1410 (Chem 1), MAE 2310 (Strength of Materials) co-requisite
MSE 3670	EMOP	Fall	PHYS 2415 (Physics 2) or instructor permission
MSE 4055	Nanoscale Science & Tech	varies	MSE 3670
MSE 4200	AM of Metals	Fall	MSE 3070
MSE 4210	Materials Processing	Spring	MSE 3070 or instructor permission
MSE 4220	Polymer Physics	varies	MSE 3050, CHE 3316 or MAE 2100
MSE 4270	Intro to Atomistic Simulations	Spring	3 rd or 4 th Year standing or instructor permission
MSE 4320	Origins of Mechanical Behavior	Spring	MSE 3060
MSE 4560	Special Projects: MSE	Fall & Spring	3 rd or 4 th Year standing or instructor permission
MSE 4592	Special Topics: MSE	Fall & Spring	3 rd or 4 th Year standing or instructor permission

BS in MSE

Suggested Course Sequence



required

elective

Courses offered bi-annually

The BS in MSE Curriculum Worksheet

(By Requirement)

Total Credits: 127

Science & Electives	Semester	Credits	Notes/Comments (AP/TRNSF)	Humanities, Social Science	Semester	Credits	Notes/Comments (AP/TRNSF)
Chem 1410 (Chem 1)		3		HSS 1		3	Notes/Comments (AP/TRNSF)
Chem 1411 (Chem 1 Lab)		1		HSS 2		3	see requirement definitions
Phys 1425 (Physics 1)		3		HSS 3		3	see requirement definitions
Phys 1429 (Physics 1 Lab)		1					
Phys 2415 or ECE 2200 (Phys 2)		3		Unrestricted Elective	Semester	Credits	Notes/Comments (AP/TRNSF)
Phys 2419 or ECE 2200 (Ph2 Lab)		1		UNRE 1		3	see requirement definitions
Math/Science Elective 1		3	see requirement definitions	UNRE 2		3	see requirement definitions
Math/Science Elective 2		3	see requirement definitions	UNRE 3		3	see requirement definitions
Applied Math	Semester	Credits	Notes/Comments (AP/TRNSF)	STS and Thesis	Semester	Credits	Notes/Comments (AP/TRNSF)
APMA 1110 (Calc 2)		4		STS 2600 (Ethics)		3	
APMA 2120 (Multiv Calc 3)		4		STS 4500 (4th year)		3	
APMA 2130 (ODE)		4		STS 4600 (4th year)		3	
APMA 3110 (Probstats)		3					
MSE Core Courses	Semester	Credits	Notes/Comments (AP/TRNSF)	ENGR and CS	Semester	Credits	Notes/Comments (AP/TRNSF)
MSE 2090 (Intro to MSE)		3		ENGR 1010 (Foundations 1)		4	
MSE 2101 (Properties Lab)		3		ENGR 1020 (Foundations 2)		3	
MSE 3101 (Characterization Lab)		3		CS 111x (Intro to Prog)		3	
MSE 3050 (Thermo)		3		Engineering Elective 1		3	see requirement definitions
MSE 3060 (Structures & Defects)		3		Engineering Elective 2		3	see requirement definitions
MSE 3670 (EMOP)		3		Technical Elective 1		3	see requirement definitions
MSE 3070 (Kinetics)		3		Technical Elective 2		3	see requirement definitions
MSE 4320 (Mech Behavior)		3		Materials R&D Capstone 1&2	Semester	Credits	Notes/Comments (AP/TRNSF)
				MSE 4592 - Capstone 1		3	
				MSE 4592 - Capstone 2		3	
MSE Electives	Semester	Credits	Notes/Comments (AP/TRNSF)				
MSE Elective 1		3	see requirement definitions				
MSE Elective 2		3	see requirement definitions				
MSE Elective 3		3	see requirement definitions				
MSE Elective 4		3	see requirement definitions				
MSE Elective 5		3	see requirement definitions				

Notes and Definitions:

HHS Electives - 9 credits from chosen list in A122 Thornton Hall

Math Science Electives - For the first one, choose from PHYS 2620, CHEM 1420, BIOL 2100, BIOL 2200, EVSC 2800, EVSC 3200, EVSC 3300 or any APMA course over 2000 (APMA 3080 Linear Algebra recommended). For the second one CHEM 3410 or 3610 (Pchem) or any 3000 or higher APMA course (APMA 3140 Partial Differential Equations recommended).

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How to Make Your Schedule

– a non-binding checklist

Use your resources:

- <https://engineering.virginia.edu/departments/materials-science-and-engineering/undergraduate/mse-major> and all the worksheets offered.
- Download the excel worksheet “BS-MSE worksheet by requirement”
- Keep a notes of all your ideas, and desires for your studies – revisit often.

Required Courses: <ul style="list-style-type: none">• General Core (science, math, CS basics)• MSE Core	Pay attention to general requirements, some might be covered by your AP credit, others can be taken in the summer at a community college. Inquire about these substitutions. Make sure you build up the prerequisites for your MSE core.
Which courses are offered in the next term?	Take the longer view – some courses are offered once an academic year and not every term. Make sure not to miss out on the required classes and prerequisites. Keep a tally!
MSE Electives	Check your interests – are you excited about electronic materials, polymers, metallurgy, corrosion.... ? No idea what that is? Contact the professor teaching those courses, or ask your designated advisor. Choose the electives from the list at the bottom of the worksheet.
Technical and Engineering Electives	Which other fields in engineering (or science or math or statistics or data science) are of interest to you? Roam Lou’s list for inspiration, ask your classmates...
Minor	Are you very interested in another field of study? Chemical Engineering, or CS or MAE are frequently combined with an MSE major. Consider a minor!
Research	Start early – you can do research in your second year! There are many, many research opportunities available to students: contact a professor with interesting research (maybe a class inspired you!), talk to your professors... Note that you can take research for credit – can be counted as technical elective, or MSE elective (max of 3 credits).
Prerequisites	Double check you have considered all required prerequisites.
Unrestricted Electives	Music? Literature? Another language? This is your chance to follow your curiosity and passions.

The Requirements for a Minor in MSE

A minimum of five MSE courses constitutes an MSE minor.

Take both of these courses:

- *MSE 2090 - Introduction to the Science and Engineering of Materials*
- *MSE 3050 - Thermodynamics of Materials*

Select at least one of these courses:

- *MSE 3060 - Structures and Defects of Materials*
- *MSE 3070 - Kinetics and Phase Transformation in Materials*

Select two courses from the following list to complete a five-course minor:

- *MSE 2101 - Materials Science Investigations: Properties Lab*
- *MSE 2200 - Intro to Additive Manufacturing and 3-D Printing*
- *MSE 2300 - Science of Cooking*
- *MSE 3060 - Structures and Defects of Materials*
- *MSE 3070 - Kinetics and Phase Transformation in Materials*
- *MSE 3080 - Corrosion, Batteries and Fuel Cells*
- *MSE 3101 - Materials Science Investigations – Characterization Lab*
- *MSE 3610 - Aerospace Materials*
- *MSE 3670 - Materials for Electronic, Magnetic and Optical Applications*
- *MSE 4030 - X-ray Scattering Techniques in Materials Science*
- *MSE 4055 - Nanoscale Science & Technology*
- *MSE 4200 - Additive Manufacturing of Metals*
- *MSE 4210 - Materials Processing*
- *MSE 4220 - Polymer Physics*
- *MSE 4270 - Introduction to Atomistic Simulations*
- *MSE 4320 - Origins of Mechanical Behavior*
- *MSE 4592 - Special Topics in Materials Science*
- *CHE 4449 - Polymer Chemistry and Engineering*

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