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Student Guide Curriculum 570

Hobson, Garth V.

Monterey, California. Naval Postgraduate School

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NAVAL
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STUDENT GUIDE

Curriculum 570
Naval-Mechanical Engineering

<http://my.nps.edu/web/mae/students>

Department of
Mechanical & Aerospace Engineering

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Contents

1. Introduction	1
2. Welcome Aboard	1
2.1. Message from the Chairman	1
2.2. Message from the Program Officer.....	2
3. Program Educational Objectives	3
4. Degree Requirements	4
4.1. Course Levels and Credit Hours	4
4.2. Master of Science in Mechanical Engineering (MSME).....	5
4.3. Master of Science in Engineering Science (Mechanical Engineering - MSES(ME)	5
4.4. Mechanical Engineer	5
4.5. Summary of Degree Requirements for Master of Science and Mechanical Engineer Degree.....	6
4.6. Total Ship Systems Engineering (TSSE) Program	6
4.7. Energy Track (Curriculum 563).....	7
5. Your Thesis.....	8
5.1. Overview.....	8
5.2. Choosing 4000-Level Electives and Thesis Tracks.....	11
6. Timeline for a Two-Year Program.....	12
6.1. If an MS degree requires only 32 course credit-hours, why are there so many courses in my matrix?	13
7. Educational Skill Requirements (ESRs) and the Subspecialty Codes (P-Codes).....	13
7.1. ABET Requirements.....	18
7.2. BSME Equivalency.....	19
8. Your Course Matrix.....	20
8.1. Validating 2000-Level Courses	21
8.2. Dropping 3000- and 4000-Level Courses.....	22
8.3. Generic 8 Quarter Matrix with Integrated JPME and Refresher	23
8.4. Generic 9 Quarter Matrix with Integrated JPME and Refresher	24
8.5. Generic 563 Naval Mechanical Engineering - Energy Track 8 Quarter Matrix (with Integrated JPME, no Refresher)	25
8.6. Generic 570 Naval/Mechanical Engineering 9 Quarter Matrix (with TSSE, no JPME, no Refresher)	26
8.7. Review Your Matrix	27
9. Filling Out the BSME Equivalency Form and the MSME Checklist	29
9.1. When to Fill Out These Forms	29
9.2. How to Fill Out These Forms	29
10. APPENDICES.....	30
Appendix 1 - MSME Checklist	30
Appendix 2 - BSME Equivalency Form.....	30
Appendix 3 - Thesis Approval Form.....	30

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1. Introduction

This document provides a guide to the resident Mechanical Engineering degree programs in the Department of Mechanical & Aerospace Engineering (MAE) Department. Separate guides are available for Distance Learning programs, the Aerospace Engineering Program, and Doctoral Programs. Much of the information contained within is based on a standard 8- quarter (2 year) 570 curriculum leading to a MSME and the subspecialty code. There are, however, students with programs of different lengths (e.g. 9 quarter, 6 quarter, 4 quarter), and this guide serves these students as well, with the necessary adjustment of the information provided. Regardless of duration, your academic program is tailored to you, and you should consult with the Program Officer and Academic Associate to ensure that your program meets your educational needs, the requirements of your sponsor, and meets degree requirements. This guide provides information on educational objectives, degree requirements, thesis requirements, required paperwork, subspecialty code requirements (for Navy Officers), and planning your educational program. The MAE Department faculty and staff are here to help you succeed.

For questions please see the following people:

CDR Todd Greene.....	Program Officer (x-2033)
Prof. Joshua H. Gordis	Academic Associate (x-2866)
Prof. Garth V. Hobson.....	Chairman (x-2888)
Prof. Claudia C. Luhrs.....	Associate Chairman (x-2568)

Acronyms:

ABET.....	Accreditation Board for Engineering and Technology
BS	Bachelor of Science
BSME	Bachelor of Science in Mechanical Engineering
ME	Mechanical Engineering
MS	Master of Science
MSES.....	Master of Science in Engineering Science
MSME	Master of Science in Mechanical Engineering
TSSE	Total Ship Systems Engineering

2. Welcome Aboard

2.1. Message from the Chairman

Welcome to the Department of Mechanical and Aerospace Engineering. This guide will help you with planning your academic program at NPS. While the guide is rather complete it is not totally proscriptive, and there can be room in some areas for variations that may better suit your

personal educational objectives. So please take the guide in the spirit it was intended - as a guide - and not a complete, regimented set of absolute requirements. If you have questions, come ask us, we are here to support you!

I recommend that you read this document in its entirety so you better understand the complete program, including the requirements and necessary paperwork. This will provide you the opportunity to start exploring your options early, whether it is validating courses you have already taken as an undergraduate, adding special courses you want to take, or starting your thesis research in a given area early.

For most of you this will be your only opportunity at fully funded graduate education, so take full advantage of it. The MAE Department has excellent faculty and experimental and computational research facilities awaiting you. There are student professional organizations, such as ASME, ASNE, and AIAA that can enhance your educational experience and help in your future career. There is the opportunity to obtain a Professional Engineers license while you are here, and there is no better time.

Finally, I welcome you and your family to Monterey. I wish you a memorable and enjoyable experience at NPS. Wherever you go from here, please keep in contact with us so that we may hear from you and share in your successes.

Garth V. Hobson, Ph.D.
Chairman, Department of Mechanical & Aerospace Engineering

2.2. Message from the Program Officer

Welcome to the Naval Postgraduate School. On behalf of the Graduate School of Engineering and Applied Sciences (GSEAS) and the entire Mechanical and Aerospace Engineering Department, I would like to take this opportunity to congratulate each of you on your acceptance and arrival at NPS. I believe that you will find this tour to be intellectually challenging and you will look back on it later in life as one of the most enjoyable tours of your career. I encourage you to seek out a balance of everything that NPS and Monterey have to offer. Maintain focus on your goal of obtaining an advanced degree from one of the finest institutions in the country, but also remember to give your mind a break and work the rest of your body from time to time. I

hope that you take advantage of the many recreational activities, from kayaking in Elkhorn Slough to hiking at Yosemite.

We have put together this MAE Department Student Guide with your academic needs in mind. Inside you will find timelines and forms designed to ensure that you are successful in meeting the various academic and administrative requirements for earning a degree. Feel free to consult with the Academic Associate and me for additional guidance as you prepare these forms for submission. Timely submission of these forms is imperative for successfully identifying any additional requirements that you may need to complete your Master's Degree.

Thesis research and presentation of your work to the faculty and your peers is another graduation requirement. You choose the area for thesis research. Do not take this decision lightly. Start your search early by learning about current research that is being conducted in the department by the faculty and other students. You may be able to continue existing research. Perhaps you have knowledge of a fleet problem or a personal interest that you want to explore! Given enough time, it could be developed into an acceptable thesis proposal complete with adequate funding for you to execute.

Please consider the faculty and staff as the most valuable resource in your academic endeavors. We are here to help you succeed. Without you, there is no Naval Postgraduate School and the service that it provides. We will do our part to make your tour successful through a blend of quality education, career guidance and esprit de corps. My door is always open and I look forward to continued interaction with each and every one of you.

Welcome Aboard!

Todd Greene
CDR USN
Program Officer, Mechanical Engineering

3. Program Educational Objectives

The overall educational objective of the Mechanical Engineering Program is to support the NPS mission by producing graduates who have knowledge and technical competence, at the advanced level in Mechanical Engineering, in support of national security.

In order to achieve this goal, the specific educational objectives are to produce alumni who are expected to achieve the following within a few years of graduation:

- Identify, formulate, and solve technical and engineering problems in Mechanical Engineering and related disciplines using the techniques, skills and tools of modern practice, including modeling and simulation. These problems may include issues of research, design, development, procurement, operation, maintenance or disposal of engineering components and systems for military applications.
- Provide leadership in the specification of military requirements, in the organization and performance of research, design, testing, procurement and operation of technically advanced, militarily effective systems. The graduate must be able to interact with personnel from other services, industry, laboratories and academic institutions, and be able to understand the role that engineering and technology have in military operations, and in the broader national and global environment.
- Communicate advanced technical information effectively in both oral and written form.

4. Degree Requirements

4.1. Course Levels and Credit Hours

Each course in the MAE Department falls into one of the following levels:

ME1xxx/AE1xxx – Introductory undergraduate-level class

ME2xxx /AE2xxx – Undergraduate-level class

ME3xxx /AE3xxx – Advanced undergraduate or introductory graduate-level class

ME4xxx /AE4xxx – Graduate-level class

The course catalog (either the print version or Python) provides the quarter credit-hours provided by all courses. For example, consider the course, ME2201 Introduction to Fluid Mechanics. This class is assigned a value of (3-2), which means that every week there are 3 hours of lecture, and 2 hours of laboratory. To calculate the quarter credit-hour (QCH) value of a class, apply the following formula:

$$\text{QCH} = \text{Lecture Hours} + \frac{1}{2} * \text{Laboratory Hours}$$

Upon successful completion of ME2201, you will earn $3 + \frac{1}{2} * 2 = 4$ QCH. Note that your matrix has four ME0810 classes, which are thesis “slots”. These are slots in your matrix which are included as a means of assigning QCH to the thesis (there is no actual lecture or lab meeting).

These classes have a value of (0-8) and therefore each ME0810 earns you 4 QCH, and hence your thesis earns a total of 16 QCH towards the Master of Science degree.

The following degree requirements are taken from the NPS Academic Catalog.

4.2. Master of Science in Mechanical Engineering (MSME)

- You must have completed work equivalent to the department's requirements for a Bachelor of Science (BS) degree. If you do not have a BS in Mechanical Engineering from an ABET-accredited undergraduate program, you may be able to establish *BSME equivalency*, and hence become eligible to earn the MSME degree. Please refer to **Section 7.2** for discussion of this issue.
- You must earn a minimum of 32 quarter hours of credits in 3000 and 4000 level courses, of which at least 12 credits must be at the 4000 level. Please see **Section 5.2** for information about further requirements for 4000 level courses.
- Of the 32 quarter hours, at least 24 quarter hours must be in courses offered by the Dept. of Mechanical & Aerospace Engineering.
- Of the 32 quarter hours, 8 quarter hours must be taken in technical topics from outside the department, at the 3000 or 4000 level.
- An acceptable thesis for a minimum of 16 credits.

4.3. Master of Science in Engineering Science (Mechanical Engineering - MSES(ME))

- You must have an acceptable academic background.
- You must earn a minimum of 32 quarter hours of credits in 3000 and 4000 level courses, of which at least 12 credits must be at the 4000 level. Please see **Section 5.2** for information about further requirements for 4000 level courses.
- Of the 32 quarter hours, at least 24 quarter hours must be in courses offered by the Mechanical Engineering Department.
- Of the 32 quarter hours, 8 quarter hours must be taken in technical topics from outside the department, at the 3000 or 4000 level.
- An acceptable thesis for a minimum of 16 credits.
- The total quarter credit-hours required is therefore 48 (coursework + thesis).

4.4. Mechanical Engineer

- You must have a superior academic record, including a graduate QPR (3000 and 4000 level classes) of 3.70 or better.

- You may apply to this program after the completion of approximately one year of graduate level study.
- Sixty-four (64) quarter hours of graduate level credits in MAE courses.
- At least 32 of the 64 credit hours must be at the 4000 level.
- In addition, at least 12 credit hours must be earned in technical courses taken outside the department, and at least one advanced mathematics course (4000 level) must be included.
- An acceptable thesis of 28 credits.
- The total quarter credit-hours required is therefore 92 (coursework + thesis).

4.5. Summary of Degree Requirements for Master of Science and Mechanical Engineer Degree

		M.S. ME/AE	Engineer ME/AE
Content	Level	Qtr-Hours (min req'd)	
MAE	4000	12	32
	3000-4000	12	20
Non-MAE	3000-4000	8	12
Thesis		16	28
Total QTR Hours		48	92

4.6. Total Ship Systems Engineering (TSSE) Program

The Total Ship Systems Engineering Program is an interdisciplinary, systems engineering and design-oriented program available to students enrolled in Mechanical Engineering programs. TSSE courses are included in the Mechanical Engineering curriculum and generally, count towards MSME degree requirements. The appropriate degree thesis requirements must be met, but theses that address system design issues are welcome. Each of the above degrees requires the TS3001 Fundamental Principles of Naval Architecture (3-2).

The TSSE program requires an additional six courses:

- TS3000 Electrical Power Engineering (3-2)
- TS3003 Naval Combat System Elements (3-2)
- TS4000 Naval Combat System Engineering (3-2)
- TS4001 Integration of Naval Engineering Systems (3-2)
- TS4002 Ship Design Integration (2-4)
- TS4003 Total Ship Systems Engineering (2-4)

If you decide you would like to add the TSSE track to your matrix, you must add these additional six courses to your matrix. Note that TS4001 and TS4003 can serve as two of the required three 4000-level classes. The third required 4000-level elective must come from a different specialization track (i.e. not a TS class). Therefore, only a net gain of three additional courses is required.

Also note:

- TS3001, TS4001, TS4002, TS4003 earn ME credit.
- TS3000, TS3002, TS3003, TS4000 earn non-mechanical engineering credit.
- TS3000 can replace EO2102 to satisfy the electrical engineering ESR.
- TS4003 can replace ME3712 to satisfy ABET BSME equivalency requirements.

If you successfully complete the TSSE program, you are eligible to earn the 5602 P-code. For further information, see Professor Jarema Didoszak, Director, TSSE Program.

4.7. Energy Track (Curriculum 563)

The energy track is a program within the MAE Dept. which provides students with a specialized knowledge in energy systems design, operation, and policy. This track earns the P-code 5603. The following additional courses are required:

OS3007	Operations Research for Energy Systems Analysts
PH3700	Fundamentals of Energy
ME4424	Combustion Fundamentals
MS4410	Advanced Energy Materials
EN3000	Defense Energy Seminar

Note that students must be enrolled in EN3000 for at least 4 consecutive quarters. When not enrolled in EN3000, the student must be enrolled in the ME seminar, ME0951. Additionally, if a student has previously taken a course in Thermodynamics, PH3700 may be deleted.

5. Your Thesis

5.1. Overview

This overview will describe the thesis, why it is very important to your graduate study, what are the steps that you will need to do and when they should or must be done, how to find an advisor, and the resources that are available to help you along the way. In the following section, questions and answers are provided for some common questions.

A thesis is a “position or proposition that a person (as a candidate for scholastic honors) advances and offers to maintain by argument.” It is a document containing results of original research and especially supporting a specific view.

The thesis is the most important part of your graduate education. While the course work lays the foundation by providing analytical methods and tools, it is the thesis that provides you with the opportunity to use this knowledge in a new, original and creative manner. During your thesis research you will be able to consolidate what you have already learned, and possibly extend this by further self-study, and to use this body of knowledge to address a new problem. The thesis will hopefully be the crowning achievement of your graduate study, and will be your introduction to the community of scholars.

The first step in the thesis process is choosing an advisor and a topic. While your formal thesis slots may be in the last 2 or 3 quarters at NPS, it is very important that you have a thesis advisor and topic chosen well before this, preferably a year or so before you plan to graduate. During the time between choosing an advisor/topic and the start of your thesis slots, you should meet regularly with your advisor and spend a few hours a week reading background material and thinking about the problem. Your research can and should in fact begin as soon as possible.

The method for choosing your topic and advisor is completely up to you. However, you are strongly advised to talk to every faculty member in all the areas that you have any interest before making decisions. There are several questions you might want to ask yourself, before talking to the faculty. What type of work do you most enjoy? Generally, thesis research may be categorized as analytical (e.g. using a pencil and paper for mathematical modeling and

derivation of solutions), computational (e.g. using finite element technique or computational fluid mechanics to find solutions, or perhaps writing computer programs yourself), experimental (e.g. designing, building, or modifying an existing set-up to obtain new data) or some combination of the three. It is generally advisable that you take a course from a professor before you make a commitment to work for him or her. The MAE Faculty periodically schedule thesis opportunity presentations, where they will discuss their current research interests and the available topics. In addition, there is a MAE website which contains short written descriptions for current thesis topics of MAE faculty. You may talk to fellow students, who are close to graduating to discuss what they have done and how they enjoyed their experience. However, the faculty member is the best source of information regarding available thesis topics. Finally, you may wish to review previous theses, as well as conference and journal publications from the various faculty members.

Note that your thesis advisor must be a Tenure Track (TT) faculty member from the MAE Dept. In addition to choosing a thesis advisor, you must also identify another faculty member who will serve as a thesis co-advisor, or alternatively, as *second reader*. This person need not be a MAE Dept. TT faculty member. A thesis co-advisor is typically someone who is technically involved with the thesis research and who will also help guide you in your research. A second reader is someone who is not directly involved with your research, but has agreed to read, critique, and edit your thesis.

After you find an advisor and agree on the topic, you are required to fill out a thesis approval form, which must be signed by the thesis advisor, the (570) Academic Associate and the Chairman of the MAE Department. The thesis approval form must fill out and submitted prior to your first thesis slot (ME0810).

While your advisor will help you along the way and provide broad guidance and feedback, it is the responsibility of the student to be self-motivated and to initiate all of the steps. Do not expect your advisor to provide a detailed, step-by-step, road map for you. You should develop independence, and think through problems first, before asking your advisor.

However, that does not in any way mean you should avoid meeting with your advisor. You should meet regularly with your advisor to discuss what you have done, what issues have arisen, how you plan to solve them, and what your next steps should be.

One common problem faced by researchers is the failure to sufficiently limit the scope of their work. Research goals being overly broad can lead to a lack of focus and prevent any contribution from being made. It may seem to you that your advisor has asked you to solve a problem that you consider trivial and you may be inclined to broaden the scope. Stay focused on the immediate problem. If you solve the problem then by all means go on to a larger problem. But initially, keep your focus on a narrow and well-defined problem.

One way that you can help yourself is to write a short Thesis Proposal. It can be useful in helping to consolidate your understanding and focusing your future work. This may be written after you have been working on the problem for several months, have read dozens of articles and it may contain the following elements:

1. Introduction to the problem. This describes the problem and why it is important.
2. State of the art. Literature review and what is not known.
3. Objectives. Your goals for the work. What would be the desired outcome(s)? Be specific. Do not say to better understand something.
4. Proposed work. Very limited and specific.

For you to make an original contribution, it generally requires that you have an understanding of what is already known, by experts in your field. Therefore, one of the primary resources on which you will depend is the NPS library and the reference staff. The library offers a wide variety of seminars on conducting research and completing a thesis.

While the world-wide-web is becoming an increasing source of information, and you should make use of it, there are many primary sources, such as books and journals, which are not available on the web. Most of the information on the web is not archival in nature – that is, it might not exist if a certain site is closed. Generally, journal articles are peer-reviewed, and hence provide one of the most reliable and authoritative sources of information. On the other extreme, for example, is Wikipedia, which is not reviewed and may include unreliable information.

One of the most valuable skills you should learn during your thesis is how to obtain and process information and how to synthesize new results from that original information.

After your research is complete you will be required to write and submit a thesis document. For many of you it will be the longest document that you have written.

Finally you are required to make an oral presentation of your thesis research to the faculty and students of the MAE Department. The presentation is approximately fifteen minutes with about a 5-minute question and answer period. A document on how to prepare and deliver this presentation is available from the MAE Department.

In addition to the forms and the guidelines contained in this document, NPS has extra requirements with regards to thesis processing and other forms to fill out. You will find all of this information at <http://www.nps.edu/Research/research1.html>. You are encouraged to also make use of the Graduate Writing Center at NPS.

5.2. Choosing 4000-Level Electives and Thesis Tracks

The requirements for the MS degree include at least three 4000-level classes. These are *electives*, in that you will choose the specific courses you will take. In your matrix, there are “open slots” reserved for this. Once you have identified a thesis advisor and topic, your advisor will most likely recommend to you some or all of your electives. These will be chosen to provide you with the advanced knowledge you will need in order to conduct research in your chosen area. Generally, thesis topics will fall into one of the following technical areas, or “tracks”:

- Fluids-Thermal Sciences
- Solid Mechanics, Shock and Vibration
- Materials Science
- Dynamics and Controls
- System Design (Weaponizing, Survivability)
- Astronautics (Controls & Structures)

You are required to choose at least two of your three 4000-level electives from the courses listed in one of the above tracks, and your third elective may be from a different track. This requirement serves to ensure that you will have some depth in a single technical area (two 4xxx courses) while obtaining some breadth by virtue of your third 4xxx course in a different technical area. If you decide to pursue the TSSE program, note that TS4001 and TS4003 can serve as your two electives

from within a single track. Your third 4000-level elective must come from a different thesis specialization area.

6. Timeline for a Two-Year Program

A standard program leading to the MS degree is eight quarters (two years). The following timeline will indicate the approximate times during your program when important actions need to be taken by you. With the exception of the first quarter all other items should be completed by the end of the indicated quarter. If your program is of shorter duration, most if not all of the indicated actions must be taken by you, but at earlier times. We will explain the various actions following the timeline.

QTR	To Do
1	<p>Review the course matrix assigned to you. Compare with the standard matrix (for the appropriate number of quarters to match your program) found in Sections 8.3 and 8.4. You may be able to validate 2000-level classes and/or drop 3000-level classes if you have taken equivalent classes elsewhere (e.g. undergraduate program). Please see Section 8.1 for further information.</p> <p>Fill out your first draft of the BSME Equivalency form in the (Appendices) and the MSME Checklist. Bring to Program Officer or Academic Associate for review.</p>
2	
3	<p>Start interviewing the faculty members in order to identify potential thesis topics. Make sure you read Section 5, Your Thesis, before you do that.</p>
4	<p>Pick your Thesis Advisor/Topic. This determines your area of specialization (i.e. “track”). Select and schedule your electives (See Section 5.2).</p>
5	<p>The Dept. Chair requires all Thesis Proposals to be signed before commencement of your first thesis slot.</p>
6	<p>Fill out (with your Thesis Advisor) and submit (to the Academic Associate) the Thesis Approval Form. This must be done prior to your first thesis slot (ME0810). Start working on your thesis.</p>
7	<p>Start your thesis slots (maybe earlier). Fill out final versions of the BSME Equivalency Form MSME Checklist.</p>
8	<p>Final revisions (if needed) of the BSME Equivalency and MSME Checklist forms. Fill out the Graduating Student Exit Survey.</p>
<p>After you graduate. Please keep in touch. Let us know when you reach important milestones in your career, change career paths, etc.</p>	

6.1. If an MS degree requires only 32 course credit-hours, why are there so many courses in my matrix?

The requirements for an MS degree are listed above in Section 4 (and can be found in the NPS Academic Catalog). As you can see, these requirements include eight courses, comprised of three ME3xxx courses, three ME/AE4xxx, and two technical 3xxx/4xxx courses taken outside the department. However, your course matrix, extending over a period of two years, consists of many more courses. Understanding the reasons for the additional courses will help you understand better the impact of changes to your matrix. Keep in mind that your specific educational background and goals will likely require modifications to your assigned matrix, and may in fact require fewer courses (while still meeting the above-stated requirements for the MS degree). Please discuss this with the Program Officer and Academic Associate.

The various courses that you will take serve several purposes. Chief among them are the following:

1. Meet credit-hour requirements for the Master of Science degree (See Section 4)
2. Meet Subspecialty Code 56xxP Engineering Skill Requirements (See Section 7)
3. Meet prerequisite requirements for graduate (4000-level) classes also taken as part of your program. See Section 5.2.
4. Provide necessary technical background to support your thesis research.
5. Meet ABET requirements (See Section 7.1).

We have described the credit-hour requirements of the MS degree previously. We will now describe the Educational Skill Requirements and the ABET requirements.

7. Educational Skill Requirements (ESRs) and the Subspecialty Codes (P-Codes)

The Educational Skill Requirements (ESR) are a set of technical disciplines in which the program sponsor (NAVSEA) expects students to have gained an understanding. As can be seen from the list provided below, you will have earned the ESR in a particular area by successfully completing those courses in that area. Many of the courses in your matrix serve to establish your ESR and hence your eligibility for the P-Code.

The following is s contained in OPNAV N12:

Officers entering into the Naval/Mechanical Engineering curriculum will be offered the necessary preparatory level courses to enable them to satisfy the equivalent of a baccalaureate degree in Mechanical Engineering. They shall meet, as a minimum, the requirements set forth by the Accreditation Board for Engineering and Technology (ABET). At the graduate level, the officer will acquire the competence to participate in technical aspects of naval systems research, design, development, maintenance and acquisition. The background to deal with future advances is gained through the emphasis on design and a combination of the core program requirements, specialization and thesis research. In pursuit of the above, the goal is for each officer to acquire a senior/upper division-level physical and analytical understanding of the following topics. It is recognized that all students may not meet all ESRs depending on individual circumstances determined by the program officer and the academic associate. However, each student will be exposed to fundamentals in all ESR areas.

ESR-1: THERMODYNAMICS AND HEAT TRANSFER: Fundamentals of thermodynamics and heat transfer with applications to all marine engineering power cycles as well as propulsion and auxiliary system cycle analysis and design.

Required Course #	Description	Alternate Course
ME2101	Thermodynamics (4-1)	Undergraduate
ME3150	Heat Transfer (4-1)	NU3159
ME3240	Marine Power and Propulsion (4-2)	

ESR-2: FLUID MECHANICS: Compressible and incompressible flow, both viscous and inviscid, with emphasis on propellers, cavitation, and design of shipboard fluid systems (e.g., fluid machinery, pumps, turbo machinery).

Required Course #	Description	Alternate Course
ME2201	Introduction to Fluid Dynamics (3-2)	Undergraduate
ME3201	Intermediate Fluid Dynamics (3-2)	

ESR-3: DYNAMICS, CONTROL, NAVIGATION, AND AUTONOMOUS SYSTEMS: Kinematics and dynamics of particle, rigid-body and multi-body mechanical systems. Modeling and simulation of engineering systems with mechanical, electrical and hydraulic components. Feedback control concepts, both frequency response and time domain, with applications to the design of component, platform, and weapon systems. Control of systems with continuous, discrete and combined logic states. Navigation and control for single and network-centric systems. Design of intelligent systems for machinery monitoring and automation, as well as autonomous vehicle operations.

Required Course #	Description	Alternate Course
ME2502	Dynamics (4-1)	Undergraduate
ME2801	Introduction to Engineering System Dynamics (3-2)	EC2300
ME3801	Dynamics and Control of Marine and Autonomous Vehicles I (3-2)	

ESR-4: STRUCTURAL MECHANICS AND VIBRATION: Statically determinant and indeterminate structural analysis, stress/strain analysis, buckling and fatigue. Shock and vibration response of marine structures, including surface ships and submarines.

Required Course #	Description	Alternate Course
ME2501	Statics (3-0)	Undergraduate
ME2601	Solid Mechanics I (3-2)	Undergraduate
ME3521	Mechanical Vibrations (3-2)	
ME3611	Solid Mechanics II (4-1)	

ESR-5: MATERIALS AND FABRICATION: Metallurgical processes and transformations; analytical approach to failure of materials in Naval Engineering use and a basic understanding of the materials technology associated with welding or marine corrosion; an introduction to the developing fields of composites and superconducting materials.

Required Course #	Description	Alternate Course
MS2201	Engineering Materials (3-2)	Undergraduate
MS3202	Failure Analysis and Prevention(3-2)	
MS3304	Corrosion and Marine Environment Degradation (3-2)	MS3606

ESR-6: COMPUTERS: A basic understanding of computer system architecture, operating systems, networking and introduction to engineering software design. Practical experience of structured programming languages and the use of integrated design tools for computational and symbolic manipulation. Use and application of mainframe, workstation and personal computers for the solution of Naval engineering design and analysis tasks. Exposure to finite element and finite difference tools and techniques, with application to the thermo-fluid and structural mechanics/dynamics areas, including experience with representative software packages.

Required Course #	Description	Alternate Course
AE2440	Matlab (3-2)	EC2440
ME3450	Computational Methods in Mechanical Engineering (3-2)	
MA3232	Numerical Analysis (3-2)	

ESR-7: MATHEMATICS: A basic understanding of statistics, multi-variable and vector calculus, matrix and linear algebra, differential equations, partial differential equations, and numerical methods and their applications in mechanical engineering fields of study.

Required Course #	Description	Alternate Course
MA1115	Multi-variable Calculus (4-0)	Undergraduate
MA1116	Vector Calculus(4-0)	Undergraduate
MA2043	Introduction to Linear and Matrix Algebra (4-0)	Undergraduate
MA2121	Differential Equations (4-0)	Undergraduate
MA3132	Partial Differential Equations (4-0)	
MA3232	Numerical Analysis (3-2)	

ESR-8: DESIGN/SYNTHESIS: Design synthesis and introduction to optimization techniques, with emphasis on the design of mechanical subsystems and their integration into the ship system.

Required Course #	Description	Alternate Course
ME3711	Design of Machine Elements (4-1)	
ME3712	Capstone Design Project (1-6)	Undergraduate Design Project, TS4003

ESR-9: ELECTRICAL ENGINEERING: Electromagnetic and circuit theories, dc circuits, steady-state ac circuits, methods of circuit analysis, including Laplace transforms. Exposure to the construction and operating characteristics of rotating machinery, static converters, and power distribution systems and multi-phased circuits.

Required Course #	Description	Alternate Course
EO2102	Introduction to Circuit and Power System Analysis (4-2)	Undergraduate TS3000 NU3009

ESR-10: NAVAL ARCHITECTURE: Fundamentals of naval architecture including the geometry, hydrostatics and hydrodynamics of monohull floating and submerged structures. Wave and skin friction analysis, power requirements of particular designs. Longitudinal and transverse stability of floating and submerged bodies, hull girder strength requirements. Introduction to sea keeping and survivability principles.

Required Course #	Description	Alternate Course
TS3001	Fundamental Principles in Naval Architecture (3-2)	Undergraduate

ESR-11: CYBER: Fundamentals of the underlying principles of cyber infrastructure and systems, inherent vulnerabilities and threats including Industrial Control Systems, and defensive security procedures.

Required Course #	Description	Alternate Course
EO2701	Introduction to Cyber Systems (4-2)	Undergraduate, EC2700

ESR-12: SPECIALIZATION: Each officer will also acquire technical competence in one or more of the following areas: THERMAL/FLUID SCIENCES, SOLID AND STRUCTURAL MECHANICS, DYNAMICS AND CONTROLS, MATERIAL SCIENCE, OR TOTAL SHIP SYSTEMS ENGINEERING through additional graduate level courses and their associated prerequisites.

Required Course #	Description	Alternate Course
ME4XXX	Specialization Elective	
ME4XXX	Specialization Elective	
ME4XXX	Specialization Elective	

For the TSSE track (5602P), substitute the courses below for the ESR-12 course requirement:

Required Course #	Description	Alternate Course
TS4001	Integration of Naval Engineering Systems (3-2)	
TS4002	Ship Design Integration (2-4)	
ME4XXX	Thesis Specialization Elective	
TS3002	Principles of Ship Design and Case Studies (3-2)	SE3100
TS3003	Naval Combat System Elements (3-2)	
TS4000	Naval Combat System Engineering (3-2)	
TS4003	Total Ship Systems Engineering (2-4)	

ESR-13: THESIS: The graduate will demonstrate the ability to conduct independent analysis, in the area of Naval/Mechanical Engineering and proficiency in presenting the results in writing and orally by means of a thesis and command-oriented briefing appropriate to this curriculum.

Required Course #	Description	Alternate Course
ME0810	Thesis Research (0-8)	
ME0810	Thesis Research (0-8)	
ME0810	Thesis Research (0-8)	
ME0810	Thesis Research (0-8)	

Some of these ESRs may be satisfied by your undergraduate education, such as if your undergraduate degree is a BSME. It is possible to validate or drop classes that appear on this list, such as if you have taken a similar class elsewhere. However, you should check with the Program Officer to make sure you understand the impact on your associated ESR's and the P-code. Please refer to Section 8 on Making Changes to Your Course Matrix. If you successfully complete the TSSE program, you are eligible to earn the 5602 P-code.

7.1. ABET Requirements

ABET is the Accreditation Board for Engineering and Technology. What is accreditation? From the ABET website:

In the United States, accreditation is a non-governmental, peer-review process that assures the quality of the postsecondary education students receive. Educational institutions or programs volunteer to undergo this review periodically to determine if certain criteria are being met.

What is ABET accreditation? Again, from the ABET website:

ABET accreditation is assurance that a college or university program meets the quality standards established by the profession for which it prepares its students. For example, an accredited engineering program must meet the quality standards set by the engineering profession. An accredited computer science program must meet the quality standards set by the computing profession.

The NPS Mechanical Engineering program is ABET-accredited at the Master's level, and The MSME degree (See Section 4.2) awarded reflects this accreditation. The MSES degree (Section 4.3) is not ABET-accredited, but is equivalent in all other respects.

In order to confer an ABET-accredited MSME degree, you must have an earned BSME degree from an ABET-accredited undergraduate program, or demonstrate that you have accumulated the equivalent education. This is explained in the following section.

7.2. BSME Equivalency

In order for you to be eligible to earn the MSME degree, you must:

1. Have a BSME degree from an ABET-accredited undergraduate program, *or*,
2. Demonstrate BSME equivalency by filling out the BSME Equivalency Checklist (included in the Appendices).

The BSME Equivalency Checklist is an accounting of all undergraduate-level courses you have taken that are equivalent to courses you would have taken in an accredited BSME program. You will fill out this list with all eligible courses from your prior schooling, and from NPS. You will then establish whether your various credit-hour totals meet or exceed the requirements, as indicated on the Checklist. If all of the requirements are met, this Checklist then serves to document that you have had the equivalent undergraduate education to that of an ABET accredited BSME program, and you are then eligible to earn the MSME. If you cannot satisfy all of the requirements on the Checklist, you are therefore not eligible to earn the MSME, and can earn the MSES.

The course accounting required by the Checklist includes courses in mathematics, up through linear algebra and differential equations, courses in science including college-level chemistry and calculus-based physics, humanities and liberal arts courses, as well as mechanical engineering, and other (non-mechanical) engineering courses. You may populate this list with courses you have taken at other colleges and universities as well as with courses you have taken here at NPS. Since your NPS Master's degree requires only 32 credit-hours, you will find that many of the courses in your matrix can be used to populate the list and contribute to you establishing BSME equivalency. In other words, once you have set aside the required 3000-level and 4000-level classes in your matrix to count toward MS credit-hour requirements, some of the remaining courses in your matrix can be used to populate the BSME Checklist. It is important to keep in mind that if a course is used to establish BSME equivalency (i.e. is included on the Checklist) it *cannot* be counted towards credit-hour requirements for the MS degree.

8. Your Course Matrix

You are assigned a course matrix when you arrive at NPS. This matrix is generic, and is intended to be modified by you with the advice and consent of the Program Officer and Academic Associate. In order to ensure proper scheduling, it is highly recommended having your matrix updated in Python by the end of the second week of your first quarter. Even though the matrix has been generated in Python, it is the student's responsibility to ensure that it meets the requirements for graduation and ESRs. Also, ensure courses selected are in the correct quarter by verifying course offerings with the NPS Academic Catalog. Generic 8-quarter and 9-quarter course matrices are shown in sections 8.3 and 8.4 respectively.

Looking at your matrix, you will notice that each quarter will have at least four courses, and several quarters may have more than four. You are required to carry a minimum of four courses per quarter (a "full load"). You will also see that there are "courses" that reappear every quarter, such as ME0951 Mechanical Engineering Seminar. This course is used for the department to bring in speakers from the military, industry, and academia to provide information on topics of current interest. Attendance by all students is mandatory, unless specially excused. Therefore, ME0951 must appear in your matrix every quarter.

All changes to your program are subject to final approval or disapproval by the department Chair. There are various modifications you might make to your matrix and also various reasons why you might do so. Modifications can include moving a class to a different quarter, adding a course, or dropping or validating a course. As we discussed in Section 6.1, the various courses which appear in your matrix in general serve a variety of purposes. So it is important that you discuss any proposed change with the Program Officer and Academic Associate.

A good thing to keep in mind is that you are attending a graduate school, with the opportunity to gain advanced knowledge in engineering. This advanced knowledge is primarily contained in the 4000-level classes. You are required to take three 4000-level classes in order to earn a MS degree. However, if possible, it is to your advantage to evaluate your matrix to see if you can take more than three. This will benefit you greatly, not only in doing your thesis research, but in the additional advanced knowledge you will gain.

One possible opportunity gained from validating and dropping courses is to make room in your matrix to earn the Mechanical Engineer's (ME) Degree. This degree involves substantially more coursework than the MS degree, and a more substantial thesis. The MS thesis earns 16 credits, while the ME degree earns 28 credits. This degree can be seen as being a great opportunity to take more advanced courses, do more research, and perhaps earn credit hours towards a Ph.D.

We will now discuss how you might remove courses you have already taken, at another college or university, from your matrix.

8.1. Validating 2000-Level Courses

You will see that there are a variety of 2000-level classes in your matrix. Validating a class is a means of documenting that you have already successfully taken this class elsewhere, and also receiving the permission to drop the class. You may have had one of more of these classes previously, such as in an undergraduate engineering program. For example, you might have taken a course in Thermodynamics at a previous college or university, if you were a Mechanical Engineering student, or a Chemical Engineering student. If you received a grade of C or better, you should consider validating this class. By validating a class, and hence dropping it from your matrix, you make room to move another class “up” (i.e. take it earlier in your matrix) and hence make room for additional 4000-level classes. Keep in mind that while you may have had a course previously, if it has been a long time since you took the course, you may benefit from taking it again at NPS. This is a judgment you must make; please consult with the Program Officer and Academic Associate for guidance. The only classes that require validation in order to drop them are 2000-level classes. 3000-level classes and above can be dropped by making a drop request in Python. The drop requires the approval of both the Program Officer and Academic Associate. See Section 8.2.

The steps you must take to **validate a course** are:

1. Put in a Validation request into Python.
2. Make an appointment with the Course Coordinator for the course, to discuss validation. Bring your transcript from the school where you took the course previously, the syllabus, and the text book (if you have it).
3. The Course Coordinator will ask you questions about the course material, and may ask you to take a test to evaluate your knowledge.

4. The Course Coordinator may then approve the validation. The approved validation request will then go the Academic Associate and Program Officer for their approval. Once approved, the validated course is excluded from calculation of the total lecture/lab hours and credit; the validated course will remain in your matrix in yellow.

8.2. Dropping 3000- and 4000-Level Courses

You may find that you have a 3000-level course in your matrix which you may have taken already at a previous school, or you may have limited time at NPS and you need to take another course and can't fit both courses in. You may request, through Python, to drop this course. The Program Officer and Academic Associate may approve this drop; however you must provide a justification for dropping this course. Keep in mind the potential impact of dropping a course on meeting the requirements for:

- Earning the MS degree (credit-hours) (See Section 4)
- Earning your P-Code (Section 7)
- Meeting ABET requirements (Section 7.2)
- Prerequisites for follow-on courses (e.g. 4000-level classes)
- Maintaining a full course load each quarter

8.3. Generic 8 Quarter Matrix with Integrated JPME and Refresher

W/Su	Course	Course	Course	Course	Course	Course	Seminar
(1)	MA1115 (4-0) (1,2,3,4) Multi-Variable Calculus (MA1113-4/EQ)	MA1116 (3-0) (1,2,3,4) Vector Calculus (MA1113-4/EQ)	ME2502 (4-1) (2, 4) Engineering Dynamics (ME2501)	MS2201 (3-2) (2,4) Engineering Materials (Undergrad courses in calc, physics and chem.)	ME2201 (3-2) (2,4) Intro to Fluid Mechanics (ME2502-C)		ME0951 (0-1) Seminar
(2)	MA2121 (4-0) (1,2,3,4) Diff Equations (MA1114)	MA2043 (4-0) (1,3) Intro to Matrix and Linear Algebra	ME2101 (4-2) (1,3) Thermodynamics (MA1115)	AE2440 (3-2) (1,3) Intro to Digital Computation Or EC2440 (3-2) (2/4)	ME2801 (3-2) (1,3) Sys Dynamics (ME2502/MA2121)		ME0951 (0-1) Seminar
(3)	MA3132 (4-0) (1,2,3,4) Partial Diff Eqns. (MA2121/MA1116)	MA3232 (4-0) (2,4) Numerical Analysis (MA1115/MA2121)	EO2102 (4-2) (2,4) Basic Electronics and Electrical Machines (MA1043/ MA2121/ ME2440)	TS3001 (3-2) (2,4) Fund Principles of Naval Architecture (ME2201/ME2601)	ME2601 (4-1) (2,4) Mechanics of Solids I (ME2501 and MA1114/EQ)		ME0951 (0-1) Seminar
(4)	ME3201 (4-1) (1,3) Applied Fluid Mechanics (ME2101/ME2201/ MA3132)	ME3450 (3-2) (1,3) Comp Methods in Mechanical Eng (ME3201-C/MA3132)	MS3202 (3-2) (1,3) Prop, Perf and Failure of Eng Materials (MS2201/EQ)	ME3611 (4-0) (1,3) Mechanics of Solids II (ME2601)		NW3230 (4-0) (1,2,3,4) Maritime and Joint Strategic Planning	ME0951 (0-1) Seminar
(5)	ME3150 (4-1) (2,4) Heat Transfer (ME2101- ME2201/MA3132-C)	ME3240 (4-2) (2,4) Marine Power and Propulsion (ME2101/ ME3201/ ME3521-C)	ME3521 (3-2) (2,4) Mechanical Vibrations (ME2503/ ME2601/ MA2121)	ME3801 (3-2) (2,4) Automatic Controls (ME2801)	ME3711 (4-1) (2,4) Design of Machine Elements (ME3611)		ME0951 (0-1) Seminar
(6)	ME0810 (0-8) Thesis	MS3304 (3-2) (3), Corrosion (MS2201) OR MS3606 (3-2) (1) Intro to Welding and Joining Metallurgy	ME3712 (4-2) (1,3) Capstone Design project (ME2801/ME3201/ ME3450)	ME4XXX Specialization Elective		NW3275 (4-0) (1,2,3,4) Joint Maritime Operations – part 1	ME0951 (0-1) Seminar
(7)	ME0810 (0-8) Thesis	ME0810 (0-8) Thesis		ME4XXX Specialization Elective	EO2701 (4-2) (2,4) Intro to Cyber Systems (Previous exposure to a high-level computer programming language)	NW3276 (2-2) (1,2,3,4) Joint Maritime Operations – part 2	ME0951 (0-1) Seminar
(8)	ME0810 (0-8) Thesis	ME4XXX Specialization Elective				NW3285 (4-0) (1,2,3,4) National Security Decision Making	ME0951 (0-1) Seminar

Sample
Course # (hours) (Quarters Offered: 1-F, 2-W, 3-Sp, 4-Su) Course Name (Prerequisites)

Legend
★ Preparatory Courses
❖ 570 Core
◆ Degree Specialization
⊗ ESR's (required for USN 5600 P-code)
● Required for EDO's
JPME (optional for EDO/CEC)

Four (graded) courses required per quarter.

8.4. Generic 9 Quarter Matrix with Integrated JPME and Refresher

Sp/F	Course	Course	Course	Course	Course	Course	Seminar
(1)	MA1113 ★(4-0) (1,2,3,4) Single Variable Calculus (Pre-Calculus)	MA1114 ★(4-0) (1,2,3,4) Single Variable Calc I w/Matrix Algebra (MA1113)	ME2501 ★❖ (4-1) (1,3) Statics (MA1113/4-C)	ME2101 ★❖(4-2) (1,3) Thermodynamics (MA1115)	AE2440 ★❖ (3-2) (1,3) Intro to Digital Computation Or EC2440 (3-2) (2/4)		ME0951 (0-1) Seminar
(2)	MA1115 ❖ (4-0) (1,2,3,4) Multi-Variable Calculus (MA1113-4/EQ)	MA1116 ❖ (3-0) (1,2,3,4) Vector Calculus (MA1113-4/EQ)	ME2502 ★❖ (4-1) (2, 4) Engineering Dynamics (ME2501)	MS2201 ★❖ (3-2) (2,4) Engineering Materials (Undergrad courses in calc, physics and chem.)	ME2601 ★❖ (4-1) (2,4) Mechanics of Solids I (ME2501 and MA1114/EQ)		ME0951 (0-1) Seminar
(3)	MA2121 ❖ (4-0) (1,2,3,4) Diff Equations (MA1114)	MA2043 ❖ (4-0) (1,3) Intro to Matrix and Linear Algebra	ME2801 ★❖ (3-2) (1,3) Sys Dynamics (ME2502/MA2121-C)	ME3611 ❖❖ (4-0) (1,3) Mechanics of Solids II (ME2601)		NW3230 (4-0) (1,2,3,4) Maritime and Joint Strategic Planning	ME0951 (0-1) Seminar
(4)	MA3132 ❖ (4-0) (1,2,3,4) Partial Diff Eqns. (MA2121/MA1116)	MA3232 ❖ (4-0) (2,4) Numerical Analysis (MA1115/MA2121)	EO2102 ❖ (4-2) (2,4) Basic Electronics and Electrical Machines (MA1043/ MA2121/ ME2440)	ME2201 ★❖ (3-2) (2,4) Intro to Fluid Mechanics (ME2502)	ME3711 ❖❖ (4-1) (2,4) Design of Machine Elements (ME3611)		ME0951 (0-1) Seminar
(5)	ME3201 ❖❖ (4-1) (1,3) Applied Fluid Mechanics (ME2101/ME2201/ MA3132)	ME3450 ❖❖ (3-2) (1,3) Comp Methods in Mechanical Eng (ME3201-C/MA3132)	MS3202 ❖❖ (3-2) (1,3) Prop, Perf and Failure of Eng Materials (MS2201/EQ)	ME3712 ❖❖ (4-2) (1,3) Capstone Design project (ME2801/ME3201/ ME3450)			ME0951 (0-1) Seminar
(6)	ME3150 ❖❖ (4-1) (2,4) Heat Transfer (ME2101/ME2201/ MA3132)	ME3240 ❖❖ (4-2) (2,4) Marine Power and Propulsion (ME2101/ ME3201/ ME3521-C)	ME3521 ❖❖ (3-2) (2,4) Mechanical Vibrations (ME2503/ ME2601/ MA2121)	ME3801 ❖❖ (3-2) (2,4) Automatic Controls (ME2801)		EO2701 ● (4-2) (2,4) Intro to Cyber Systems (Previous exposure to a high-level computer programming language)	ME0951 (0-1) Seminar
(7)	ME0810 ❖ (0-8) Thesis	MS3304 ❖❖ (3-2) (3), Corrosion (MS2201) OR MS3606 ❖❖ (3-2) (1) Intro to Welding and Joining Metallurgy	ME4XXX ❖❖ Specialization Elective			NW3275 (4-0) (1,2,3,4) Joint Maritime Operations – part 1	ME0951 (0-1) Seminar
(8)	ME0810 ❖ (0-8) Thesis	ME0810 ❖ (0-8) Thesis	TS3001 ❖❖ (3-2) (2,4) Fund Principles of Naval Architecture (ME2201/ME2601)	ME4XXX ❖❖ Specialization Elective		NW3276 (2-2) (1,2,3,4) Joint Maritime Operations – part 2	ME0951 (0-1) Seminar
(9)	ME0810 ❖ (0-8) Thesis	ME4XXX ❖❖ Specialization Elective				NW3285 (4-0) (1,2,3,4) National Security Decision Making	ME0951 (0-1) Seminar
		Sample Course # (hours) (Quarters Offered: 1-F, 2-W, 3-Sp, 4-Su) Course Name (Prerequisites)				Legend ★ Preparatory Courses ❖ 570 Core ❖ Degree Specialization ❖ ESR's (required for USN 5600 P-code) ● Required for EDO's JPME (optional for EDO/CEC) Four (graded) courses required per quarter.	

updated Mar 2017

8.5. Generic 563 Naval Mechanical Engineering - Energy Track 8 Quarter Matrix (with Integrated JPME, no Refresher)

W	Course	Course	Course	Course	Course	Course	Seminar
W (2)	MA1115 (4-0) (1,2,3,4) Multi-Variable Calculus (MA1113-4/EQ)	MA1116 (3-0) (1,2,3,4) Vector Calculus (MA1113-4/EQ)	ME2502 (4-1) (2, 4) Engineering Dynamics (ME2501)	MS2201 (3-2) (2,4) Engineering Materials (Undergrad courses in calc, physics and chem.)	ME2201 (3-2) (2,4) Intro to Fluid Mechanics (ME2502-C)		ME0951 (0-1) Seminar
Sp (3)	MA2121 (4-0) (1,2,3,4) Diff Equations (MA1114)	MA2043 (4-0) (1,3) Intro to Matrix and Linear Algebra	ME2101 (4-2) (1,3) Thermodynamics (MA1115)	AE2440 (3-2) (1,3) Intro to Digital Computation Or EC2440 (3-2) (2/4)	ME2801 (3-2) (1,3) Sys Dynamics (ME2502/MA2121)		EN3000 (2-0) Energy Seminar
Su (4)	MA3132 (4-0) (1,2,3,4) Partial Diff Eqns. (MA2121/MA1116)	MA3232 (4-0) (2,4) Numerical Analysis (MA1115/MA2121)	EO2102 (4-2) (2,4) Basic Electronics and Electrical Machines (MA1043/ MA2121/ ME2440)	OS3007 (4-0) (4) Operations Research for Energy Systems Analysts	ME2601 (4-1) (2,4) Mechanics of Solids I (ME2501 and MA1114/EQ)		EN3000 (2-0) Energy Seminar
F (1)	ME3201 (4-1) (1,3) Applied Fluid Mechanics (ME2101/ME2201/ MA3132)	ME3450 (3-2) (1,3) Comp Methods in Mechanical Eng (ME3201-C/MA3132)	MS3202 (3-2) (1,3) Prop, Perf and Failure of Eng Materials (MS2201/EQ)	ME3611 (4-0) (1,3) Mechanics of Solids II (ME2601)		NW3230 (4-0) (1,2,3,4) Maritime and Joint Strategic Planning	EN3000 (2-0) Energy Seminar
W (2)	ME3150 (4-1) (2,4) Heat Transfer (ME2101- ME2201/MA3132-C)	ME3240 (4-2) (2,4) Marine Power and Propulsion (ME2101/ ME3201/ ME3521-C)	ME3521 (3-2) (2,4) Mechanical Vibrations (ME2503/ ME2601/ MA2121)	ME3801 (3-2) (2,4) Automatic Controls (ME2801)	ME3711 (4-1) (2,4) Design of Machine Elements (ME3611)	PH3700 (4-0) (2) Fundamentals of Energy (May be dropped with ENG/Thermo UND)	EN3000 (2-0) Energy Seminar <small>Overload (look to validate/ drop ME3711 or PH3700)</small>
Sp (3)	ME0810 (0-8) Thesis	MS3304 (3-2) (3), Corrosion (MS2201) OR MS3606 (3-2) (3-2) (1) Intro to Welding and Joining Metallurgy	ME3712 (4-2) (1,3) Capstone Design project (ME2801/ME3201/ ME3450)	ME4424 (3-2) (3) Combustion Fundamentals		NW3275 (4-0) (1,2,3,4) Joint Maritime Operations – part 1	EN3000 (2-0) Energy Seminar
Su (4)	ME0810 (0-8) Thesis	TS3001 (3-2) (2,4) Fund Principles of Naval Architecture (ME2201/ME2601)		MS4410 (4-1) (4) Advanced Energy Materials (MS3304)	EO2701 (4-2) (2,4) Intro to Cyber Systems (Previous exposure to a high-level computer programming language)	NW3276 (2-2) (1,2,3,4) Joint Maritime Operations – part 2	ME0951 (0-1) Seminar
F (1)	ME0810 (0-8) Thesis	ME0810 (0-8) Thesis	ME4XXX Specialization Elective			NW3285 (4-0) (1,2,3,4) National Security Decision Making	EN3000 (2-0) Energy Seminar

Sample
Course # (hours) (Quarters Offered: 1-F, 2-W, 3-Sp, 4-Su) Course Name (Prerequisites)

Legend
★ Preparatory Courses
❖ 570 Core
◆ Degree Specialization
⊗ ESR's (required for USN 5600 P-code)
Energy Track
● Required for EDO's
JPME (optional for EDO/CEC)

Four (graded) courses required per quarter.

updated Mar 2017

8.6. Generic 570 Naval/Mechanical Engineering 9 Quarter Matrix (with TSSE, no JPME, no Refresher)

W	Course	Course	Course	Course	Course	Seminar
W (2)	MA1115 (4-0) (1,2,3,4) Multi-Variable Calculus (MA1113-4/EQ)	MA1116 (3-0) (1,2,3,4) Vector Calculus (MA1113-4/EQ)	ME2502 (4-1) (2, 4) Engineering Dynamics (ME2501)	MS2201 (3-2) (2,4) Engineering Materials (Undergrad courses in calc, physics and chem.)	ME2201 (3-2) (2,4) Intro to Fluid Mechanics (ME2502-C)	ME0951 (0-1) Seminar
Sp (3)	MA2121 (4-0) (1,2,3,4) Diff Equations (MA1114)	MA2043 (4-0) (1,3) Intro to Matrix and Linear Algebra	ME2101 (4-2) (1,3) Thermodynamics (MA1115)	AE2440 (3-2) (1,3) Intro to Digital Computation Or EC2440 (3-2) (2/4)	ME2801 (3-2) (1,3) Sys Dynamics (ME2502/MA2121)	ME0951 (0-1) Seminar
Su (4)	MA3132 (4-0) (1,2,3,4) Partial Diff Eqns. (MA2121/MA1116)	MA3232 (4-0) (2,4) Numerical Analysis (MA1115/MA2121)	ME2601 (4-1) (2,4) Mechanics of Solids I (ME2501 and MA1114/EQ)	TS3001 (3-2) (2,4) Fund Principles of Naval Architecture (ME2201/ME2601)		ME0951 (0-1) Seminar
F (1)	ME3201 (4-1) (1,3) Applied Fluid Mechanics (ME2101/ME2201/MA3132)	ME3611 (4-0) (1,3) Mechanics of Solids II (ME2601)	TS3000 (4-2) (1) Basic Electronics and Electrical Machines (MA2043/ MA2121/ ME2440)	SE3100 (3-2) (1,3) Fundamentals of Systems Engineering OR TS3002	NW3230 (4-0) (1,2,3,4) Maritime and Joint Strategic Planning	ME0951 (0-1) Seminar
W (2)	ME3150 (4-1) (2,4) Heat Transfer (ME2101- ME2201/MA3132-C)	ME3240 (4-2) (2,4) Marine Power and Propulsion (ME2101/ ME3201/ ME3521-C)	ME3521 (3-2) (2,4) Mechanical Vibrations (ME2503/ ME2601/ MA2121)	TS3003 (3-2) (2,4) Naval Combat System Elements (ME2503)	NW3275 (4-0) (1,2,3,4) Joint Maritime Operations – part 1	ME0951 (0-1) Seminar
Sp (3)	MS3202 (3-2) (1,3) Prop, Perf and Failure of Eng Materials (MS2201/EQ)	ME3450 (3-2) (1,3) Comp Methods in Mechanical Eng (ME3201/MA3132)	TS4000 (3-2) (3) Naval Combat System Engineering (TS3000/ TS3003)	TS4001 (3-2) (3) Integration of Naval Engineering Systems (TS3000/ TS3001/ TS3002)	NW3276 (2-2) (1,2,3,4) Joint Maritime Operations – part 2	ME0951 (0-1) Seminar
Su (4)	ME0810 (0-8) Thesis	ME3801 (3-2) (2,4) Automatic Controls (ME2801)	ME3711 (4-1) (2,4) Design of Machine Elements (ME3611)	TS4002 (2-4) (4) Ship Design Integration (TS4001/ TS4000)	NW3285 (4-0) (1,2,3,4) National Security Decision Making	ME0951 (0-1) Seminar
F (1)	ME0810 (0-8) Thesis	ME4XXX Specialization Elective	MS3304 (3-2) (3), Corrosion (MS2201) OR MS3606 (3-2) (1) Intro to Welding and Joining Metallurgy	TS4003 (2-4) (1) Total Ship Systems Engineering (TS4002)		ME0951 (0-1) Seminar
W (2)	ME0810 (0-8) Thesis	ME0810 (0-8) Thesis	EO2701 (4-2) (2,4) Intro to Cyber Systems (Previous exposure)	ME4XXX Specialization Elective		ME0951 (0-1) Seminar
		Sample Course # (hours) (Quarters Offered: 1-F, 2-W, 3-Sp, 4-Su) Course Name (Prerequisites)			Legend ★ Preparatory Courses ❖ 570 Core ◆ Degree Specialization ⊕ ESR's (required for USN 5600 P-code) TSSE Track ● Required for EDO's JPME (optional for EDO/CEC)	

updated Mar 2017

Four (graded) courses required per quarter.

8.7. Review Your Matrix

When you arrive at NPS and are assigned a matrix, there are several important issues to carefully review. We will describe the various courses in your matrix, and the purposes they serve. Those courses that you might be able to validate or drop (in order to add additional 4000-level classes) will be identified.

ME2xxx - Undergraduate-level Mechanical Engineering (ME): These courses are provided for those students who do not have ME degrees, or who have been out of school for a long time and need a refresher. The credit earned by these courses cannot be used to satisfy MS degree requirements, but can be used to establish BSME equivalency (See Section 7.2). These courses are typically prerequisites for the ME3xxx classes. These classes are also part of ESR requirements and hence contribute to you earning the P-Code (see Section 7).

You should consider **validating** (see Section 8.1) as many of the 2000-level classes as possible. If you have taken these classes previously, you might be able to validate these classes, creating more room in your matrix for additional 4000-level classes, or perhaps adding an additional program such as the TSSE program (See Section 4.6), which requires six additional classes.

MA1xxx-MA3xxx –Undergraduate through Graduate-level Math: These classes provide you with necessary mathematics for the engineering classes. Several engineering classes explicitly require one of these math classes as a prerequisite. ABET requires that all students receiving the MSME degree to have taken a linear algebra class, i.e. linear algebra is a specific ABET requirement for eligibility for the MSME degree. You may be able to validate some (or all) of the MA1xxx-2xxx classes, including **MA2043**, if you have taken them elsewhere. If you have not taken a linear algebra class elsewhere, and you intend to earn the MSME degree, you must take this class. You can discuss validation with the Course Coordinator for the specific math class, and this faculty member can be found in the Math Dept. Many of these math classes are ESR requirements, and hence contribute to you earning the P-Code (see Section 7).

ME3xxx - Advanced undergraduate or introductory graduate-level ME: These classes constitute the core of the Mechanical Engineering program. They contribute to the credit-hour requirements for the ME degree, are ESR requirements (contribute to you earning the P-Code, see Section 7), and individually, may be prerequisite for other classes, such as graduate-level (4xxx) Mechanical and Astronautical Engineering classes.

If you have taken one or more of these classes elsewhere, you may be able to drop them, with approval of the Program Officer and Academic Associate. Discuss this with the Program Officer and the Academic Associate.

ME4xxx - Graduate-Level ME: These classes are chosen by you. Specific ME4xxx classes are frequently required by your Thesis Advisor, as they will provide you with the advanced knowledge required for you to perform the research. At least three 4xxx classes are required for the MS degree. Please see Section 5.2 for specific requirements for graduate electives. Note that the ESR (Section 7) requires each Officer to obtain technical specialization by taking electives from within a single “track” (See Section 5.2).

ME0810 ME Thesis: These four slots provide you with 16 credit-hours for your thesis. You may have no more than two thesis slots in a single quarter, and you are limited to four slots total for the MS degree.

AE2440 (or EC2440) Matlab: Due to the widespread use of Matlab in coursework and thesis research, this course is provided as an introduction to the use of Matlab. If you feel you don’t need this course, due to prior experience with Matlab, or confidence in your ability to learn it on your own, you may drop this class, with approval of the Program Officer and Academic Associate.

EO2102 Intro to Circuit & Power Systems Analysis: This course is provided to meet an ESR. If you have taken a basic circuits class elsewhere, you may drop this course, with approval of the Program Officer and Academic Associate. Note that TS3000 can be used to satisfy this ESR.

NW3xxx – Naval War College JPME: If you are a URL Officer, you will have the four Naval War College (NW) courses in your matrix. If you are an EDO you will not take this course. These courses are offered every quarter, so moving them to different quarters, if necessary, is possible.

9. Filling Out the BSME Equivalency Form and the MSME Checklist

As discussed in previous section (Section 7.2), every student must fill out the BSME Equivalency form prior to graduation. Additionally, every student must also fill out the MSME Checklist. The MSME Checklist documents all of the classes you have taken which contribute to the credit-hours required for the MS degree. All students, regardless of the specific degree they are earning (MSME or MSES) must fill out this form.

9.1. When to Fill Out These Forms

These forms are reviewed and signed by the Program Officer, Academic Associate, and the Chairman prior to your graduation. Therefore, final versions of these forms must be in your folder (stored by the Ed. Tech) at this time. As you progress through your program, your course matrix will undoubtedly change, such as when you select your specific 4000-level classes. You should keep these forms up to date as you progress through the program, so that at graduation time, the forms are accurate and complete. Nobody wants to find themselves without sufficient credit-hours in their last quarter, thereby jeopardizing their degree eligibility. Note that if you have a BSME degree from an ABET- accredited program, you can fill out and sign the BSME Equivalency form in your first quarter. The form can then be reviewed and signed by the Program Officer and Academic Associate.

9.2. How to Fill Out These Forms

You should first fill out the MSME Checklist. This form asks you to list all of the courses that will count towards the required credit-hours for the MS degree. In short, this form requires 3 ME3xxx course, 3 ME/AE4xxx courses, and two technical 3000 or 4000-level classes from outside the MAE department (most students use MA3132 and MA3232 for this purpose, which are included in your matrix by default). Once a class is listed on your MSME Checklist, you may not list them on your BSME Equivalency form. Your remaining classes (classes not listed on the MSME Checklist) are available to be included on your BSME Equivalency form if you do not have BSME degree from an ABET-accredited program.

If you have a BSME degree from an ABET-accredited program, filling out the BSME form is still required, but involves only completing the first page. If not, you must completely and accurately fill out the entire form. You will most likely need your undergraduate transcript in order to do this. Please see the Program Officer and Academic Associate for guidance.

10. APPENDICES

Appendix 1 - MSME Checklist

Appendix 2 - BSME Equivalency Form

Appendix 3 - Thesis Approval Form