An Educational Agreement

Between

The Trustees of the Stevens Institute of Technology

And

Montclair State University

For the

Articulated
Baccalaureate in Physics – Master of Engineering in Mechanical Engineering
Degree Program

Dated as of May 1, 2017

The Trustees of the Stevens Institute of Technology ("Stevens"), One Castle Point on Hudson, Howe Center, 13th Floor, Hoboken, New Jersey 07030, and Montclair State University ("MSU"), 1 Normal Avenue, Montclair, NJ 07043, hereby formally agree as of May 1, 2017 to the establishment of an Educational Articulation Agreement in an effort to encourage the entrance of students into the engineering profession.

WHEREAS, Stevens is an educational institution serving the region and the State as a primary provider of engineering education; and

WHEREAS, MSU is dedicated to the provision of undergraduate educational programs;

WHEREAS, the College of Science and Mathematics of MSU offers the B.S. in Physics, among other degree and non-degree programs;

WHEREAS, Stevens offers the M.E. in Mechanical Engineering, among other degree and non-degree programs;

NOW, THEREFORE, MSU and Stevens hereby agree as to the terms of mutual and individual responsibilities related to the offering of an Articulated Baccalaureate BS Physics – M.E. degree program in Mechanical Engineering (as further described herein, the "Articulated Program").

A. GENERAL GUIDELINES

A.1 MSU agrees to offer the Baccalaureate in Physics and Stevens agrees to offer the Master's program in Mechanical Engineering, in each case in accordance with their respective policies and procedures and the general guidelines described below.

A.2 Stevens will award the M.E. degree to students covered by this Agreement upon the recommendation of the Stevens' Department of Mechanical Engineering and obtaining all other approvals required by Stevens' policies and procedures.

A.3 MSU will award the B.S. degree upon the recommendation of the MSU Department of Mathematical Sciences and obtaining all other approvals required by MSU's policies and procedures.

A.4 An Advisory Committee (the "Committee") shall be formed, comprised of equal representation of faculty/staff appointed by MSU and Stevens and jointly chaired by a co-director from MSU and a co-director from Stevens. The Committee shall provide advice on the overall operation of the Articulated Program. The Committee will meet as needed with the program co-directors to review the progress of the Articulated Program. The Committee shall be advisory in nature, shall make recommendations to the parties for approval of all matters and shall have no authority to create new academic or administrative policies without further approval by the appropriate institution.

A.5 The Committee shall be responsible for recommending criteria for admission into the Articulated Program, advertising and publicity, recruitment brochures, evaluation, interviewing, selection based on established criteria, and notification of applicants. The Committee shall establish procedures within each institution which ensure that, upon admission, all applicants are informed of the specific requirements for continued good standing and the requirements for acceptance at Stevens at the completion of the undergraduate phase. Ultimate admission to Stevens will remain the prerogative of Stevens, and the Committee will establish procedures to ensure that all prospective students are aware of this condition to admission.

A.6 The Committee shall be responsible for advising, counseling and reviewing the progress of each student in the undergraduate phase of the Articulated Program. It is recognized that students in the Articulated Program must fulfill all the necessary curricular requirements of each of MSU and Stevens to qualify as candidates for the baccalaureate and Master's degrees. If the candidate were to drop out of the Stevens graduate program, the courses completed at Stevens would still be counted towards the undergraduate degree at MSU.

A.7 The Committee shall be responsible for coordinating the baccalaureate requirements at the MSU undergraduate colleges/schools with the pre-requisites for admission to Stevens, and shall recommend students from the program for admission to Stevens based upon their performance in the Articulated Program. Stevens shall retain final authority to admit students to Stevens.

A.8 Salary and non-salary support for faculty and staff associated with the Articulated Program will be provided by the institution where the faculty/staff appointment is held, as determined to be appropriate in the sole discretion of such institution.

A.9 Faculty/staff office space will be provided by the institution where the faculty/staff appointment is held, as determined to be appropriate in the sole discretion of such institution.

A.10 While matriculated at MSU, each student will be entitled to the same services and privileges accorded to all regularly enrolled MSU students, and while enrolled at Stevens each student will be entitled to the same services and privileges accorded to all regularly enrolled Stevens students.

B. ELIGIBILITY AND ADMISSION CRITERIA

B.1 Qualified students who are interested in the Articulated Program will be identified in their second semester as candidates for the Articulated Program so that they may be suitably advised to take the necessary courses and stay in track. They will formally apply at the beginning of the 2nd semester of their third year (sixth semester from freshman entry) for admission into the graduate program at Stevens.

B.2 For admission into Stevens for the Mechanical Engineering phase of the Articulated Program, applicants must have completed their general education requirements and all the suggested major courses outlined in Appendix I and III with an overall grade point average of 3.0 and a cumulative math and science grade point average of 3.50 or better. In the event of advanced placement credit in the prerequisite sciences, applicants will still be required to take substituted upper level science courses at MSU. Performance in these sciences will be a component for the basis of evaluation for admission into the engineering phase of the Articulated Program. The Committee shall periodically review the eligibility and admission criteria and recommend modifications as appropriate.

B.3 After preliminary evaluation of the applications by the Committee, selected applicants will be invited for interviews with members of the Committee from Stevens and MSU respectively. Following this interview, the Committee will make recommendations to their admissions office and obtain final decisions regarding the student's eligibility to be admitted to the undergraduate phase of the Articulated Degree program. Applicants will be notified of admission decisions in writing as early as possible after the interviews.

B.4 All applicants and accepted and enrolled students in the Articulated Program must satisfy MSU and Stevens requirements, including, but not limited to, student immunization and health requirements and disciplinary disclosure.

C. ARTICULATED PROGRAM REQUIREMENTS

C.1 Prior to matriculation at Stevens, each applicant must have successfully completed three years of undergraduate matriculation with the required overall grade point average of 3.0 and a math/science grade point average of 3.5.

C.2 All Stevens applications must be submitted to the Stevens Graduate School by January 15th of the year during which the student applicant is beginning the 6th semester at MSU;

C.3 No withdrawals or incomplete grades in any Articulated Program requirement course at MSU will be accepted by Stevens;

C.4 Those applicants who meet the academic criteria noted above may be invited for an interview with Stevens Admissions Committee, however, MSU will establish procedures to ensure that those applicants who are invited are advised that the invitation does not guarantee acceptance into the Mechanical Engineering phase of the Articulated Program.

C.5 Applicants who are not invited for interview, or are not selected for admission to Stevens, shall be notified of the decision as early as possible, and may reapply for regular admission the following year through the Stevens Graduate School. Upon completing the fourth year of the Articulated Program, these students will be eligible to graduate with a B.S. in physics from MSU despite the absence of admission to Stevens.

C.6 During their fourth year in the Articulated Program, students who have been admitted to Stevens will enroll in the first year of Mechanical Engineering courses, which may be

applied towards fulfilling credit requirements for the undergraduate Physics degree at MSU. The MSU baccalaureate degree will be conferred at the end of four years or when a student has completed the requirements for the degree. It is the responsibility of the student to satisfy all requirements for their degree(s), including cross registration and submission of Stevens transcripts to MSU, enabling transfer of up to 15 credits.

C.7 The MSU Co-Director of the Articulated Program will meet regularly with students in the Articulated Program and inform the Committee of any matters or recommendations concerning the Articulated Program or individual students.

C.8 The parties acknowledge and agree that both parties are covered by the Federal Family Educational Rights and Privacy Act ("FERPA") and neither party will share educational records of any student except in compliance with FERPA including without limitation 34 CFR§99.34. For purposes of FERPA compliance, the parties shall liaise through the Committee and their respective registrar's offices.

D. FINANCIAL ARRANGEMENTS

D.1 Financial aid, scholarships and fellowships shall be awarded to students in the Articulated Program by MSU and Stevens, respectively, on the same basis as awarded to other students at these institutions, and within the sole discretion of each such institution.

D.2 MSU will bill for and collect all student fees and tuition for students enrolled in the baccalaureate phase of the Articulated Program at MSU (prior to matriculation at Stevens).

D.3 Stevens will bill for and collect all student fees and tuition for students enrolled in the Stevens phase of the Articulated Program (subsequent to matriculation at Stevens).

D.4 The cost for administering the Articulated Program will be shared equally by MSU and Stevens.

E. GOVERNING LAW; OTHER LEGAL MATTERS

E.1 This Agreement shall be governed by the laws of the State of New Jersey, in which State this Agreement has been made.

E.2 The parties agree that all Federal and State laws against discrimination, and all rules and regulations promulgated thereunder, shall be applicable to all activities under this agreement. Each institution agrees to consider and admit students into the Articulated Program on the basis of merit without regard to race, national or ethnic origin, color, religion, age, sex, sexual orientation, gender identity or expression, marital status or disability, genetic information, veteran status, or any other basis protected by law.

E.3 MSU is an agency of the State of New Jersey. Any agreement or arrangement signed or entered into on behalf of the State of New Jersey by a State official or employee shall be subject to all of the provisions of the New Jersey Torts Claims Act, NJSA 59:1-1 et seq., the New Jersey Contractual Liability Act, NJSA 59:13-1, et seq., and the availability of appropriations. The State of New Jersey does not carry public liability insurance, but the liability of the State and the obligations of the State to be responsible for tort claims against its agencies and employees is covered under the terms and provisions of the New Jersey Tort Claims Act. The Act also creates a special self-insurance fund and provides for payment and claims against the State of New Jersey against its employees for which the State of New Jersey is obligated to indemnify against tort claims which arise out of the performance of their duties. Claims against MSU or its employees should be referred for handling to the Attorney General, Division of Law, Claims Service Section, Richard

Hughes Complex, Trenton, New Jersey 08625. Furthermore, the State of New Jersey self funds for Workers Compensation and Disability.

E.5 Stevens shall provide for professional and general liability coverage insuring Stevens and its faculty, students, and employees performing activities under this Agreement providing limits of coverage of $1,000,000/$3,000,000 on an occurrence type basis pursuant to N.J.S.A. 59:1 – 1et seq., the State of New Jersey Tort Claims Act.

E. REPORTS

E.1 The co-directors of the Articulated Baccalaureate/M.E. Program shall submit a written report annually to the appropriate academic officers holding jurisdiction, summarizing the activities of the Articulated Program along with academic transcripts for each student in the Program (subject to FERPA compliance).

F. OTHER CONSIDERATIONS

F.1 This Agreement shall be for a term of five (5) years, commencing on May 1, 2017, and terminating on June 30, 2022. At least six months prior to the expiration of this Agreement, or no later than on January 31, 2022, the parties agree that they will conduct a review of the Articulated Program and determine whether to renew or terminate this Agreement. If the parties agree to extend the term of this Agreement for another five (5) years, its terms may be modified or changed only with the written consent of both parties.

F.2 This Agreement may be terminated (a) by mutual agreement of the parties or (ii) by either party upon the occurrence and continuation of a material breach by a party of any term or condition of this Agreement, provided that written notice has been given

by the non-defaulting party and, if such default is capable of cure, the defaulting party has not cured such failure within thirty (30) days of receipt of such notice.

It is further agreed that in the event that either party terminates this Agreement, and notwithstanding any other provision of this Agreement, both parties will assume a responsibility to all students enrolled in their respective degree programs as of the date of the termination notice, to permit said students to complete such program.

F.2 Copies of this Agreement shall be filed in the offices of the University Provost at MSU and in the Office of the Provost at Stevens.

F.3 This Agreement shall not be assigned or transferred, nor shall any obligation or right be delegated, without written consent of Stevens and MSU.

F.5 This Agreement shall be binding upon the parties hereto and their successors.

F.6 In this Agreement, Stevens and MSU shall continue to be autonomous and shall be governed independently by their respective governing bodies and administration.

F.7 Any notice by either institution to the other regarding this Agreement shall be in writing and sent by registered or certified mail and addressed as follows:

1) Provost and Vice President for Academic Affairs, Stevens Institute of Technology, One Castle Point on Hudson, Hoboken, New Jersey 07030, with a copy to the General Counsel at the same address; or

2) The Provost, MSU, 1 Normal Avenue, Montclair, NJ 07043.

F.8 Miscellaneous Provisions.

(a) Entire Agreement. This Agreement constitutes the entire agreement between the parties pertaining to the subject matter hereof, and supersedes all prior and contemporaneous agreements, understandings, negotiations and discussions of the Parties, whether oral or written.

(b) Severability. If any provision of this Agreement or portion thereof is held invalid, illegal, void or unenforceable by reason of any rule of law, administrative or judicial provision or public policy, such provision shall be ineffective only to the extent invalid, illegal, void or unenforceable, and the remainder of such provision and all other provisions of this Agreement shall nevertheless remain in full force and effect.

(c) Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original, but taken together shall constitute one instrument.

(d) Relationship of the Parties. Nothing contained herein shall create any agency, partnership, or joint venture between the parties. Neither party shall have any right or authority to create any obligation or responsibility, express or implied, on behalf of or in the name of the other party, or to bind the other party contractually in any manner whatsoever. Under no circumstances, as a result of this Agreement, shall any employee, agent, or representative of either party be considered an employee, agent or representative of the other party, and no employee, agent or representative of either party shall be entitled to any payment from the other party in the nature of benefits under workers' compensation or disability benefits laws, or otherwise, for any accident, illness, occurrence or event arising out of or relating to this Agreement.

IN WITNESS WHEREOF, Stevens and MSU have caused this Agreement to be executed by their duly authorized officers and their seals hereunder to be affixed as of the day and year as set forth above.

Dr. Christophe Pierre
Provost and Vice President for Academic Affairs

Dr. Willard Gingerich
Provost

APPENDIX I. MSU BS in Physics Degree Requirements

MONTCLAIR STATE UNIVERSITY

BS PHYS -- Fall 2016
Montclair State University
Department of Mathematical Sciences

I. Major Requirements	**38 sh**
A. Physics Core (24 sh)	
PHYS 191 University Physics I	4
PHYS 192 University Physics II	4
PHYS 210 Mechanics	4
PHYS 240 Electricity and Magnetism	4
PHYS 350 Optics	4
PHYS 460 Modern Physics	4
B. Physics Electives (14 sh)	
B.I Program Requirements (12 sh)	
PHYS 320 Thermodynamics	3
PHYS 368 Fluid Mechanics	3
PHYS 430 Cmpt Simulations of Phys Systems	
Or MATH 463 Numerical Analysis	3
The following courses can replace PHYS 350	
ARID 220	
Or ARID 221	
Or PHYS XXX Material Science	3
B.II Physics Electives (2 sh)	
PHYS 242 Circuit Theory	3
PHYS 245 Electronics and Digital Circuits	3
PHYS 247 Microprocessors and Applications	3
PHYS 280 Astronomy	4
PHYS 380 Observational Astronomy	4
PHYS 464 Quantum Mechanics	3
PHYS 480 Astrophysics	3
PHYS 495 Laboratory Research in Physics	1-4

II. Collateral Requirements	**30-31 sh**
MATH 122 Calculus I	4
MATH 221 Calculus II	4
MATH 222 Calculus III	4
MATH 420 Differential Equations	
Or MATH 460 Applied Mathematics	
Or PHYS 377 Mathematical Physics	3-4
CSIT 111 Fundamentals of Programing I	3
CHEM 120 General Chemistry I	4
CHEM 121 General Chemistry II	4
MATH 235 or 335 Linear Algebra	4

III. GenEd Requirement		**29 sh**
A. New Student Experience	*MATH 102*	1
C. Communications		9
ENWR 105 College Writing I		
ENWR 106 College Writing II		
CMST 101 Fundamentals of Speech		
D. Fine and Performing Arts		3
F. Humanities		6
F1. World Literature/General Humanities		
F2. Philosophy/Religion		
G. Fund. of Programming I	*CSIT 111*	*(0)*
H. Math	*MATH 122, 221*	*(0)*
I. Natural/Physical Science	*PHYS 191*	*(0)*
J. Physical Education		1
K. Social Science		9
American/European History		
Non-Western Culture		
Social Science		
L. Gen Ed Elective	*CHEM 120*	*(0)*

IV. World Languages and Cultures Requirement	**9 sh**
A. World Languages	6
B. World Cultures	3

VI. Free Electives	**17-18 sh**
Transfer Credits from SIT	15
Free elective (suggested: Lab Research)	2-3

Minimum total required for graduation **120 sh**

Descriptions for some important MSU courses

(See https://www.montclair.edu/catalog/view_requirements.php?CurriculumID=1101)

1. PHYS191: University Physics I

This one-semester calculus-based course including laboratory is a study of the principles of physics and some applications to society's problems. Topics covered include mechanics, thermodynamics, fluids, and harmonic motion. (3 hours lecture, 2 hours lab.) *4 sh.*
Prerequisites: MATH 122 is prerequisite or co-requisite.

2. PHYS192: University Physics II

Calculus-based course. Study of some principles of physics and some applications to society's problems. Topics include: wave motion, sound and noise pollution, optics, electricity, lasers, nuclear theory, radiation, nuclear reactors, waste disposal. (3 hours lecture, 2 hours lab.) *4 sh.*
Prerequisites: MATH 221 is prerequisite or co-requisite.

3. PHYS210: Mechanics

Classical mechanics: Kinematics, Newton's laws, impulse and momentum, statics, work and energy, oscillations, general motion, central force motion, non-inertial frames, system of particles, methods of handling data. (3 hours lecture, 2 hours lab.) *4 sh.*
Prerequisites: PHYS 191.

4. PHYS240: Electricity and Magnetism

Basic principles of electromagnetism: Coulomb's law and general techniques in electrostatics, currents and their associated magnetic field, electromagnetic induction and magnetic properties of materials. Foundations of Maxwell's equations (without detailed solutions). Laboratory experiments. (3 hours lecture, 2 hours lab.) *4 sh.*
Prerequisites: PHYS 192. MATH 222 is a prerequisite or co-requisite.

5. PHYS350: Optics

Propagation of light, optical components, instruments and photometry. Interference, diffraction and polarization with elements of spectroscopy. (Offered alternate years.) Meets the University Writing Requirement for majors in Physics. (3 hours lecture, 2 hours lab.) *4 sh.*
Prerequisites: PHYS 240.

6. PHYS460: Modern Physics

Special relativity, kinetic theory of matter; quantization of electricity, light and energy; nuclear atom; elementary quantum mechanics and topics on solid state. (Offered alternate years.) (3 hours lecture, 2 hours lab.) *4 sh.*
Prerequisites: PHYS 210, 240.

7. PHYS430: Computer Simulations of Physical Systems

This course applies computer techniques and numerical analysis to model physical systems. Simulations and calculations will be done of falling bodies, gravitational orbits, scattering, oscillations, electrical circuits, molecular dynamics, Monte Carlo techniques, chaos, quantum systems. (3 hours lecture.) *3 sh.*
Prerequisites: MATH 221, PHYS 191, PHYS 192, and CMPT 183.

8. PHYS368: Fluid Mechanics
Mechanics of continuous media, liquids and gases; stress, viscosity, Navier-Stokes and Euler Equations, exact solutions, potential flow, circulation and vorticity, dimensional analysis and asymptotic models, boundary layers, stability theory and applications to industrial and environmental problems. Cross listed with MATH 468. (3 hours lecture.) *3 sh.*
Prerequisites: PHYS 210 or MATH 222.

9. PHYS320: Thermodynamics
Thermodynamic systems; laws of thermodynamics; entropy; kinetic theory; transport processes; statistical thermodynamics. (Offered alternate years.) (3 hours lecture.) *3 sh.*
Prerequisites: MATH 222 and PHYS 210.

10. ARID220: Introduction to Computer Aided Solid Modeling Representation
Beginning course enabling students to build conceptual and performance skills required to create and visualize three dimensional objects on a computer. Starting Summer 2012: This course is about the fundamentals of digital parametric modeling. Content is organized around part modeling, assembly models and technical drawing generation. Students are taught to build conceptual and performance models required in the practice of visualizing and testing three dimensional objects on computer. The course emphasizes the purpose and importance of digital modeling in the design process. This subject requires students to apply their knowledge of geometry, problem solving and 3D visualization ability. Students are expected to explore the possibilities of digital modeling with curiosity and inventiveness, maximizing their confidence and skill level. (2 hours lecture, 2 hours lab.) *3 sh.*
Prerequisites: ARID 100 and ARID 101.

11. ARID221: Surface Modeling Techniques
Application of computer graphics to visualize problems associated with product design relating to form, space, color and factors of human interaction. Starting Summer 2012: The second part of the Digital Modeling course sequence focuses on expanding students' knowledge gained in ARID 220 and builds on the material of previous course subjects. Content provides an in depth knowledge of Computer Aided Design as it applies to product development on the corporate level. Simulation and visualization of problems, related to form and technological issues are discussed. Students are expected to independently explore the wide range of possibilities and approaches to digital modeling. (2 hours lecture, 2 hours studio.) *3 sh.*
Prerequisites: ARID 220.

12. PHYS377: Mathematical Physics
Vector analysis, complex variables, ordinary and partial differential equations, matrices. (Not offered every year.) (3 hours lecture.) *3 sh.*
Prerequisites: 2 years of physics and MATH 222.

13. MATH335: Linear Algebra
The course content will cover the foundations of the algebra of vector spaces, matrix operations, matrix invertibility theorems, linear independence, span, basis, linear transformations, finite dimensional Hilbert Spaces, Gram-Schmidt process, projections, eigenvalues and eigenvectors, and applications. The focus of the course will be to develop advanced mathematical skills in reading and understanding abstract mathematical definitions, constructing examples, and developing mathematical proofs. Meets the University Writing Requirement for majors in Mathematics. (4 hours lecture.) *4 sh.*
Prerequisites: MATH 222 or equivalent.

14. MATH420: Ordinary Differential Equations
A course in the theory and applications of ordinary differential equations which emphasizes qualitative aspects of the subject. Topics include analytic and numerical solution techniques for linear and nonlinear systems, graphical analysis, existence-uniqueness theory, bifurcation analysis, and advanced topics. Prerequisite: MATH 335. (4 hours lecture.) *4 sh.*
Prerequisites: MATH 335.

15. MATH463: Numerical Analysis
Finite differences, approximation theory, linear and non-linear equations, error analysis. (3 hours lecture.) *3 sh.*
Prerequisites: MATH 222 and 335.

APPENDIX II. Stevens' M.E. in Mechanical Engineering Degree Requirements

The Master of Engineering in Mechanical Engineering program offers seven areas of concentration.

The Master's in mechanical engineering requires thirty credits. The program structure is as follows:

- Two required core courses
- At least four courses from any one of the seven concentrations below must be chosen
- Four elective courses must be chosen. These are explained in the "Elective Courses" section below.

Required Courses

- ME 635 Modeling and Simulation
- ME 641 Engineering Analysis I

Concentration Courses

Product Design

- ME 520 Analysis and Design of Composites
- ME 615 Thermal Systems Design
- ME 658 Advanced Mechanics of Solids
- ME 659 Advanced Structural Design
- ME 663 Finite Element Method
- ME 665 Advanced Product Development

Manufacturing

- ME 565 Introduction to Additive Manufacturing
- ME 566 Design for Manufacturability
- ME 644 Computer Integrated Design and Manufacturing
- ME 645 Design of Production Systems
- ME 652 Advanced Additive Manufacturing
- ME 653 Design for Additive Manufacturing

Thermal, Fluids, Energy

- ME 510 Power Plant Engineering
- ME 601 Engineering Thermodynamics
- ME 604 Advanced Heat Transfer
- ME 615 Thermal Systems Design
- ME 674 Fluid Dynamics

- ME 675 Computational Fluid Dynamics and Heat Transfer

Pharmaceutical Manufacturing

- ME 530 Introduction to Pharmaceutical Manufacturing
- ME 535 Good Manufacturing Practice in Pharmaceutical Facilities Design
- ME 540 Validation and Regulatory Affairs in Pharmaceutical Manufacturing
- ME 628 Manufacturing and Packaging of Pharmaceutical Oral Solid Dosage Products
- ME 629 Manufacturing of Sterile Pharmaceuticals
- ME 647 Environmental Systems (HVAC) in Healthcare Manufacturing

Medical Devices

- ME 525 Biomechanics
- ME 526 Biofluid Mechanics
- ME 580 Medical Device Design and Technology
- ME 658 Advanced Mechanics of Solids
- ME 660 Medical Devices Manufacturing
- ME 674 Fluid Dynamics

Robotics & Control

- ME 598 Introduction to Robotics
- ME 621 Introduction to Modern Control Engineering
- ME 622 Optimal Control and Estimation of Dynamical Systems
- ME 631 Mechanical Vibrations I
- ME 651 Analytic Dynamics
- ME 654 Advanced Robotics

Micro/Nano Systems

- ME 573 Introduction to MEMS
- ME 581 Introduction to BioMEMS
- ME 680 Fundamentals of Micro/Nano Fluidics
- ME 681 Applications of Advanced Micro/Nano Materials, Structures, and Devices
- NANO 525 Techniques of Surface and Nanostructure Characterization
- NANO 600 Nanoscale Science and Technology

Elective Courses

Four elective courses may be chosen. Of these four courses, a maximum of two courses may be non-ME courses, and of the non-ME courses, a maximum of one may be a non-SES course (i.e. any Stevens graduate course). A student may substitute a Project (**ME 800** Special Problems in Mechanical Engineering, 3 credits) or a Master's Thesis (**ME 900** Thesis in Mechanical Engineering, 6 credits) for the appropriate number of courses.

Appendix III. Suggested Sequence for Five-Year BS in Physics – M.E. in Mechanical Engineering

The following sequence assumes exemption from all basic skills requirements as a result of meeting or exceeding the required scores on the MSU Basic Skills Placement Test.

3+2 Program – Bachelor's (Physics) and Master's (Mechanical Engineering)

The 3+2 Program summarized below combines a Bachelor's degree in Physics with a Master's degree in Mechanical Engineering program, earned over a 5-year period. The undergraduate courses highlighted in light gray are taken at Montclair State University (MSU) (Terms 1-6) and Stevens Institute of Technology (SIT) (Terms 7 and 8), leading to a Bachelor's degree in Physics granted by MSU. The graduate courses highlighted in light blue are taken at SIT (Terms 8-10), leading to a Master's degree in Mechanical Engineering granted by SIT.

Term 1		Term 2	
PHYS 191 University Physics I	4	PHYS 192 University Physics II	4
MATH 122 Calculus I	4	MATH 221 Calculus II	4
CSIS 110 Fundamentals of Programming I	3	ENWR 106 Writing II	3
GNED 199 New Student Seminar	1	CMST 101 Fundamentals of Speech	3
ENWR 105 Writing I	3	Physical Education	1
GNED General Education	3	World Cultures	3
Total	**18**	**Total**	**18**
Term 3		**Term 4**	
PHYS 210 Mechanics	4	PHYS 240 Electricity & Magnetism	4
MATH 222 Calculus III	4	PHYS 368 Fluid Mechanics *OR* PHYS 430 Computer Simulations of Physical Systems *OR* MATH 463 Numerical Analysis	3
ARID 220 Intro to Computer Aided Solid Modeling Representation *OR* ARID 221 Surface Modeling Techniques *OR* Materials Science	3	MATH 235 Introduction to Linear Algebra *OR* MATH 335 Linear Algebra	4
GNED General Education	3	PHYS 320 Thermodynamics *OR* PHYS 460 Modern Physics	3
GNED General Education	3	GNED General Education	3
Total	**17**	**Total**	**17**
Term 5		**Term 6**	
PHYS Physics Elective OR PHYS 350 Optics	3-4	PHYS 368 Fluid Mechanics *OR* PHYS 430 Computer Simulations of Physical Systems *OR* MATH 463 Numerical Analysis	3
PHYS 377 Mathematical Physics *OR* MATH 420 Ordinary Differential Equations *OR* MATH 460 Intro to Applied Mathematics	3-4	CHEM 121 General Chemistry II	4
CHEM 120 General Chemistry I	4	PHYS 320 Thermodynamics *OR* PHYS 460 Modern Physics	3
General Education	3	General Education	3
Language	3	Language	3
Free Elective	0-2	Free Elective	1
Total	**18**	**Total**	**17**
Term 7		**Term 8**	
ME 126 Mechanics of Solids	4	ME 483 Control Systems	3
ME 322 Engineering Design VI	2	ME 491 Manufacturing Processes & Systems	3
ME 345 Modeling & Simulation	3	ME 663 Modeling & Simulation (Required Course)	3
ME 354 Heat Transfer	3	ME 664 Engineering Analysis (Required Course)	3
ME 361 Design of Machine Components	3	**Total**	**6+6**
Total	**15**		
Term 9		**Term 10**	
ME Concentration Course I	3	ME Concentration Course III	3
ME Concentration Course II	3	ME Concentration Course IV	3
ME Elective Course I	3	ME Elective Course III	3
ME Elective Course II	3	ME Elective Course IV	3
Total	**12**	**Total**	**12**

3+2 Program - Bachelor's (Physics) and Master's (Mechanical Engineering)
Stevens Undergraduate Course Summaries

ME 126 Mechanics of Solids: Fundamental concepts of particle statics, equivalent force systems, equilibrium of rigid bodies, analysis of trusses and frames, forces in beam and machine parts, stress and strain, tension, shear and bending moment, flexure, combined loading, energy methods, statically indeterminate structures. (Prerequisites: *PEP 11 Mechanics, MA 115 Calculus 1, MA 122 Integral Calculus)*

ME 322 Engineering Design VI: This course is intended to teach modem systematic design techniques used in the practice of mechanical engineering. Methodology for the development of design objective(s), literature surveys, base case designs, and design alternatives are given. Economic analyses with an emphasis on capital investment and operating costs are introduced. Integrated product and process design concepts are emphasized, with case studies. Students are encouraged to select their senior capstone design project near the end of the course, form teams, and commence preliminary work. A number of design projects are required of all students. (Co-requisites: *ME 345 Modeling and Simulation;* Prerequisites: *E 321 Engineering Design* V)

ME 345 Modeling and Simulation: Modeling and simulation methodologies including model-block building, logical and data modeling, validation, simulation and trade-off analysis, decision-making, and optimization. Product and assembly modeling; visual simulation; process modeling; production modeling; process plans and resource modeling, entity flow modeling including conveyors, transporters, and guided vehicles: Input and output statistical analysis. Several CAD/CAE simulation software are used. (Prerequisites: *MA 221 Differential Equations,*
ME 225 Dynamics and *ME 234 Mechanical Engineering Thermodynamics)*

ME 354 Heat Transfer: Basic modes of heat transfer, steady heat conduction, extended surface heat transfer, transient heat conduction, computational methods, forced and free convection, boiling and condensation, thermal radiation, heat exchangers. Design projects. (Prerequisites: *MA 227 Multivariable Calculus, ME 234 Mechanical Engineering Thermodynamics* and *ME 342 Fluid Mechanics)*

ME 361 Design of Machine Components: Application of the principles of strength of materials to the analysis and design of machine parts. Stress and deflection analysis. Curved bars, multi-support shafts, torsion, cylinders under pressure, thermal stresses, creep and relaxation, rotating disks, fasteners, springs, bearings, gears, brakes and other machine elements are considered. Failure of structural materials under cyclic stress. (Prerequisites: *MA 221 Differential Equations* and *E 126 Mechanics of Solids)*

ME 483 Control Systems: Analysis and synthesis of feedback control systems to achieve specified stability and performance criteria, stability via root-locus techniques, Nyquist's criterion, Bode and Nichol's plots, effect of various control laws and pole-zero compensation on performance, applications to servomechanisms, hydraulic and pneumatic control systems, analysis of nonlinear systems. (Prerequisites: *MA 227 Multivariable Calculus* and *ME 225 Dynamics)*

ME 491 Manufacturing Processes and Systems: Analysis of both bulk-forming (forging, extrusion, rolling, etc.) and sheet-forming processes, metal cutting, and other related manufacturing processes, physics and stochastic nature of manufacturing processes and their effects on quality, rate, cost and flexibility; role of computer-aided manufacturing in manufacturing system automation; methodologies used to plan and control a manufacturing system: forecasting, production scheduling, facility layout, inventory control, and project planning. (Prerequisites: *ME 345 Modeling and Simulation* and *ME 361 Design of Machine Components)*

APPENDIX IV. Stevens Courses transfer as MSU elective credit

The requirements for the MSU Physics degree will have been satisfied in the first 3 years of study at MSU.

Stevens Courses:

Required:

1. ME635 Modeling and Simulation- 3cr
2. ME 641 Engineering Analysis I - 3cr

Optional: Any 3 courses from the following:

3. ME concentration I- 3cr
4. ME concentration II- 3cr
5. ME concentration III- 3cr
6. ME concentration IV- 3cr
7. ME Elective I - 3cr
8. ME Elective II - 3cr
9. ME Elective III- 3cr
10. ME Elective IV- 3cr