

## **Proposal: Joint Master of Environmental Management and Master of Engineering Management Degree**

**February 27, 2008**

### **Overview and Goals**

This document outlines an educational collaboration between Pratt's Master of Engineering Management Program (MEMP) and the Nicholas School's Master of Environmental Management (MEM) program. The goals of this collaboration are:

- Provide a broad perspective to blend the MEMP students' engineering backgrounds and the MEM students' training in natural and social environmental sciences, resulting in graduates with a strong mix of technical and contextual knowledge and tools well suited to careers in several environmental sectors, particularly energy and environment, environmental health, and water resources.
- Attract new students to both programs.
- Foster cooperation between Pratt and Nicholas on environmental issues of joint interest.
- Enhance the diversity of students taking MEM and MEMP courses.

### **Pratt MEMP program overview**

The Master of Engineering Management Program (MEMP) is an interdisciplinary professional program that integrates management, technology, and a practical internship to produce tomorrow's technology leaders. It is a one year program requiring 30 credits:

- 12 credits from four required business courses (Finance, Marketing, Law and Management).
- 12 credits from four technical electives.
- 6-credits from an internship.

MEMP applicants are expected to have strong science or engineering backgrounds, including 3 semesters of college calculus and three semesters of engineering, mathematical sciences, or natural sciences.

*Participating MEMP faculty (\*adjunct/contract instructors):* F. Hadley Cocks, James D. Cox (Law), Robert Coyle\*, Bradley A. Fox\*, Jeffrey T. Glass, Guerry Grune\*, Joseph Holmes\*, Joel Huber (Fuqua), Kimberly Jenkins\*, Josiah Knight, Gurhan Kok (Fuqua), David L. Lange (Law), Barry Myers, Jeff Peirce, Robert Price\*, Charles J. Skender\*, Vivek Wadhwa\*, Jesko von Windheim\*

### **Nicholas MEM program overview**

The Nicholas Master of Environmental Management (MEM) Degree focuses on producing graduates who are able to integrate science and policy to meet environmental challenges. The MEM requires 48 credits completed over two years. There are a variety of programs within the MEM degree, some emphasizing environmental social science and some emphasizing environmental natural science. All MEM graduates must complete a substantial Master's project featuring in-depth research in the program area in which the student is studying and a novel analysis. Qualified students from any MEM program could participate in the joint MEMP/MEM degree.

MEM applicants come from varying undergraduate backgrounds. One semester each of introductory statistics and calculus are school wide prerequisites; each MEM program has one or more additional prerequisites (e.g., ecology, organic chemistry, microeconomics).

Each MEM program has its own curriculum requirements within a common structure consisting of (1) core natural and social science courses, (2) courses chosen from an area of in-depth study from the program subject matter, (3) analytical skills and professional tools courses pertinent to the program subject matter, and (4) electives. Specifics about MEM program curricula are given at the end of this proposal in the sample course plans for various combinations of MEM program areas with the MEMP degree.

### Existing Joint Degrees

The Nicholas School offers a variety of joint degrees, with MBA, JD and MPP the most common. In joint degree programs, students complete 36 credits in the Nicholas School. They are able to use coursework from their other degree programs to meet the substance (but not the credits) of requirements for their MEM programs. For example, students in the joint MEMP/MEM program might use a MEMP management course to fulfill the substance of a tools course for their MEM curriculum. This strategy, along with eliminating most free electives, allows joint degree students to meet virtually all of their MEM program requirements in 36, rather than 48, Nicholas School credits.

Pratt’s MEMP program offers a concurrent degree with the engineering MS program and is also investigating a joint degree with the Law School. These degrees allow the transfer of 6-9 credits into the MEMP from the joint degree program.

### Proposed Joint MEMP/MEM degree

The proposed joint MEMP/MEM degree would require 60 total credits, taking between 24 and 28 months to complete, including 6 credits for the MEMP internship and 7 credits for the MEM master’s project and MP seminar.

A generic sample curriculum for a joint MEMP/MEM degree is shown below. Similar sample curricula for particular MEM programs appear at the end of this proposal. The sample curricula assume 3 credits per course; where course credits differ, a student may take more or fewer courses in a semester. For some MEM programs, MEMP core courses may satisfy one or more MEM program requirements (e.g., Finance may satisfy a tools requirement, or IP Law may satisfy a social science requirement), freeing up more choice in Nicholas School credits than is shown below.

	Summer (June – August)	Fall (September – December)	Spring (January – May)
First Year	<i>MEMP Internship (6 credits)</i>	<i>MEMP Finance</i> <i>MEMP Marketing</i> 2 MEM core courses	<i>MEMP IP Law</i> <i>MEMP Management</i> 2 MEM core courses MEM skills/tools course
Second Year	MEM Internship (not required)	<i>MEMP Elective</i> 2 MEM courses in in-depth area MEM tools/skills course MEM Master’s Project (3 cr)	<i>MEMP Elective</i> MEM course in in-depth area MEM tools/skills course MEM Master’s Project and Seminar (4 credits)
Third Year	Completion of MEM Master’s Project	Optional semester to complete MEM Master’s Project and any additional credits needed to satisfy requirements <sup>1</sup>	

<sup>1</sup>Tuition revenue from 3<sup>rd</sup> year studies will be split 50/50 between the MEM and MEMP.

The curriculum above meets all requirements for MEMP and the MEM program, distributing requirements of both degree programs across a minimum of four academic semesters and three summers (28 months). Most students will need to spend a fifth semester finishing the MEM Masters Project and any remaining course credits. The fifth semester will especially be necessary for non-native English speakers who must take English courses to enhance their language skills and for students who must take additional courses during the first year to meet MEMP or MEM prerequisites (which would not earn any credit towards the graduate degrees).

#### *Admissions*

Acceptance into the MEMP/MEM program will require separate application and admission to each school, with applicants meeting prerequisites for each program and each school.

#### *Tuition*

The Nicholas School will be responsible for billing and collecting tuition. The Nicholas School of the Environment will be responsible for transferring the appropriate funds to the MEMP each semester.

Tuition is set by the Board of Trustees each year. The MEMP/MEM tuition will be calculated based on the annual tuitions for the MEMP and MEM degrees. For the 2007-2008 year, the MEMP tuition for one year enrollment is \$33,000 and the Nicholas School of the Environment tuition for two years enrollment is \$53,200. Separately, the cost of both degrees would be \$86,200. The proposed joint degree program would cost the student \$66,300 (slightly more than 2 years of MEMP tuition), for a savings of \$19,900.

Students will be charged a flat tuition for the first two years of study. Students requiring additional coursework after two years have the option of being charged on a per credit basis. The cost per credit will be the annual tuition divided by 24. Students requiring additional time to complete the Master of Environmental Management Master's project will be required to register for continuation following the Master of Environmental Management rules. There is a small fee, currently \$350, for continuation.

All financial aid for joint degree students will be administered through the Nicholas School Office of Financial Aid.

#### *Revenue Sharing*

Pratt and the NSOE will share revenues from this program proportional. The NSOE will receive 75% of its standard tuition and the Pratt School of Engineering will receive 80% of its standard tuition. The annual tuition for students in this program is the weighted average of these.

For example in 2007-2008, the NSOE tuition is \$26,600 and the MEMP tuition is \$33,000. The tuition for a student enrolled in the joint degree program would be

$$\text{Joint MEM/MEMPTuition} = 0.75 \times \$26,600 + 0.8 * \$16,500 = \$19,950 + \$13,200 = \$33,150$$

Note: Since the MEMP is only a 1 year program, only half of the annual tuition is considered in the calculation.

Tuition revenue from 3<sup>rd</sup> year studies will be split 50/50 between the MEM and MEMP. Any continuation fees that are received will all go to the MEM since these fees are directly associated with the completion of the MEM project.

*Job Placement*

Program graduates will be able to use the resources of the Nicholas School of the Environment Career Services office as well as the Duke Career Center and the MEMP career placement advisor to seek employment.

*Program Support*

The existing administrative support at Pratt and NS for enrollment, financial aid, and career services can handle the expected several MEMP/MEM joint-degree students. If the program grows beyond this level, then additional administrative support will be needed to ensure program success.

**Summary**

A joint MEMP/MEM degree program would further strengthen each school's already strong emphasis on interdisciplinary studies. This program will allow students to complete two degrees in 24-28 months instead of three years, with significant tuition savings. While each school would sacrifice a portion of its standard tuition revenue, each will benefit from the enrollment of students who would not have applied absent the joint program. Additionally, by combining the strengths of these two programs, the joint degree will better enable students to make an impact on engineering and environmental management concerns that face the world today and in the future.

Approved by:

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Professor and Dean, Pratt School of Engineering

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Date

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Date

*Sample Curricula for MEMP/MEM programs:*

Curriculum requirements for joint degrees can be met as follows, with MEMP contributions to MEM program requirements (but not to MEM credits) shown in bold. (Note that “NS credits” means courses taken for credit toward the MEM degree; these need not be Nicholas School courses.)

*Energy & Environment MEMP/MEM*

Within the Nicholas MEM, the Energy & Environment program is intended to provide students with a broad perspective on energy and its related challenges, and an understanding of the important links between markets, policy, technology and the environment.

- “Energy & Environment” core course (3 NS cr)
- MEMP core courses (Finance, Marketing, IP Law, Management – 12 Pratt cr)
- In-depth Energy and Environment courses from 3 areas:
  - Energy Resources & Technology (courses in geology and engineering) (6 NSOE cr)
  - Environmental Science (6 NS cr)
  - Markets & Policy (courses in economics, law, business and policy) – (3 NSOE cr),  
**[MEMP IP Law, MEMP Marketing]**
- 8-9 credits in tools (e.g., Energy Analysis, Financial Analysis, Applied Data Analysis) – (5-6 NSOE cr) **[MEMP Finance, MEMP Management]**
- 11-12 credits in electives, including experiential short courses, specializing electives, and integrating electives, including electives from the Pratt School of Engineering.(5-6 NSOE cr, 6 Pratt cr)
- MEM Master’s Project and MP seminar (7 NS cr)
- MEMP internship (6 Pratt cr)

	Summer	Fall	Spring
First Year	<i>MEMP Internship (6 credits)</i>	<i>MEMP Finance</i> <i>MEMP Marketing</i> MEM Energy & Environment ENV Environmental Science MEM Energy Economics	<i>MEMP IP Law</i> <i>MEMP Management</i> MEM Energy Technology MEM Applied Regression Analysis
Second Year	MEM Internship (not required)	<i>MEMP Elective</i> MEM Energy Elective MEM Energy Analysis MEM Elective MEM Master’s Project (3 credits)	<i>MEMP Elective</i> MEM Energy Policy MEM Environmental Science MEM Master’s Project and Seminar (3 credits)
Third Year	Complete of MEM Masters Project	Optional semester to complete MEM Master’s Project and any additional credits needed to satisfy requirements	

*Participating Energy and Environment Faculty (adjunct/contract instructor):* Lincoln Pratson, Peter Malin, Natalia Mirovitskaya, Marty Smith, Erika Weinthal, Simon Rich\*, Pogo Davis\*, James Rabenhorst\*, Cary Gravatt\*, Joe DeCarolus\*, Tim Johnson\*

*Environmental Health and Security MEMP/MEM:*

Environmental Health and Security (EHS) seeks to instill in the student a science-based approach combining integrated assessment for humans, biota, and natural resources.

- EHS core courses (ENV 160 Environmental Chemistry and Toxicology, ENV 298.02 Environmental Epidemiology, ENV 246 Survey of Environmental and Occupational Health, course in ecology or global change (12 NS cr)
- MEMP core courses (Finance, Marketing, IP Law, Management) (12 Pratt cr)
- In-depth Environmental Health and Security from 3 areas (9 NS cr):
  - Combined courses bridging human and environmental health
  - Environmental health (at least 3 cr)
  - Human health (at least 3 cr)
- Tools (one course in statistics, two in a focal area such as risk analysis, geospatial analysis, and one course in law, policy, other social science ((e.g., Energy Analysis, Financial Analysis, Applied Data Analysis) – (9 NS cr) [**MEMP IP Law**])
- 6 credits in electives, including electives from the Pratt School of Engineering.(6 Pratt cr)
- MEM Master’s Project and MP seminar (7 NS cr)
- MEMP internship (6 Pratt cr)

	Summer	Fall	Spring
First Year	<i>MEMP Internship (6 credits)</i>	<i>MEMP Finance</i> <i>MEMP Marketing</i> ENV Occup Health and Safety ENV Env Epidemiology	<i>MEMP IP Law</i> <i>MEMP Management</i> ENV Env Chem and Tox ENV tools course ENV/BIO ecology/global change
Second Year	MEM Internship (not required)	<i>MEMP Elective</i> ENV Env Health course ENV statistics course) ENV Human Health course MEM Master’s Project (3 credits)	<i>MEMP Elective</i> ENV Combined human/env health ENV tools course ENV Master’s Project and Seminar (4 credits)
Third Year	Complete MEM Master’s Project (3 credits)	Optional semester to complete MEM Master’s Project and any additional credits needed to satisfy requirements	

*Participating Environmental Health and Security Faculty (\*adjunct/contract instructor):* David E. Hinton, Marcia Angle\*, Richard T. Barber, Celia Bonaventura, Joe Bonaventura, Richard DiGiulio, Jonathan Freedman, Peter Haff, Prasad Kasibhatla, Randall Kramer, Seth Kullman, Marie Lynn Miranda, Daniel Richter, Jonathon Wiener

*Water and Air Resources MEMP/MEM*

The program in Water and Air Resources (WAR) enables students to understand the physical, chemical, and biological processes affecting aquatic and atmospheric environments. The program concentrates on problems that span the natural divisions of the biosphere, soil, plants, lakes, watersheds, and the atmosphere, and teaches quantitative techniques, including measurement and modeling methods used by researchers and environmental managers.

- Core courses in physical sciences, chemical sciences and biological/ecological sciences pertinent to water and air resources (9 NS cr)
- One course in law, policy or economics [**MEMP IP Law**]
- MEMP core courses (Finance, Marketing, IP Law, Management) (12 Pratt cr)
- Three specialization courses in water or air resources (3-9 NS cr) [**MEMP electives**]
- Three courses in analytical tools (3-9 NS cr) [**MEMP electives**]
- Electives, including electives from the Pratt School of Engineering.(2-11 NS cr, 6 Pratt cr)
- MEM Master’s Project and MP seminar (7 NS cr)
- MEMP internship (6 Pratt cr)

	Summer	Fall	Spring
First Year	<i>MEMP Internship (6 credits)</i>	<i>MEMP Finance</i> <i>MEMP Marketing</i> ENV physical science course ENV tools course	<i>MEMP IP Law</i> <i>MEMP Management</i> ENV chemical science course ENV biol/ecological science course ENV tools course
Second Year	MEM Internship (not required)	<i>MEMP Elective</i> ENV water/air resources ENV water/air resources ENV Elective MEM Master’s Project (3 credits)	<i>MEMP Elective</i> ENV water/air resources ENV tools course ENV Master’s Project and Seminar (4 credits)
Third Year	Complete MEM Masters Project	Optional semester to complete MEM Master’s Project and any additional credits needed to satisfy requirements	

*Participating Water and Air Resources Faculty (\*adjunct/contract instructor):* John D. Albertson, Paul Baker, Prasad S. Kasibhatla, Gabriel G. Katul, Ram Oren, Lincoln Pratson, Kenneth Reckhow, Curtis J. Richardson, Daniel D. Richter, John J. Vandenberg\*

## **Addendum to MEM/MEMP Joint Degree Proposal**

**12/22/2007**

*Market for the MEM/MEMP Joint Degree Program:* There has recently been explosive growth in society's awareness of environmental issues such as global warming, over-fishing in marine ecosystems, and the decline of rain forests. This is coupled with a significantly improved understanding of the need for new energy sources due to the environmental impact of fossil fuels, the possible limitations of reserves and dramatically increasing prices. The solutions to these overwhelming problems will require multiple disciplines. Although the Nicholas School covers many disciplines from environmental science to public policy, engineering innovations will also certainly be required in these solutions. Similarly, although the Pratt School covers many different engineering and technology areas, implementation in the complex realm of public projects will require much more than just technical innovation. New technological innovations and their implementation in the complex context of government policies, social predispositions, individual rights, and cultural diversity will require a multitude of skills; this complex situation defines the value and need for the joint MEM/MEMP Degree Program.

Despite the clear need for, and value of, this multidisciplinary approach, it is very difficult to predict the actual market for a joint degree in this area. Neither program is viewing the joint degree as a primary avenue for a majority its students but rather views this as another option in their portfolio. The goal is to provide a unique degree opportunity in this portfolio for a select group of students. Although there may be a higher demand than anticipated given the nature of the global warming debate and energy issues, we currently estimate the steady state market for the program to be between 5 and 10 students per year. There are already a few of the 26 MEM students in the Nicholas Energy & Environment capable of pursuing the joint degree. We plan to attract more such students by actively marketing the program in parallel with the many marketing efforts already undertaken by both programs. We also expect to see undergraduates in Pratt and Nicholas opting to stay an extra two years to complete the joint degree, particularly those who undertake the new Undergraduate Certificate in Energy & Environment being jointly administered by Pratt and Nicholas.

It is important to recognize that there is no "minimum viable number of students" because there are virtually no additional costs associated with running this joint degree. In addition, it is expected to simultaneously raise the awareness of all students within both programs of the multidisciplinary nature of these fields. It will also enhance the co-curricular opportunities for all students in both programs. In fact, the two programs have already held joint round tables with visitors due to the relationships that have developed during the planning of this joint degree. In addition, engineering management students have participated as climate change fellows in the Nicholas School.

*Broad Benefits to the Nicholas School and the Pratt School:* A variety of ancillary benefits for both schools will be derived from this joint program. First, from an academic perspective, the heightened awareness of the multi-faceted nature of environmental and energy issues will be realized on both sides of the degree. The engineering management students will be exposed to the energy value chain and apply market and policy structures and understand environmental and social impacts. The environmental management students will be introduced to the technology



and business drivers for many of these issues and develop project management skills. We expect that many of the co-curricular activities that engineering management students are involved in will be influenced by the connection with the Nicholas School. For example, for the past two years, engineering management student teams have won the Cures competition for improving global health in developing countries. Expanding such teams to address environmental and energy issues in developing countries is a natural next step. The SmartHome technology being developed by students will also be influenced by this collaborative program, pushing the state of the art in green and low energy consumption housing.

These activities support Duke's mission of "Knowledge in the Service of Society". To enable technology to be utilized in the service of society, the physical, biological, chemical, ecological, economic, legal and social areas at the heart of the Nicholas MEM must all be addressed. Thus, bringing together the students who have focused on engineering and technology with those who have focused on the environmental science and policy issues is a natural way to enhance the value of each group's education. Again, this goes well beyond just the students who are in the joint degree program to impact all of the students in each program through round tables with external experts, joint seminars and field trips. Connecting the two programs will also enable critical mass to be developed within specific areas of energy and the environment. One can envision groups dedicated to, for example, wind power or solar power within the broader context of the joint program and the overlapping interest of students in both the MEM and MEMP. These co-curricular activities are also expected to attract MS and PhD students to address the deeper technological issues related to these technologies.

This joint program will also link extremely well with the Gendell Center for Engineering, Energy and the Environment and, thus with undergraduate students. Although developed entirely independently, the education provided by the joint degree supports the same vision as the Gendell Center, i.e. enabling students to address "causes and solutions to complex environmental issues." The joint MEM/MEMP students will be expected to participate in efforts to establish this as a premier center with an applied educational objective that utilizes strengths of both the Pratt School and Nicholas School. New activities are expected to evolve from this joint degree activity which complement the Gendell Center mission. In addition to the newly approved Undergraduate Certificate in Energy & Environment, these activities include student chapters of energy and environmental management, student club activities related to local environmental issues, student participation in national conferences and workshops, competitions to analyze commercial opportunities in these areas, etc.