PROPOSAL FOR NEW PROFESSIONAL SCIENCE MASTER’S (PSM) TRACK IN SPACE STUDIES

Submitted by

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Dr. Daniel Carson, Dean, Wiess School of Natural Sciences,
and
The PSM Faculty Oversight Committee, represented by
Dr. Barry Dunning, Dr. Kathy Ensor, Dr. Dale Sawyer, Dr. Janet Braam

In collaboration with
Dr. Andrew Meade, Professor and Chair, Department of Mechanical Engineering and Materials Science, George R. Brown School of Engineering

Overview:

The objective of the Professional Science Master’s (PSM) programs is to provide students with a wider range of science-based career opportunities. Students take advanced science and engineering courses together with business, ethics, and communication classes while acquiring practical experience in the form of an internship. Rice University’s PSM program currently offers interdisciplinary degrees in four tracks: Bioscience Research and Health Policy, Environmental Analysis and Decision Making, Subsurface Geoscience, and Nanoscale Physics. This proposal seeks the approval to expand the existing program with a new track that will train students interested in space engineering program management, providing them with the tools to face the complex challenges inherent in US space policy, human and robotic space exploration, and science in space exploration and technology development.

The existing Rice PSM degrees equip students with the skills needed to connect advanced scientific concepts in a business or governmental setting. Students are educated in the scientific approach to problems, while simultaneously being trained in vital business concepts, policy and ethics issues, verbal and written communication, and rounding out their education with advanced practical training in the field of their interest. This unique combination of an interdisciplinary curriculum and hands-on experience enables students to move seamlessly into the scientific/technical workforce. Expanding the existing program with a Space Studies track will give students the opportunity to deepen their technical and engineering knowledge and fulfill the critical need in the space industry for well-qualified professionals interested in the new paradigm for space exploration and utilization. Recent changes in the Space Policy of the United States have significantly affected the space enterprise, particularly in the Greater Houston Area. With an increased emphasis on the commercialization of space exploration there is a greater need for the broad education and expertise afforded by the Rice PSM program. Over the course of the next few years the NASA Johnson Space Center and the associated aerospace industries will be changing the
way they do business with a larger focus on translating space technologies to other sectors (e.g. energy, medicine) and a stronger emphasis on research and development, working more closely with universities, strengthening their entrepreneurial activities, and partnering more broadly. The Space Studies track provides a strong foundation in these activities. The Space Studies track is geared to help individuals increase their knowledge of space engineering, science, program management, and policy. The program includes advanced engineering, biological, and physical science classes and introduces students to economics, public policy, and management disciplines, all of which impact space commercialization and national policy. Our program focuses on training engineers interested in program management providing them with the tools to face the complex challenges inherent in US space policy, human and robotic space exploration, and the role of science in space exploration and technology development. Through the development of their writing, research, and analytical and communication skills, graduates of this program can have a profound impact on policies, regulations, and laws governing the space industry within the United States, especially in the new age of increased commercialization and government-industry partnerships in space business.

The program will be carried out as a collaboration between the Wiess School of Natural Sciences and the George R. Brown School of Engineering. Students in this track will participate not only in deepening their scientific and engineering knowledge via coursework and by learning how to implement this knowledge at a systems level in a laboratory and/or commercial setting, but will also pursue topical research in an area pertinent to their interests and primary focus with the goal of addressing real world problems in a research and development environment.

**Brief History of the existing PSM program:**

The Sloan Foundation provided support to develop the three original Professional Science Master’s tracks at Rice University in 2001: we have recently added the Bioscience Research and Health Policy Track. In order to be recognized by the Council of Gradate Schools as a “PSM” program, a certain set of criteria has to be met. The course content has to be composed of at least 4 – 6 courses in science, technology, engineering, mathematical or computational sciences and statistics, together with a professional skills component, in our case business, policy, and communication training, and the required internship.

The required advanced “disciplinary” courses provide students with a solid foundation in their chosen field together with practical experience and training in the use of computers for modeling and other applications. Students also take a number of elective courses tailored to their specific interests. The four track options included in the Rice PSM program are listed below with a brief summary of their objectives:

**Bioscience Research and Health Policy:** This degree started enrollment in 2011 and offers a deep background in biological sciences complemented by courses in sociology, economics and policy studies to foster the students’ understanding of the role of science in policymaking and the role of public policy in science. In addition to science courses, students will take an
overview course in Science Policy and Ethics, a management course and a seminar jointly with the students involved in the other tracks. Furthermore, direct access to the James A. Baker III Institute for Public Policy will allow students to work closely with policy scholars as well as meet with many of the leaders in science and technology policy. This program focuses on training bioscience and health policy analysts, providing them with the tools to face the complex challenges inherent in the bioscience research, public health, and the U.S. healthcare systems and health-related industries.

**Environmental Analysis and Decision Making:** This interdisciplinary degree focuses on the quantitative and analytical aspects of environmental studies. It aims to teach quantitative skills such as statistics, remote sensing, data analysis, and modeling, in addition to laboratory and computer skills, which will give students the ability to anticipate problems, not just solve them. The degree includes focus areas in Environmental Sustainability, Management and Policy, and Quantitative Decision Making. Graduates will have the skills and knowledge to pursue careers with environmental consulting firms, energy production companies, engineering companies, government agencies and environmental think tanks.

**Subsurface Geoscience:** This track is designed for students who would like to become proficient in applying geological knowledge and geophysical methods to find and develop reserves of oil and natural gas. The program prepares students to be "explorationists," with strong skills in using seismic and other geophysical methods along with geological principles to find oil and natural gas. Students can also choose to be trained to become technical experts in aspects of exploration seismology. With Rice located in the center of the oil and gas industry, graduates have a wide range of opportunities to pursue careers related to the petro-chemical industry.

**Nanoscale Physics:** This program prepares students for a career in nanoscience by combining a strong component in quantum theory, which governs the behavior of systems at the nanoscale, with the study of practical nano- and meso-scale devices. This provides the student with the knowledge required to successfully navigate the emerging fields of nanoscale science and nanotechnology. In addition, a year-long course in methods of experimental physics is offered to ensure that students obtain the advanced practical skills valuable to the nanotechnology industry. Rice is a well-established leader for nanotechnology, with researchers active in many areas allowing students to pursue interdisciplinary studies in a variety of nanoscale science areas including carbon nanotubes, nanoshells, nano-based materials, and nano-biology.

The Rice PSM program has been very well received by students, their enthusiasm for it being demonstrated by our retention and completion rates. Since inception of our program, the majority of enrolled students have finished the course work and graduated successfully. Students who decided to leave the program during and after completion, were drawn to pursue a PhD track (six students out of 114) and have been accepted to such programs at Rice, Duke and other universities (This also demonstrates the high quality of students admitted to our program). Four students had to withdraw from the program when they encountered financial difficulties to pay Rice tuition.
We have an excellent history of placing students in internships and jobs after graduation, in fact 97% of the students found employment within 4 - 6 months after graduation.

The enrollment statistics for the various PSM tracks are presented in Table I

Table I: Comprehensive Enrollment Statistics for Fiscal Year F02 – F11:

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<thead>
<tr>
<th>TRACK</th>
<th>F02</th>
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<td>6</td>
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<td>114</td>
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</tbody>
</table>

Further Application Statistics can be found under APPENDIX I

Graduation Rate
We have had 28 graduates from our EADM track, 22 from our SG track and 15 from our NP track. All full-time students have taken 21 months, i.e. 3 semesters plus an internship to complete the degrees. Part-time students usually take 2 or 3 extra semesters until completion.

Job Placement:
All our graduates have found jobs within 4 - 6 months of graduation from Rice. (See APPENDIX II, Graduation History: Listing of graduates, graduation years and hiring companies)

Interdisciplinary Nature of the PSM Program:

Departments at Rice University involved with the PSM program tracks are Biochemistry and Cell Biology, Physics and Astronomy, Statistics, Civil and Environmental Engineering, Earth Science and Ecology. Due to this interdisciplinary nature and the flexibility of the PSM Program it has had an excellent record in student success. Students have access to a broad range of existing graduate courses offered in many departments, and are able to target their own specific interests and goals through the careful choice of elective courses.

Furthermore, the PSM Program Director, Dagmar Beck, has established a strong student support structure. Students have access to workshops and events organized by the Center for Career Development, activities offered by individual departments, and regular luncheons with faculty to increase interactions. In addition, students receive individual communication training and support from the PSM Communication faculty assigned to help them with their
communication needs. PSM students are encouraged to engage in projects/activities offered across campus and disciplines.

Overview of Program Requirements:

In general, the PSM degree requires completion of approx. 40 semester hours of graduate study of which 30 hours must be taken at Rice. The requirements are broken into three general areas:

- **Science Courses**
  Each degree track requires a unique set of technical courses (science or engineering) that provide students with advanced expertise beyond the bachelor’s level. This technical core expertise allows students to develop the deeper technical understanding that is needed by industry and government organizations. Students supplement these foundation courses by choosing electives in line with their areas of interest. For a detailed list of course requirements, see our web site at www.profms.rice.edu

- **Internship**
  A three- to six-month internship with a company, government agency or national laboratory is required. At the completion of this internship, students must report on their internship project both in writing and orally. These presentations form an important component of the overall degree program.

- **Cohort Courses**
  The cohort courses provide the additional skills students need for a non-academic career. Students increase their knowledge of business, management, ethics and communication by completing the following courses:
  - **Management for Science and Engineering:** This course is designed to give students insights into how technology-oriented firms manage intellectual property, marketing, organizational behavior, strategy, accounting, and finance.
  - **Science Policy and Ethics:** This course provides students with a broader understanding of the ways politics, policy, and ethics interact with the world of business, science and technology.
  - **Professional Science Master’s Seminar:** This weekly seminar serves to provide students with exposure to local industry leaders. Students also get the opportunity to meet industry leaders who speak about their own career development and decisions. The exposure to corporate guest speakers and participation in career-related activities, allows the students to further their knowledge in their respective concentrations, and to get the chance to develop vital networking skills. The seminar also offers communication training segments throughout the semester.

**Typical Curriculum** for this 21-months program requiring approx. 40 credit hours:
(Example from the Nanoscale Physics track)
Specific core requirements for the PSM in Nanoscale Physics include:

**PHYS 533**  Nanostructure and Nanotechnology I (F)
**PHYS 537**  Methods of Experimental Physics I (F)
**PHYS 539**  Characterization and Fabrication (TBA)
**PHYS 534**  Nanostructure and Nanotechnology II (S)
**PHYS 538**  Methods of Experimental Physics II (S)
**PHYS 416**  Computational Physics (S)

Required Cohort Courses:
**NSCI 610**  Management for Science and Engineering (F)
**NSCI 501**  Professional Master’s Seminar (F, S)
**NSCI 512**  Professional Master’s Project (F, S)
**NSCI 511**  Science and Technology Policy (S)

Four Elective Courses, two of which must be science or engineering 500 level or above and an internship.
Details on Proposed New Program Track:

PROFESSIONAL SCIENCE MASTER’S IN SPACE STUDIES

The purpose of this proposal is to introduce a new track into our program to focus on training students in Space Science and Engineering with the intent of creating new options for engineering and science students interested in working in the space technology industry or related government entities, e.g. NASA, as well as governmental relations positions in non-profit organizations, industry and academic institutions.

There is a critical need in the space industry for well-qualified professionals interested in the new paradigm for space exploration and utilization. Recent changes in the Space Policy of the United States have significantly affected the space enterprise, particularly in the Greater Houston Area. With an increased emphasis on the commercialization of space exploration there is a greater need for the broad education and expertise afforded by the Rice PSM program. Over the course of the next few years the NASA Johnson Space Center and the associated aerospace industries will be changing the way they do business with a larger focus on translating space technologies to other sectors (e.g. energy, medicine) and a stronger emphasis on research and development, working more closely with universities, strengthening their entrepreneurial activities, and partnering more broadly. The Space Studies track provides a strong foundation in these activities. The Space Studies track is geared to help individuals increase their knowledge of space engineering, science, program management and policy. The program includes advanced engineering, biological and physical science classes and introduces students to economics, public policy, and management disciplines, which impact space commercialization and national policy. Our program focuses on training scientists and engineers interested in program management providing them with the tools to face the complex challenges inherent in US space policy, human and robotic space exploration, and the role of science in space exploration and technology development.

The suite of courses that make up this program, required and elective, provide the students with a robust framework of technical skills relevant to space-related science, engineering and technology. For example, the space science, earth science, solar physics and astrophysics courses give the students an understanding of the phenomena in the universe that are the observational targets of many space missions and that drive the engineering design of these missions. In addition, the solar and space science courses provide the scientific background needed to understand the space environment that provides severe engineering challenges for the development of orbiting hardware. The engineering courses have been selected for their relevance to the development of space hardware and space instrumentation. Some of these courses are of direct relevance, e.g. Aerospace Engineering, while the remaining ones are focused on general principles that have a direct bearing on space hardware development. The life science courses are particularly relevant to the Human Space Flight program, the focus of NASA in Houston, and provide the scientific background in systems biology that have applications both in long-duration human spaceflight and in biological experimentation, a mainstay of science on the International Space Station. The computational courses are included to provide the students with the necessary skills to complement the science and
engineering expertise and to introduce them to the economics of engineering management, a key component of the PSM program.

Through the development of their writing, research, and analytical and communication skills, graduates of this program can have a profound impact on policies, regulations, and laws governing the space industry within the United States, especially in the new age of increased commercialization of and government-industry partnerships in space.

The program will be carried out as a collaboration between the Wiess School of Natural Sciences and the George R. Brown School of Engineering. Students in this track will participate not only in deepening their scientific and engineering knowledge via coursework and learning how to implement this knowledge at a systems level in a laboratory and/or commercial setting but will also pursue topical research in an area pertinent to their interests and primary focus with the goal to addressing real world problems in a research and development environment.

**Student Learning Objectives of Space Studies track:**

The guiding educational principles for this track will be

- To equip students with advanced scientific, engineering, and program management skills
- To achieve professional competency in engineering and science implementation and application
- To achieve a broad systems level understanding of the tools and methodologies needed in the space industry
- To teach quantitative skills and data analysis
- To equip students with the enabling leadership, communication, and research skills to solve real world problems in space, and related, technology
- To gain exposure in a real life experience in solving technical problems in an R&D environment via their participation in an internship
- To train students how to integrate their engineering and science knowledge with their understanding of policy and management decisions to enhance their work experience

**Educational Objective:**

This program will give students a deep background in science and engineering complemented by courses in economics, policy, and management to foster their understanding of how each of these areas contribute to the design and organization of space and related technology and engineering projects. Their coursework will provide them with research and study skills to enable them to develop strategies for managing complex engineering projects and to understand the connections between programmatic/scientific objectives and their implementation.
Track Requirements:
The curriculum is built on a framework of:
- Engineering and space science
- Space environment
- Business/management, cost/budget management, policy and economics
- Professional development: (i.e. communication training, research and/or practical experience, etc.)
- 40 credit hours required (approx. 13 - 14 courses), plus an internship

Recommended Background:
Applicants for the Professional Master’s in Space Studies must have:

- B.A. or B.S. degree in a related science or engineering program that included course work in general physics, chemistry, calculus, linear algebra, and differential equations
- Scores from the general Graduate Record Examination (GRE)
- Strong quantitative abilities
- Statistics, introductory economics and computer skills are preferred

Along the same framework of the existing tracks, this new master’s degree will consist of the following courses:

Cohort Courses:

Two Cohort Courses, a Seminar and an Internship Project: (already in place within existing programs):

NSCI 610 Management in Science and Engineering (F and S) (3 credit hours)
NSCI 511 Science Policy and Ethics (S) (3 credit hours)
NSCI 501 Professional Master’s Seminar (F, S) [required for two semesters, 1 credit hour each] - with industry speakers/ and communication workshops

Plus NSCI 512 Internship Project (1 credit hour) that allows faculty to grade the internship reports and presentation.

Note: Resources for these courses are already in place; faculty have been teaching the management course (in Fall and Spring) and the policy course (in Spring) on an annual basis.

The PSM Program Director has been hosting the seminar inviting guest speakers to campus since inception of the program. The seminar serves to provide students with a variety of industry contacts, opportunities to practice their networking skills and communication skills training.

These cohort courses are common to all of the PSM degree offerings at Rice. They are designed to equip students with the skills needed to connect advanced scientific concepts in a business or governmental setting. Students are educated in the scientific approach to
problems, while simultaneously being trained in vital business concepts, policy and ethics issues, verbal and written communication, and rounding out their education with advanced practical training in the field of their interest. This unique combination of an interdisciplinary curriculum and hands-on experience enables students to move seamlessly into the scientific/technical workforce.

At present, these course have sufficient commonality to be useful to all of the PSM offerings. However, as student numbers increase there might be a need to develop a more targeted science policy course with a more specialized focus, for example, one related to bioscience, energy and the environment, or nanotechnology and space policy topics.

Five required engineering/science courses, including:

A revised Solar System Physics course will serve as overview course for this track. It will evolve from an existing course: ASTR 470 Solar System Physics, which is currently being updated and revised by David Alexander. This 3-credit course is part of the Space Physics core in the Physics and Astronomy curriculum and requires no additional funding. The course goals are to:

- introduce students to some of the physical processes at work in the Solar System.
- identify current problems of interest to modern solar and planetary science,
- understand the effects of these processes on the space environment around the earth and other planets.

This is a solar system physics course that will be augmented to talk about the space environment around the earth. It will contain some of the science relevant to solar system bodies (Poynting-Robertson effect, Hydrostatic Equilibrium, MHD, planetary loss, planetary heating, solar wind solutions, shocks, trapped radiation, planetary magnetospheres, ionospheric structure, atmospheric loss, basic plasma physics etc.) that have applications elsewhere in astrophysics and some operational components, e.g. Space Weather, which concentrates on the space radiation environment mostly and the impact of this radiation on spacecraft systems.

The physics and the underlying mathematics will be put in context with the research applications to help familiarize the students with the research process. Regular class lectures will be augmented by a weekly discussion topic and at least one of the homework assignments will involve the reading and summarizing of a relevant research paper.

A Space Seminar course on “real-world” subjects such as:
- General, commercial and scientific aspects of space
- Mission planning and design
- Astrodynamics/orbital mechanics
- Spacecraft navigation
- Payload definition
- Space environment
- Structures
- Materials
- Propulsion and maneuvering
- Power
- Human factors
- Risk management
- Budget/finance, cost management
- Export control regulations
- Principal investigator role and case studies

This is a 1-credit hour class with the specified topics to each of be taught by industry experts and organized by faculty. (see seminar outline on page 16)

Three required 3-credit hour technical courses

Two required 3-credit hour economics and computational courses

Four elective courses according to student’s interest

Plus: a 3 – 6 months internship

**Internship:**

Practical experience is offered via a 3 – 6 month work immersion. The internship will be under the guidance of a host company, government agency, or non-profit organization. A summary of the internship project is required in both oral and written form as part of the Professional Master’s Seminar.

The faculty advisor will work with students to make sure they adhere to Rice regulations for graduate degrees that require students to take at least 15 credit hours at the graduate level (400/500 and above)

Internships are envisioned with local aeronautical industries, NASA, LPI, government, and others.

**Faculty members advising students and joining the PSM Oversight Committee are:**

Dr. David Alexander  Rice, Professor of Physics and Astronomy
Dr. Andrew Meade  Rice, Professor and Chair of Department of Mechanical Engineering and Material Science
Existing PSM Oversight Committee:

Dr. Daniel D. Carson, Dean of School of Natural Sciences, Professor of Biochemistry and Cell Biology
Dr. Janet Braam, Professor and Chair of Biochemistry and Cell Biology
Dr. Evan Siemann, Professor and Chair of Department of Ecology and Evolutionary Biology
Dr. Kathy Ensor, Professor and Chair of Department of Statistics
Dr. Dan Cohan and Dr. Qilin Li, CEVE Professors
Dr. Barry Dunning, Professor and Chair of Department of Physics & Astronomy
Dr. Doug Natelson, Professor, Physics and Astronomy
Dr. Dale Sawyer, Professor, Earth Science

Dagmar Beck: PSM Program Director
Emalie Thock: PSM Program Coordinator

PSM Board of Affiliates

Partnership and collaboration with industry is an integral part of Rice University’s Professional Science Master’s Degree Program. To facilitate this connection, an External Advisory Board was organized to advise and support the program. This Board of Affiliates consists of professionals in a wide variety of science-related industries, fields, and occupations. As this new track has a different industry base than the existing tracks, it was decided to create a second Board of Affiliates.

Purpose of the Board of Affiliates:

1. To consult and advise the Program on curriculum, structure, and recruitment;
2. To provide a link to industry to facilitate internships and career paths for students in the Program;
3. To provide a link to corporations, government labs, and other science-based organizations to facilitate general support for the Program;
4. To serve as a sounding board of economic and employment trends in industry and government affecting the Program and its students;
5. To assist the Program in the identification and solicitation of financial and other resources;
6. To serve as mentors to students in the Program by answering questions and communicating via email as needed;
7. To speak at the Master Seminar series.

Organization:

The Board of Affiliates of the Rice Professional Master’s Degree Program consists of individuals, in science- or engineering-based careers and organizations, corporations, and laboratories, who are committed to supporting this unique program. New Board members are to be nominated by the Program Director with mutual consent of the existing Board and
program’s Oversight Committee, and are appointed by the Dean of Natural Sciences. The Board meets once a year.

Outcome:

At the Board meeting, the corporate affiliates will be expected to meet with the Oversight Committee and students, to provide input about their industries, their workforce needs, the Rice program and coursework, and assist in identifying ways to improve it.

PSM Board of Affiliates for Space Studies track:

Eugena Bopp       Wyle Corp., Integrated Science and Engineering  
Jim Burch         V.P., Space Science and Engineering Division, Southwest Research Institute  
Gail Chapline     Technical Assistant to Director of Engineering.  
Mark Craig        SAIC, NASA Account Manager and Contracts Officer  
Franklin Chang Diaz  Ad Astra Rocket  
Jon Hall          JSC, Human Resources Training Lead and Chairman of the Engineering Academy Board  
Cleon Lacefield   LM Space Systems, Orion Crew Exploration Vehicle, Lockheed Martin  
Helen Lane        NASA, JSC Space and Life Sciences, Chief Scientist for Biological Sciences and Applications Space Life Sciences at NASA/Johnson Space Center.  
Laurence Price    Lockheed Martin, Manager  
Steve Deiker      Lockheed Martin  
Kamlesh Lulla,    NASA, Director for University Collaboration and Partnership Office  
Steve Mackwell    Director, Lunar and Planetary Institute  
Steward O’Dell    ERC Clear Lake  
John Scott        NASA, JSC - Chief, Energy Conversion Branch
## CURRICULUM DRAFT FOR PSM IN SPACE STUDIES (rev 3 16 12)

### 40 Credit Hours required:

<table>
<thead>
<tr>
<th>3 Cohort Courses:</th>
<th>Course Titles</th>
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<tr>
<td>NSCI 511</td>
<td>Required Science &amp; Technology Policy and Ethics (S)</td>
<td>Matthews, Beck</td>
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<tr>
<td>NSCI 610</td>
<td>Required Management for Scientists and Engineer (F)</td>
<td>Barron, Wilkinson</td>
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<tr>
<td>NSCI 501</td>
<td>Required Master Seminar incl. communication training</td>
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### 5 required technical courses

| NSCI = ASTR 470  | Required Space Science and Space Weather Overview Course/ Solar System Physics (F) | Alexander |
| NSCI 5XX         | Required Space Studies Seminar Course (S) | Various |
| MECH 572         | Required Aerospace Systems Engineering (S) | Muratore |
| STAT 410*        | Required Intro to Regression and Statistical Computing (F) | Merenyi |

Choose the fifth course from the list below

| ASTR 554         | Astrophysics of the Sun (S) | Bradshaw |
| ASTR 451         | Astrophysics I: Sun and Stars (F) | Johns-Krull |
| BIOC 415         | Experimental Physiology (S) | Caprette |
| BIOC 540         | Metabolic Engineering (F) | Gonzalez |
| ESCI 460         | Geological and Geophysical Fluid Dynamics (S) | Lenardic |
| ESCI 414         | Physics and Chemistry for the Atmosphere (F) | Lenardic |
| MECH 454         | Computational Fluid Mechanics (F) | Tezduyar |

### 2 Economics/Computation Courses:

| CEVE 528 | Engineering Economics (S) | Segner |
| MECH 454 | Computational Fluid Mechanics (F) | Tezduyar |
| PHYS 416 | Computational Physics (S) | Toffoletto |
| STAT 310 or 405 | Probability and Statistics / Statistical Computing and Graphics (F) | Wickham |

**NOTE: Depending on background, other courses can be chosen.**

| STAT 502/541/640 | Neural Networks and Information Theory, Multivariate Analysis, Data Mining and Statistical Learning – available with pre-requisites for specific focus areas |

### 4 Science/ Technical Elective Courses:

Choose 4 Electives according to student’s interest

### FOCUS: ENGINEERING

<p>| CEVE 504 | Atmospheric Particular Matter (S) | Griffin |
| CEVE 505 | Eng. Project Development &amp; Management (F) | Segner |
| CEVE 511 | Atmospheric Processes (F) | Cohan |</p>
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<td>CEVE 576</td>
<td>Structural Dynamics and Control (S)</td>
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<td>COMP/ELEC/MECH 498</td>
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<td>COMP 551</td>
<td>Advanced Mobile Robotics/Lab</td>
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<td>Convective Heat Transfer (F)</td>
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**FOCUS: SCIENCES**

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</tr>
</thead>
<tbody>
<tr>
<td>ASTR 542</td>
<td>Nebular Astrophysics (F)</td>
<td>Hartigan</td>
</tr>
<tr>
<td>ASTR 551</td>
<td>*Astrophysics I: Sun and Stars (F)</td>
<td>Johns-Krull</td>
</tr>
<tr>
<td>ASTR 552</td>
<td>Astrophysics II: Galaxy &amp;Cosmology (S)</td>
<td>Fossati</td>
</tr>
<tr>
<td>ASTR 554</td>
<td>Astrophysics of the Sun (S)</td>
<td>Bradshaw</td>
</tr>
<tr>
<td>ASTR 555</td>
<td>Protostars and Planets (S)</td>
<td>Johns-Krull</td>
</tr>
<tr>
<td>ASTR 565</td>
<td>Compact Objects (S)</td>
<td>Baring</td>
</tr>
<tr>
<td>ASTR 700</td>
<td>Independent Study Course (F,S)</td>
<td>Alexander</td>
</tr>
</tbody>
</table>

**NOTE:** *FOCUS AREAS IN EARTH SCIENCE, PHYSICS AND LIFE SCIENCES can be chosen - depending on student’s background.*

*Students will consult with academic advisor about appropriate selection of their elective science courses.*

**FOCUS: MANAGEMENT**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGMT 734</td>
<td>Technology Entrepreneurship (S)</td>
<td>Watkins</td>
</tr>
<tr>
<td>MGMT 629</td>
<td>Business Plan Development (F)</td>
<td>Crist</td>
</tr>
<tr>
<td>MGMT 601</td>
<td>Financial Statement Analysis (F)</td>
<td>Crawford</td>
</tr>
<tr>
<td>MGMT 618</td>
<td>Complexities of People and Organizations (F)</td>
<td>George</td>
</tr>
<tr>
<td>MGMT 658</td>
<td>Applied Risk Management (S)</td>
<td>Kapadia</td>
</tr>
<tr>
<td>MGMT 619</td>
<td>Corporate Governance (S)</td>
<td>Sanders</td>
</tr>
<tr>
<td>MGMT 719</td>
<td>Thinking Strategically (S)</td>
<td>Pazgal</td>
</tr>
<tr>
<td></td>
<td>and others …</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** *All required courses are typically available every year. However, students are requested to consult with their academic advisors about availability and additional course offerings before enrolling.*
### SPACE STUDIES SEMINAR TOPIC OUTLINE:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
</table>
| 1    | Why space?  
  Commercial:  
    - communications  
    - earth observation  
    - aids to terrestrial navigation  
    - speculative (e.g. mineral recovery, power generation)  
  Scientific:  
    - earth observation  
    - planetary observation  
    - human exploration |
| 2    | Mission planning and design  
  Defining objectives  
  Assessing opportunities (e.g. seasonal terrestrial events, planet and moon alignments, comet or asteroid approaches)  
  Event definition and sequencing |
| 3    | Astrodynamics/orbital mechanics  
  Trajectory constraints, energy management  
  Acceleration maneuvers  
  Timing |
| 4    | Spacecraft navigation  
  State vector definition  
  Range and velocity measurements  
  Trajectory estimation  
  Command timing |
| 5    | Payload definition  
  Functional definition  
  Mass and power budgeting  
  Dimensional requirements  
  Launch packaging constraints |
| 6    | Space environment  
  Pre-launch (test and storage)  
  Launch  
  On-orbit  
    - Thermal/vacuum  
    - Electromagnetic radiation  
    - Energetic particles (solar wind, cosmic rays)  
    - Meteroid  
    - Chemical (e.g. monoatomic oxygen) |
| 7    | Structures  
  Loads  
  Mechanical/thermal/electrical decoupling  
  Deployment and articulation |
<table>
<thead>
<tr>
<th></th>
<th>Spring Break</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Materials</td>
</tr>
<tr>
<td></td>
<td>Load-bearing</td>
</tr>
<tr>
<td></td>
<td>Thermal insulation/reflection/protection</td>
</tr>
<tr>
<td></td>
<td>Fluid transfer/sealing</td>
</tr>
<tr>
<td></td>
<td>Electrical shielding/bonding</td>
</tr>
<tr>
<td></td>
<td>Lubricating</td>
</tr>
<tr>
<td>10</td>
<td>Propulsion</td>
</tr>
<tr>
<td></td>
<td>Chemical</td>
</tr>
<tr>
<td></td>
<td>Ionic</td>
</tr>
<tr>
<td></td>
<td>Passive</td>
</tr>
<tr>
<td>11</td>
<td>Power (electrical)</td>
</tr>
<tr>
<td></td>
<td>Solar</td>
</tr>
<tr>
<td></td>
<td>Chemical (e.g. fuel cells)</td>
</tr>
<tr>
<td></td>
<td>Nuclear</td>
</tr>
<tr>
<td>12</td>
<td>Human factors</td>
</tr>
<tr>
<td></td>
<td>Physiological</td>
</tr>
<tr>
<td></td>
<td>• launch/reentry</td>
</tr>
<tr>
<td></td>
<td>• weightlessness</td>
</tr>
<tr>
<td></td>
<td>• radiation exposure</td>
</tr>
<tr>
<td></td>
<td>Psycho-social</td>
</tr>
<tr>
<td></td>
<td>Cognitive</td>
</tr>
<tr>
<td></td>
<td>Mobility and extravehicular activity</td>
</tr>
<tr>
<td>13</td>
<td>Risk management</td>
</tr>
<tr>
<td></td>
<td>• identification</td>
</tr>
<tr>
<td></td>
<td>• mitigation</td>
</tr>
<tr>
<td></td>
<td>• reliability</td>
</tr>
<tr>
<td></td>
<td>• test</td>
</tr>
<tr>
<td>14</td>
<td>Budget/finance, cost management</td>
</tr>
<tr>
<td>15</td>
<td>Export control regulations</td>
</tr>
<tr>
<td>16</td>
<td>Principal Investigator role and case studies</td>
</tr>
</tbody>
</table>

Note: Depending on students’ background more advanced courses are available to take instead of STAT 410, such as Multivariate Analysis; Data Mining and Statistical Learning; Applied Bayesian Methods. Students will choose appropriate courses with guidance by their advising faculty.

No new faculty needs to be hired to support this new track. Existing workload for faculty involved in teaching courses of this track should remain reasonable as numbers of enrollment in the new track will be capped to 5 – 8 students.

**Educational Pathway:** Demonstration on how the curriculum can be completed in 21 months:
Sample curriculum:

YEAR 1

**Fall Semester** (14.5 Credit Hours)
- NSCI 670  Space Science and Space Weather Overview Course (3)
- STAT 410  Data/Numerical Analysis (3)
- MECH 599  Human Factors in Space (3)
- MGMT 719  Thinking Strategically (1.5)
- NSCI 610  Management in Science and Engineering (3)
- NSCI 501  Professional Master's Seminar (1)

**Spring Semester** (12.5 Credit Hours)
- NSCI 5XX  Space Studies Seminar (1)
- MECH 572  Aerospace Systems Engineering (3)
- ASTR 554  Astrophysics of the Sun (3)
- MGMT 629  Business Plan Development (1.5)
- NSCI 501  Professional Master's Seminar (1)
- NSCI 511  Science Policy & Ethics (3)

**Summer**
- NSCI 510  Industrial or Academic Internship

**YEAR 2 / Fall Semester**
- NSCI 510  Industrial or Academic Internship (continued)

**Spring Semester** (13 Credit Hours)
- MECH 599 /Sec 2  Spacecraft Navigation (3)
- CEVE 504  Atmospheric Particular Matter (3)
- PHYS 416  Computational Physics (3)
- CEVE 528  Engineering Economics (3)
- NSCI 512  Internship Project (1)

**Total of 40 Credit Hours**

**Text for General Announcements:** see attached under Appendix VI

**Assessment and Oversight of the Program**

In addition to the periodic review process under SACS (Southern Associations of Colleges and Schools), under which all programs at Rice are assessed, the PSM (Professional Science Master’s) Program has several mechanisms implemented to review its performance related to educational goals, student satisfaction, internship outcome, communication and business skills improvements:
Overview by Faculty: Oversight Committee meetings are scheduled twice a year to discuss educational outcome of courses, student issues and performance, curriculum and course issues.

Faculty Advising: Students are encouraged to meet with advisor faculty on a regular basis

Internship Overview: Internship projects are approved by faculty members and, when combined with performance evaluations of students during their internships, provide an assessment of the quality and effectiveness of this program element. Evaluation of internship projects occurs by a mixed internal and external panel consisting of science and communication faculty providing assessment of value of the student's experiences and accomplishments during their coursework and their internship. This panel grades and evaluates the internship reports and presentations.

Communication Assessment: Communication skills are assessed at the beginning of the study course of each student via an assessment workshop. Results from the workshop are evaluated on an individual basis resulting in individualized recommendations by faculty. Students are monitored and mentored during their studies to ensure improvements of their communication skills.

Annual Review: An Annual Review of the program and its outcomes is performed by the Board of Affiliates

Student Feedback: Interim and final student surveys are used to evaluate the quality of the program and its faculty.

Curriculum Map: see attached under Appendix III

Program Management and Administrative Procedures

The Program Director in collaboration with all other parties involved in the Rice PSM Program has successfully managed the existing program tracks over the last 8 years. We anticipate no problems in the management of the new track or in accommodating an overall increase in student numbers. The program has established strong interdisciplinary cooperation between the departments and set a model of management starting with recruitment, admission and enrollment, to student interactions and advising. We have excellent interactions with corporations and receive assistance with placement for internships and job positions. The involved personnel meet throughout each semester to review the ongoing process, and makes necessary adjustments or changes when needed to ensure that students are successful and reach their goals.

Organization: The PSM Program is based in the School of Natural Sciences. The Dean of Natural Sciences, Dr. Daniel D. Carson, supervises program related activities. The Program Director, Dagmar Beck, and her assistant, Emalie Thok, collaborate with the Oversight Committee Faculty and the Board of Affiliates to run this program. The Rice Center of Career Development assists when needed.

The duties of the Program Director include:
  • Manage the budget
  • Coordinate all activities with relevant departments
• Oversee student recruitment and selection for the Program
• Monitor the students during course work and internships to ensure a successful completion
• Foster and nurture connections between all involved academic officials
• Maintain and expand existing ties with industries contacts
• Coordinate with the PI and Faculty Coordinators on a regular basis
• Act as mentor and counsel to all PSM students

Enrollment for the new track is envisioned at 3 - 6 students in the first years of program availability. As described above, the Program Director will oversee the admission process, arrange for faculty advisors, monitor student progress and communicate with students and faculty throughout the two years of students’ presence at Rice. Additional monitoring and assessing has been described above.

**Oversight Committee:** Faculty involved in the PSM Program teaching PSM related courses, are familiar with the program, and have a good rapport with the students serving as advisors to the PSM students. The committee consists of two professors from Civil and Environmental Engineering department, one from the Statistics department, and one from the Ecology department; two from the Physics and Astronomy department, two from Earth Science and one from Biochemistry and Cell Biology (see faculty listing on page 9/10). We will expand the existing Oversight Committee by faculty members from the department of Physics and Astronomy and the department of Mechanical Engineering and Materials Science.

**Second PSM Board of Affiliates:** For this track we will assemble a separate Board of Affiliates consisting of 12 - 14 representatives from space industry, government and other space organizations. They will act as an advisory board and meet annually to review the progress of the PSM program. Board members also assist with mentoring of the students, providing feedback on industry trends, and giving advice on other key issues.

**Resources:** Financial resources are in place to establish this track. No extensive library and information resources will be required for this track. No new physical facilities or classrooms are required to support this program. There is no need to hire extra staff. The impact of the new track on the existing tracks will be positive as new students will cohort with existing students creating a larger and more integrated PSM student body on campus.

The PSM program has not only financially supported faculty directly involved in the tracks, but has also supported lecturers of required courses, and has distributed monies to the departments directly involved with the tracks. We are committed to continue this support in the future.

**PSM Program Budget** see under Appendix IV

**Institutional Commitment:** The existing program is well established within the Wiess School of Natural Sciences and has fostered close cooperation between various schools and departments on campus. The program has established an ongoing working relationship with
the various departments and faculty involved in providing the courses for the tracks, but also is supported by the Career Development Center. As mentioned earlier, the program has also financially remunerated faculty and departments involved in each track. The program is recognized within the highest levels of the university offering continued support of its efforts. Furthermore, the program has established ongoing relationships with local industry representatives and municipal organizations seeking involvement with the university.

The new track enjoys not only the fullest support and commitment from the related industry and governmental organizations but also has the full support of the faculty involved in teaching courses related to the new space science study area. Support letters from academia, corporations and government organizations are attached (see under Appendix VII.)

Similar programs in the U.S.: see under Appendix V

A few slightly similar programs exist at other schools, and the focus of these programs, as can be seen in the appendix, is more narrow and different from our proposed Space Studies track.

For example, the program at UH is fundamentally dissimilar, it is a traditional M.S. program and focuses on human physiology in space.

The program at University of Dakota shows some similarities but is also a traditional M.S. program; the programs at USC, MIT and other schools are highly focused on engineering.

Professional prospects and work applications for graduates of the program:

When developing this new program track, government and space related agencies, and corporations involved with NASA and space science were contacted to get feedback on industry interest in a program such as the new space track.

The space track targets employees within aerospace industries, such as NASA, and related organizations, who intend to broaden their knowledge and skill base. Employees in space-related industry, government agencies, and possibly foreign markets who seek career advancement within the space related industries, and science students interested in working in related positions in non-profit space-related organizations (e.g. the Lunar and Planetary Institute), government organizations, and academic institutions.

Career Opportunities for Graduates:

Space Studies graduates will have careers in a variety of different areas in space related occupations, including: government, i.e. NASA as space technicians, payload specialists, etc; space related industry sectors, the burgeoning commercial space sector, national laboratories, science/research organizations, law firms, medical centers, education sector, military, and public relations.
Positive feedback was received from the advisory group and support to offer internships has been expressed by:

Southwest Research Institute; NASA JSC; Ad Astra Rocket; NASA/Space Life Sciences, Lockheed Martin Space Systems; Lunar and Planetary Institute; Wyle Houston; Boeing; and others

**Financial Resources and Launch of new Track:**

We presently have enough funds from overall PSM revenues to carry out this new track. Depending on the approval by the Faculty Senate, we aim at establishing this program track in time for Fall 2012 allowing us to recruit and attract top students and compete with other programs in the field (see below). A marketing plan/ad campaign schedule is in place for the existing tracks and this will be modified to include the new track once it is approved. Brochures and a special marketing plan will be developed to get the word out to potential prospects for this track on a short notice. Announcement will be made nationwide through our membership with the National Professional Science Master’s Association and Council of Graduate Schools.

**Distribution of Funds**

Funds resulting from income from this particular track will be disbursed to the involved departments, i.e., offering core courses, on a student participation model. Faculty joining the Oversight Committee and acting as advisors to the new students will receive funds on an annual basis to support their efforts and offer an incentive for their participation.

**Conclusion**

As Rice enters its second century, it has developed a vision that includes an expansion in size to realize more fully its ambition to be an institution of national and international distinction that attracts the very best students and researchers from around the globe. The PSM Program’s goals are aligned well with Rice’s overall goals of engaging better with the City of Houston; creating partnerships with local industry and organizations; strengthening graduate programs; fostering collaborative relationships with other institutions; increasing investment in interdisciplinary endeavors; and investing in professional programs. The PMS program is integral to these goals and has already greatly contributed towards achieving them.

This is particularly relevant to the PSM in Space Studies. Recent changes in the Space Policy of the United States have significantly affected the space enterprise in the Greater Houston Area. With an increased emphasis on the commercialization of space exploration there is a greater need for the broad education and expertise afforded by the Rice PSM program. Over the course of the next few years the NASA Johnson Space Center and the associated aerospace industries will be changing the way they do business with a larger focus on translating space technologies to other sectors (e.g. energy, medicine) and a stronger emphasis on research and development, working more closely with universities,
strengthening their entrepreneurial activities, and partnering more broadly. The Space Studies track provides a strong foundation in these activities.

List of all Attachments:
Appendix I: Application/Enrollment Statistics
Appendix II: Graduation/Job Placement History
Appendix III: Curriculum Map
Appendix IV: PSM Program Budget 2012
Appendix V: Examples of similar space programs
Appendix VI: Text for General Announcements
Appendix VII: Support letters
RICE FACULTY SENATE

PROPOSAL FOR NEW PSM TRACK
IN SPACE STUDIES

APPENDIX I

Enrollment Statistics for the four existing PSM tracks
APPENDIX I:

Enrollment Statistics for the four existing PSM tracks:

Table I: Application Statistics for Existing Tracks for F02 – F11

<table>
<thead>
<tr>
<th>Application Year</th>
<th>Inquiries</th>
<th>Applications</th>
<th>Total Admissions</th>
<th>Total Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>F02</td>
<td>n/a</td>
<td>20</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>F03</td>
<td>287</td>
<td>33</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>F04</td>
<td>191</td>
<td>31</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>F05</td>
<td>171</td>
<td>31</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>F06</td>
<td>109</td>
<td>36</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>F07</td>
<td>108</td>
<td>50</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td>F08</td>
<td>106</td>
<td>53</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>F09</td>
<td>164</td>
<td>48</td>
<td>31</td>
<td>17</td>
</tr>
<tr>
<td>F10</td>
<td>157</td>
<td>48</td>
<td>30</td>
<td>18</td>
</tr>
<tr>
<td>F11</td>
<td>204</td>
<td>60</td>
<td>39</td>
<td>18</td>
</tr>
</tbody>
</table>

Note: Table reflects the total number of students actually enrolled in all three tracks per year specified (under column: Total Acceptance).

Minority Enrollment:

Our program has been successful to attract female students to these degree programs in STEM related fields. 45% of our graduates over the last 8 years have been female.

The incoming class of 22 students for Fall 2010/Spring 2011 included 9 female students. The incoming F12 class of 18 students includes 11 female students.
RICE FACULTY SENATE

PROPOSAL FOR NEW PSM TRACK
IN
SPACE STUDIES

APPENDIX II

PSM Program Tracks’ Internship and Employment History
**APPENDIX II**

**INTERNSHIP PLACEMENT AND EMPLOYMENT HISTORY**

**RICE PSM PROGRAM**  
**Fall 02 - Fall 11 Enrollment Period**

**SUBSURFACE GEOSCIENCE TRACK**

<table>
<thead>
<tr>
<th>LAST NAME</th>
<th>FIRST NAME</th>
<th>GENDER</th>
<th>COUNTRY</th>
<th>Graduation Year</th>
<th>Internship</th>
<th>Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nebo</td>
<td>Nd</td>
<td>M</td>
<td>Nigerian</td>
<td>2005</td>
<td>SG</td>
<td>Total</td>
</tr>
<tr>
<td>Yi</td>
<td>Ye</td>
<td>F</td>
<td>China</td>
<td>2006</td>
<td>SG</td>
<td>ExxonMobil</td>
</tr>
<tr>
<td>Centanni</td>
<td>Sylvia</td>
<td>F</td>
<td>US</td>
<td>2006</td>
<td>SG</td>
<td>Schlumberger</td>
</tr>
<tr>
<td>Valerio</td>
<td>Adriana</td>
<td>F</td>
<td>Venezuela</td>
<td>2007</td>
<td>SG</td>
<td>Marathon Oil</td>
</tr>
<tr>
<td>Reed</td>
<td>Danny</td>
<td>M</td>
<td>US</td>
<td>2007</td>
<td>SG</td>
<td>Halliburton/Hilcorp/Baker Hughes, Shell</td>
</tr>
<tr>
<td>Claxton</td>
<td>Glennis</td>
<td>F</td>
<td>Trinidad</td>
<td>2007</td>
<td>SG</td>
<td>Conoco Phillips</td>
</tr>
<tr>
<td>McAlallen</td>
<td>Shwana</td>
<td>F</td>
<td>USA</td>
<td>2007</td>
<td>SG</td>
<td>Anadarko StatOil</td>
</tr>
<tr>
<td>Mardambek</td>
<td>Jeremy</td>
<td>M</td>
<td>USA</td>
<td>2008</td>
<td>SG</td>
<td>ConocoPhillips</td>
</tr>
<tr>
<td>Bunge</td>
<td>George</td>
<td>M</td>
<td>USA</td>
<td>2010</td>
<td>SG</td>
<td>Schlumberger</td>
</tr>
<tr>
<td>Cornejo</td>
<td>Gisselle</td>
<td>F</td>
<td>Venezuela</td>
<td>2009</td>
<td>SG</td>
<td>Nobel Energy, moved to CA</td>
</tr>
<tr>
<td>Mills</td>
<td>Joe</td>
<td>M</td>
<td>USA</td>
<td>2009</td>
<td>SG</td>
<td>Schlumberger</td>
</tr>
<tr>
<td>Shipman</td>
<td>Gregory</td>
<td>M</td>
<td>USA</td>
<td>2011</td>
<td>SG</td>
<td>ExxonMobil</td>
</tr>
<tr>
<td>Hong</td>
<td>Ting</td>
<td>F</td>
<td>China</td>
<td>2010</td>
<td>SG</td>
<td>Teledrill, Inc</td>
</tr>
<tr>
<td>Cornette</td>
<td>Brian</td>
<td>M</td>
<td>USA</td>
<td>2009</td>
<td>SG</td>
<td>Maritech Microseismic</td>
</tr>
<tr>
<td>Ge</td>
<td>Liang</td>
<td>M</td>
<td>China</td>
<td>2010</td>
<td>SG</td>
<td>Baker Hughes/Schlumberger</td>
</tr>
<tr>
<td>Ko</td>
<td>Kyungnam</td>
<td>M</td>
<td>Korea</td>
<td>2010</td>
<td>SG</td>
<td>Korea Gas/Korea Gas</td>
</tr>
<tr>
<td>Ochterbeck</td>
<td>Chris</td>
<td>M</td>
<td>USA</td>
<td>2010</td>
<td>SG</td>
<td>Chevron Landmark Halliburton</td>
</tr>
<tr>
<td>Jarvis</td>
<td>Ryan</td>
<td>M</td>
<td>USA</td>
<td>2011</td>
<td>SG</td>
<td>ExxonMobil</td>
</tr>
<tr>
<td>Mathukutty</td>
<td>Shibu</td>
<td>M</td>
<td>USA</td>
<td>2011</td>
<td>SG</td>
<td>Halliburton/Landmark Halliburton</td>
</tr>
<tr>
<td>Park</td>
<td>Hyungseon</td>
<td>F</td>
<td>Korea</td>
<td>2011</td>
<td>SG</td>
<td>Korea Gas</td>
</tr>
<tr>
<td>Huang</td>
<td>Mengqui</td>
<td>M</td>
<td>China</td>
<td>2011</td>
<td>SG</td>
<td>Schlumberger ION Geophysical</td>
</tr>
<tr>
<td>Stolldorf</td>
<td>Travis</td>
<td>M</td>
<td>USA</td>
<td>2010</td>
<td>SG</td>
<td>moved to PhD Rice PhD</td>
</tr>
<tr>
<td>Talley</td>
<td>Julian</td>
<td>M</td>
<td>USA</td>
<td>2010</td>
<td>SG</td>
<td>Chevron</td>
</tr>
<tr>
<td>Zhang</td>
<td>Grace</td>
<td>F</td>
<td>China</td>
<td></td>
<td>SG</td>
<td>on leave S/F10, not graduated yet</td>
</tr>
<tr>
<td>Zhang</td>
<td>Max</td>
<td>M</td>
<td>China</td>
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RICE FACULTY SENATE

PROPOSAL FOR NEW PSM TRACK
IN
SPACE STUDIES

APPENDIX III

Curriculum Mapping
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<tr>
<th>Unit Name: Professional Master's Program in Natural Sciences</th>
<th>Institute Mission Statement</th>
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<tr>
<td>Contact Name: Dagmar Beck</td>
<td>The mission of Rice University, shaped largely by its founder and the first president, is to provide an unsurpassed undergraduate education in science, engineering, the arts, humanities, and social sciences: to produce internationally distinguished scholarship and research and excellent graduate education in carefully focused areas; to ensure that such an education remains affordable; to maintain the distinctive character of a community of learning that is relatively small in scale; and to serve the continuing educational needs of the larger community.</td>
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<tr>
<td>Contact Email Address: <a href="mailto:dlbeck@rice.edu">dlbeck@rice.edu</a></td>
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<tr>
<td>Unit Mission Statement</td>
<td>Institute Mission Statement</td>
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<td>The goal of the Professional Master's Program at Rice University is the integration of an interdisciplinary course of study with shared practical experiences, and the enhancement of student's science background with key skills in management, communications, policy, and ethics.</td>
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<td>General goals:</td>
<td>The purpose of this new track is on training students in Space Engineering and Science with the intent of creating new options for engineering and science students interested in working in the space technology industry or related government entities, e.g. NASA, as well as governmental relations positions in non-profit organizations, industry and academic institutions.</td>
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<tr>
<th>Educational Outcome by Graduation</th>
<th>Methods to achieve goal</th>
<th>Assessment Methods and Criteria</th>
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<tr>
<td>To equip students with advanced scientific, engineering and program management skills</td>
<td>Curriculum requires completion of 6 engineering and science classes</td>
<td>Oversight Committee meetings serve to discuss educational outcome of courses, student issues and performance, curriculum and course issues</td>
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<table>
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<th>Educational Outcome by Graduation</th>
<th>Methods to achieve goal</th>
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<td>To achieve professional competency in engineering and science implementation and application. To achieve a broad systems level understanding of the tools and methodologies needed in the space industry</td>
<td>In addition to above, students will select five elective courses from science, engineering and/or management</td>
<td>Faculty/student meetings will ensure guidance of student within his/her interest area</td>
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<tr>
<td>To teach quantitative skills and data analysis</td>
<td>Students are required to take a course in data analysis offered by the Statistics department</td>
<td>Course faculty will assess performance of students by grading and feedback to Program Director.</td>
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To gain exposure in a real life experience in solving technical problems in an R&D environment

Participating in a required internship

Internship needs faculty approval through the Internship Definition Document.

Internship offers practical application of methods learned. Performance of student is being evaluated on a regular basis by internship provider. Forms and time schedules are being provided. Internship providers and interns submit an Interim and Final Evaluation report to Program Director giving feedback on progress of internship. Frequent communication between program and organization/Supervisor are maintained during the internship. Evaluation of Internship project presentation by a mixed internal and external panel provides assessment of value of the student's experiences and accomplishments during the internship. Assessment methods consist of a) Internship report, b) interim and c) final internship provider (company) evaluation, and d) interim and e) final student evaluations reviewed by faculty.

<table>
<thead>
<tr>
<th>Educational Outcome by Graduation</th>
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<tbody>
<tr>
<td>To equip students with the enabling leadership, communication, and research skills to solve real world problems in space, and related technology</td>
<td>The program has two communication faculty assessing communication skills when students enter Rice's program. They provide feedback to each student and to the group as a whole via weekly seminars. Students receive individual guidance by communication faculty to improve writing and presenting skills.</td>
<td>Presentation is given to a mixed audience of business representatives, faculty members and students, and graded by all faculty present. PSM Communication Faculty offers practice and coaching sessions to improve presentation and communication skills. Master Seminar offers exposure to communication topics. Short writing tasks are required.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Educational Outcome by Graduation</th>
<th>Methods to achieve goal</th>
<th>Assessment Methods and Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build business and management skills to be effective within an environment of a business or organization</td>
<td>Coursework will provide them with research and study skills enabling them to develop specific policy recommendations. Students are also required to participate in a Science Policy and Ethics course.</td>
<td>Two internship reports are required, one written for a business audience and one written for a technical audience. Reports are evaluated by faculty advisor and PSM Communication faculty.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Educational Outcome by Graduation</th>
<th>Methods to achieve goal</th>
<th>Assessment Methods and Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>To train students how to integrate their engineering and science knowledge with their understanding of policy and management decisions to enhance their work experience</td>
<td>Students attend the cohort course Management for Scientist and Engineers. This course is for science and engineering graduate students who want to understand the basics of management in new and/or small technology based businesses. The concepts covered will provide an overview of management particularly relevant to students who are interested in careers in technology or entrepreneurial ventures.</td>
<td>Students are exposed to teamwork projects, give presentations, undertake case studies, participate in case discussions and experiential exercises and receive regular peer review.</td>
</tr>
<tr>
<td>Educational Outcome by Graduation</td>
<td>Methods to achieve goal</td>
<td>Assessment Methods and Criteria</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------</td>
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</tr>
<tr>
<td>...con’d ....</td>
<td>NSCI 610/ENGI 610 is team taught to provide insight into how technology oriented firms manage people, projects, accounting, marketing, strategy, intellectual property, organizations and entrepreneurship.</td>
<td>A variety of methods will be used to explain the concepts and practices of management including; readings, case discussions, exercises, guest speakers, two written assignments and a leadership movie.</td>
</tr>
<tr>
<td>Achieve professional standards and ethics</td>
<td>Students attend a Science and Technology Policy and Ethics course taught by a fellow of the Baker Institute. This course will explore processes how policy is conceived, influenced and established. Explore how government policies and regulations impact science, research and development, and business.</td>
<td>Internship providers will offer written feedback on student's performance and business and ethical acumen during and after internship. Student will submit an internship report at the end of the internship covering internship project, research, policy and business related experiences during the internship.</td>
</tr>
</tbody>
</table>
RICE FACULTY SENATE

PROPOSAL FOR NEW PSM TRACK IN SPACE STUDIES

APPENDIX IV

PSM Program Budget
PSM SPACE STUDIES TRACK BUDGET

<table>
<thead>
<tr>
<th></th>
<th>1st Yr</th>
<th>2nd Yr</th>
<th>3rd Yr</th>
<th>4th Yr</th>
<th>5th Yr</th>
<th>5-YR. TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPENSES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty Advisors</td>
<td>10,000</td>
<td>10,000</td>
<td>10,000</td>
<td>10,000</td>
<td>10,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Course Development</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Marketing/Track Specific</td>
<td>3,000</td>
<td>4,000</td>
<td>4,000</td>
<td>5,000</td>
<td>5,000</td>
<td>21,000</td>
</tr>
<tr>
<td>Communications Salary/Fringe</td>
<td>7,596</td>
<td>7,596</td>
<td>7,596</td>
<td>7,596</td>
<td>7,596</td>
<td>37,980</td>
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<tr>
<td>Internship Stipend</td>
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<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>6,000</td>
<td>30,000</td>
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<tr>
<td>Total Expenses</td>
<td>32,596</td>
<td>33,596</td>
<td>33,596</td>
<td>34,596</td>
<td>34,596</td>
<td>168,980</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REVENUES</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected New Students by year</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Total Projected Revenues</td>
<td>81,000</td>
<td>122,400</td>
<td>149,400</td>
<td>163,200</td>
<td>163,200</td>
<td>679,200</td>
</tr>
<tr>
<td>Net Track Revenues for PSM Operating Budget</td>
<td>48,404</td>
<td>88,804</td>
<td>115,804</td>
<td>128,604</td>
<td>128,604</td>
<td>510,220</td>
</tr>
</tbody>
</table>

Tuition @ $13,500/semester x 3 semesters / Internship @ $300 x 1 semester

PSM program operating expenses for the tracks are included in the existing PSM operating budget (e.g., administration, office supplies, marketing, promotion, travel, printing, etc.)

After operating costs and commitments are met each fiscal year, net revenues are distributed to the participating departments based on student enrollment by track.

The projected number of students only reflects our most conservative projections based a minimum return to self-sustain the track. We do anticipate a greater number of students, especially after the first three years. Growth of student numbers is only limited by the cap the core departments will set. The cap is anticipated to be between 5 – 8 students. We do expect student numbers to be similar to the existing tracks.
RICE FACULTY SENATE

PROPOSAL FOR NEW PSM TRACK
IN
SPACE STUDIES

APPENDIX V

Similar Programs at other Universities
APPENDIX V: EXAMPLES OF SIMILAR PROGRAMS IN THE US

University of Houston: Master of Science in Human Space Exploration Sciences

The graduate program in Human Space Exploration Sciences focuses on developing individuals with the necessary skills and understanding to allow them to enter the space exploration workforce with ease. This will be achieved by providing both academic and practical training to our students that will not only provide a solid foundation in the academy but also sensitize them to the unique challenges faced when working in the human space flight environment.

The degree plan is designed to provide a course of study at the graduate level which provides a broad human physiology background with a strong specialization in those areas focusing on human physiological adaptation to space flight and the area known in the space industry as “man-in-the-loop”, a central concept/component of the manned space flight program.

Graduates will not only receive training in normal/space physiology, but will also complete an integrated academic program that blends bioengineering, space architecture/habitat development and advanced technologies as they apply to the unique challenges of extended human habitation and exploration of space.

Degree Plan

A schematic representation of the M.S. in Human Space Exploration Sciences degree plan is given below.

![Degree Plan Diagram]
Brief overview of some of the advances courses in this program is given below:

**PEP 7397 Advanced Topics – Physiological Adaptation to Space Flight - 1 (3hr)**

- Gravity as a modulator of physiological adaptation in the systems covered below
- Fluid Physics, thermodynamics, cellular level responses, systems level responses
- The microgravity environment and disruption of mechano-signaling
- Specific adaptations of physiological systems to microgravity (short and long-term adaptations)
  - Muscle
  - Bone
  - Neuronal system
- Implications for exploration class missions
- Recent Concepts/Challenges

**PEP 7397 Advanced Topics – Physiological Adaptation to Space Flight - 2 (3hr)**

- Gravity as a modulator of physiological adaptation in the systems covered below
- Fluid Physics, thermodynamics, cellular level responses, systems level responses
- Specific adaptations of physiological systems to microgravity (short and long-term adaptations)
  - Immune function
  - Nutritional Support
  - Pharmacology
  - Radiation
- Implications for exploration class missions
- Recent Concepts/Challenges

**PEP 7397 Advanced Topics – The Space Flight Habitat (3hr)**

- Microgravity as a driving force in design
- Space craft design as it relates to human interactions
- Habitat design (space craft, Lunar and Martian)/Space Architecture
- Equipment design as it relates to human use in microgravity
- Extended mission habitat design and challenges
- Psychosocial issues and the space flight habitat
- Ground based analogues, countermeasures

Thesis hours will take the form of a capstone research experience conducted in conjunction with the HHP faculty advisor and/or NASA-Johnson Space Center content expert. This capstone experience can take the form of a traditional thesis research project relevant to human physiology in the space environment, basic or applied technology development enabling extended human habitation of space presented in a thesis format or a program management project in the space exploration field modeled on the thesis experience employed in the Department of Information and Logistics Technology.
University of Dakota M.S. in Space Studies

Courses for Master of Science Program:

Survey, Independent Studies, Colloquium, Capstone and Thesis Courses

- 501 - Survey of Space Studies I
- 502 - Survey of Space Studies II
- 590 - Space Studies Colloquium
- 593 - Individual Research in Space Studies
- 595 - Space Studies Capstone
- 996 - Continuing Enrollment
- 997 - Independent Study
- 998 - Spst Thesis

Social Area (Policy, Management, Business) Courses

- 450 - International Space Programs
- 540 - Space Economics and Commerce
- 541 - Management of Space Enterprises
- 545 - Space and the Environment
- 551 - History of the Space Age
- 552 - History of Astronomy and Cosmology
- 555 - Military Space Programs
- 560 - Space Politics and Policy
- 561 - Public Administration of Space Technology
- 565 - Space Law
- 570 - Advanced Topics in Space Studies
- 574 - Remote Sensing in Developing Countries
- 575 - Remote Sensing Law and Policy
- 581 - Field Visits to Space Centers

Technical Area (Science, Engineering) Courses

- 405 - Space Mission Design
- 410 - Life Support Systems
- 425 - Observational Astronomy
- 430 - Earth System Science
- 435 - Global Change
- 460 - Life in the Universe
- 500 - Introduction to Orbital Mechanics
- 505 - Spacecraft Systems Engineering
- 506 - Advanced Orbital Mechanics
• 512 - Human Performance in Extreme Environments
• 515 - Human Factors in Space
• 519 - Closed Ecological Systems for Life Support
• 520 - Asteroids, Meteorites & Comets
• 521 - The Planet Mars
• 522 - Remote Sensing Principles
• 523 - Remote Sensing Applications
• 524 - Current Topics in Astrobiology
• 525 - Technical Issues in Space
• 526 - Advanced Observational Astronomy
• 527 - Extraterrestrial Resources
• 528 - Space Environment and the Sun
• 529 - Introduction to Radio Astronomy
• 570 - Advanced Topics in Space Studies

Other Programs are mostly focused on Engineering, such as:

**American Military University in Charlestown, West Virginia**

The Master of Science in Space Studies program is devoted to the interdisciplinary study of space, including the historical, political, economic, legal, commercial, scientific and technical issues that make up this complex field of study. Through challenging course work and in-depth research projects, students will gain the multidisciplinary knowledge and tools required to become the well rounded scholars demanded by humankind’s use and exploration of space.

**M.S. in Astronautical Engineering at USC Viterbi**

The Master of Science in Astronautical Engineering is designed for those with B.S. degrees in science and engineering who desire to work in the space sector of the aerospace industry, government research and development centers, and laboratories. In some cases the applicant may be required to take 1 or 2 deficiency courses (upper-division undergraduate courses). The decision to require deficiency courses is made by the Astronautics program coordinators.

Most classes for the M.S. are available through the [USC Distance Education Network (DEN)](DEN).

**M.S. in Aeronautics and Astronautics at MIT**

Degree is focused on aerospace vehicle engineering, engineering of large-scale, complex aerospace systems, and aerospace information engineering.
RICE FACULTY SENATE

PROPOSAL FOR NEW PSM TRACK
IN
SPACE STUDIES

APPENDIX VI

Draft Text for Rice General Announcements
Appendix VI: General Announcements

Proposed text for requirements to appear in the General Announcements (this is similar to but slightly different from the narrative of the requirements offered above):

Professional Master’s Degree in Space Studies
The Wiess School of Natural Science

Degrees offered: MS
Rice University is offering this new degree for the first time in 2012. This degree is one of five tracks in the professional master’s program at Rice housed in the Wiess School of Natural Sciences and focuses on training students in Space Engineering and Science with the intent of creating new options for engineering and science students interested in working in the space technology industry or related government entities, e.g. NASA, as well as governmental relations positions in non-profit organizations, industry and academic institutions.

The Space Studies track is geared to help individuals increase their knowledge of space engineering, related science, program management, and policy. The program includes advanced engineering, biological and physical science classes and introduces students to economics, public policy, and management disciplines, which impact space commercialization and national policy. Our program focuses on training engineers interested in program management, providing them with the tools to face the complex challenges inherent in US space policy, human and robotic space exploration, and science in space exploration and technology development.

These master’s degrees are designed for students seeking to gain further technical core expertise coupled with enhanced management and communication skills. These degrees instill a level of scholastic proficiency that exceeds that of the bachelor’s level, and they create the cross-functional aptitudes needed in modern industry and government.

The program will be carried out as a collaboration between the Wiess School of Natural Sciences and the George R. Brown School of Engineering. Students in this track will participate in deepening their scientific and engineering knowledge via coursework and learn how to implement this knowledge at a systems level in a laboratory and/or commercial setting. They will also pursue topical research in an area pertinent to their interests and primary focus with the goal to addressing real world problems in a research and development environment.

Degree Requirements for MS in Space Studies
In addition to the core science courses, students are required to complete a 3-to-6-month internship and take a set of cohort courses focusing on business and communications. At the conclusion of their internship, students must present a summary of their internship project in both oral and written form as part of the professional master’s seminar.
Part-time students who already work in their area of study may fulfill the internship requirements by working on an approved project with their current employer. For general university requirements for graduate study, see page x, and also see Professional Degrees.

**Admission**
Admission to graduate study in Space Studies is open to qualified students holding a bachelor’s degree in a related science or engineering program that included course work in general physics, chemistry, calculus, linear algebra, and differential equations. Scores from the general Graduate Record Examination (GRE), good critical thinking and communication skills and strong quantitative abilities. Statistics, introductory economics and computer skills preferred. Department faculty evaluate the previous academic record and credentials of each applicant individually and make admission decisions.

**Three Cohort Courses:**

- NSCI 511 Science Policy and Ethics (S)
- NSCI 610 Management for Science and Engineering (F,S)
- NSCI 501 Master Seminar (F,S)

**Five Science courses:**

- NSCI = ASTR 470 Space Science and Space Weather Overview
- STAT 410 Intro to Regression and Statistical Computing (F)
- NSCI 5XX Space Studies Seminar Course (S)
- MECH 572 Aerospace Systems Engineering (S)

*With fifth course to be chosen from the list below:*

- ASTR 554 Astrophysics of the Sun (S)
- ASTR 451 Astrophysics I: Sun and Starrs (F)
- BIOC 415 Experimental Physiology (S)
- BIO 540 Metabolic Engineering (F)
- ESCI 414 Physics and Chemistry for the Atmosphere (F)
- ESCI 460 Geological and Geophysical Fluid Dynamics (F)
- MECH 454 Computational Fluid Mechanics (F)

**Two Statistics/Computation Courses:** The analytical competency requirement provides career-enhancing, marketable skills in in finance, economics and computation. Students can choose courses as follows:

*Choose two courses from:*

- CAAM 453 Numerical Analysis I (F)
- CEVE 528 Engineering Economics (S)
- ESCI 450 Remote Sensing *(not available every year)*
MECH 454  Computational Fluid Mechanics (F)
PHYS 416  Computational Physics (S)
STAT 310  Probability and Statistics (F)
STAT 405  Statistical Computing and Graphics (F)
STAT 502/541/640  Neural Networks and Information Theory, Multivariate Analysis, Data Mining and Statistical Learning –
available with pre-requisites for specific focus areas

4-5 Electives according to student’s interest: These course electives reflect individual academic interests and career goals.

Focus: Engineering

CEVE 504  Atmospheric Particular Matter (S)
CEVE 505  Eng. Project Development & Management (F)
CEVE 511  Atmospheric Processes (F)
CEVE 576  Structural Dynamics and Control (S)
COMP/ELEC/MECH 498  Intro to Robotics (S)
COMP 551  Advanced Mobile Robotics/Lab
MECH 474  Advanced Computational Mechanics (S)
MECH 583  Convective Heat Transfer (F)
MECH 591  Gas Dynamics (S)
MECH 599  Human Factors in Space (S)
MECH 599/Sect 2  Spacecraft Navigation (S)
MECH 691  Hypersonic Aerodynamics (F)

and others …

Focus: Sciences (Astro Science/Earth Science/Life Sciences)

ASTR 542  Nebular Astrophysics
ASTR 551  Astrophysics I: Sun and Stars (F)
ASTR 552  Astrophysics II Galaxy and Cosmology (S)
ASTR 554  Astrophysics of the Sun (S)
ASTR 555  Protostars and Planets (S)
ASTR 565  Compact Objects (S)
ASTR 700  Independent Study Course

NOTE: FOCUS AREAS IN EARTH SCIENCE, PHYSICS AND LIFE SCIENCES can be chosen - depending on student’s background. Students will consult with academic advisor about appropriate selection of their elective science courses.
Focus: Management

MGMT 734  Technology Entrepreneurship
MGMT 629  Business Plan Development (F)
MGMT 601  Financial Statement Analysis (F)
MGMT 618  Complexities of People and Organizations (F)
MGMT 658  Applied Risk Management (S)
MGMT 619  Corporate Governance (S)
MGMT 719  Thinking Strategically (S)
and others …

NOTE: This listing doesn’t reflect all courses available every year. Also note, not all courses are offered every year. Students are requested to consult with their academic advisors before enrolling.

A 3 – 6 months internship: Practical experience is offered via a 3 – 6 month work immersion. The internship will be under the guidance of a host company, government agency, or non-profit organization. A summary of the internship project is required in both oral and written form as part of the Professional Master’s Seminar.
RICE FACULTY SENATE

PROPOSAL FOR NEW PSM TRACK
IN
SPACE STUDIES

APPENDIX VII

Support Letters
Ms Dagmar Beck
Program Director
Professional Science Master's Program
Rice University

Dear Ms. Beck:

I endorse the Professional Science Master's program in Space Studies at Rice. Graduates with a strong grounding in both science, engineering, communication and management will contribute materially to government and private management.

In my 30 years experience in aerospace and defense industries I have experienced directly the need for scientific and technical awareness in program management and decision making. Both the public and private sectors require technically informed leaders to develop goals that are both visionary and realistic and to accomplish these goals efficiently. Programs like the Professional Science Master's will help students to leverage the experience of their predecessors to advance the investigation, exploration, and exploitation of space.

Rice's intellectual resources in physical sciences, engineering, management, and policy provide rigor and substance to this program, and Rice's location and reputation will attract outside experts to add their specialized knowledge and experience. I believe graduates of this program will be singularly well equipped to contribute to efforts in industrial and governmental settings.

Sincerely,

Stewart C. O'Dell, P. E.
Senior Engineering Specialist
ERC, Inc.
September 20, 2011

Professor David Alexander
Department of Physics and Astronomy - MS108
Rice University
6100 Main St
Houston TX 77005

Ref.: Professional Master’s Degree in Space Studies at Rice

Dear Professor Alexander:

I wish to offer my strongest support and encouragement for the creation of a new professional master’s degree in Space Studies at Rice. Over the past decade, we have seen a tremendous growth in the international community engaged in the exploration of space. At the same time, the national paradigm for exploration has evolved, with the retirement of shuttle and the ongoing development of new launch capabilities in both the commercial and government sectors. We are seeing an increased focus within the robotic and human programs on innovation and engagement. To remain competitive, today’s space industry will need graduates trained in science, engineering, communication, and management/finance, especially those cross-trained in several of these disciplines.

As the Director of a NASA-funded scientific research, education/training, and service organization, I work directly with the NASA customer and associated contractor community to understand their needs for today and the future. These needs include scientific and technical advice and support, interns and outreach activities, meetings/conferences and resources management, and connection to the broader university community.

In my opinion, the proposed track in Space Studies will fill a critical need for talented individuals already having experience or wanting to gain additional training in this area. Rice’s connection with NASA and other space related organizations will give students the opportunity to work with experienced individuals in the industry, and provide practical work. Rice and the PSM Program will provide them with extraordinary access to top scientists, as well as leaders in industry and government. I believe that graduates of this program will have many opportunities to apply their education and professional training.

Sincerely,

Stephen Mackwell, PhD
Director

USRA
3600 BAY AREA BOULEVARD • HOUSTON, TEXAS 77058-1113
(281) 486-2128 • mackwell@lpi.usra.edu • www.lpi.usra.edu
October 7, 2011

Professor Dagmar Beck
Program Director
Professional Science Master's Program
Rice University
6100 Main Street, MS 103
Houston, Texas 77005-1827

Dear Professor Beck:

Having read the outline and proposed syllabus for the "Professional Science Master’s in Space Studies" (PSMSS) at Rice University, we believe that this program would be very useful for professionals entering aerospace and related industries. The business of designing and developing satellites and payloads for space is challenging and complex, involving a sometimes-daunting array of scientific, engineering, and management challenges. Formal instruction in these areas would certainly provide a solid foundation for many positions at the Lockheed Martin Space Systems Company (LMSSC).

LMSSC has a long-standing student internship program that we believe would be a good fit for PSMSS students who also meet our entrance requirements. This program provides real-world aerospace and defense work experience. Interns work on current LMSSC programs including satellite and payload instrument programs and groundbreaking technology research projects. Our interns often go on to positions either with Lockheed Martin or other aerospace organizations. We would welcome applications from qualified candidates in the PSMSS program.

We wish you good luck with the PSMSS program.

Sincerely,

Kenneth E. Washington
Professor David Alexander  
Department of Physics and Astronomy

Dear David:

I am writing in support for the creation of a new professional science master's degree in Space Studies at Rice.

As you know, space science and engineering are not my fields; but my experience in policy leads me to believe that in the future of the non-defense U.S. space applications program will be led, increasingly, by the private sector. It is my view that the space industry (and some parts of government) will need graduates trained not only in science and engineering but in communication and management/finance, as well, to deal effectively with the changes underway in most anything having to do with space applications.

The proposed track in Space Studies will be ideal for science and engineering students who are not interested in a research degree but want a career in space applications. It will also allow people who already have professional experience to advance their education in space-related fields. Rice’s connection with the space industry, NASA, and other space related agencies will provide students the opportunity to network with experienced individuals in the industry and government, and allow them to identify opportunities for internships or project work in this field.

Having taught in the PSM Program in the past, I know how well the program is managed and how much the students appreciate the interdisciplinary and multi-faceted educational experience. I am hopeful that in the future Rice will offer many more professional masters degrees. I believe that this particular degree will be an important component of Rice’s new space initiative and demonstrate the university’s serious commitment to be, once again, a major player in space.

Sincerely,

Neal Lane, Ph.D.
Senior Fellow, James A Baker III Institute for Public Policy
Malcolm Gillis University Professor
Professor of Physics and Astronomy
Rice University
Faculty Senate Curriculum Committee
Rice University
CAMPUS

Dear Committee:

I am pleased to add my voice in support the proposed Professional Science Master’s (PSM) Degree Program track in Space Studies. The national initiative to establish a network of PSM programs was stimulated and supported by the Sloan Foundation in the 1990s for the express purpose of providing a high-quality graduate education track for individuals whose path and purpose in science graduate education were aimed at private sector, non-research careers. It was recognized at the time that canonical graduate programs in science were both overly protracted and lacking in the specific content and experiences that could most efficaciously prepare students for such nonacademic career paths. It has since become apparent that – at Rice and elsewhere – the PSMs are indeed filling a real need for the students … and that the business and industry well recognize the value of PSM education.

Rice already has a successful program of PSM offerings in several fields, thus having established the viability of the concept in Houston and within Rice. Properly designed and executed, these programs fill a real educational and social need, and can do so in ways that capitalize on existing course offerings without creating a large additional burden on the faculty or the institution. One critical consideration in the design of – and decision to offer – such programs is the existence of need and opportunity. Space activities have expanded in the recent years, and there is ample reason to expect that the expansion will continue. There is growing emphasis on the development of an expanded free-standing private industrial base to serve private needs outside of the government programs. The need – as seen by students and by business and industry – for a space studies PSM has become apparent. It has also become apparent that such a program can prepare Rice PSM graduates for attractive career opportunities.

I have carefully examined the proposal for the Rice Space Studies PSM. In my view, the proposed program is carefully thought through and well designed. I have confidence that it will rapidly become a highly respected and valuable program, as viewed on national and international bases. The educational value, the outlook for graduates, and the opportunity for the university to help meet a growing societal need, speak in favor approving this program.

Sincerely,

Eugene H. Levy
National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

October 14, 2011

Reply to Attn of: SA42-11-011

Dagmar K. Beck
Program Director
Professional Science Master's
Wuets School of Natural Sciences
6100 Main Street, MS-103
Rice University
Houston, TX 77005

Dear Dr. Beck:

NASA has had a long and productive relationship with Rice University beginning at the
establishment of Johnson Space Center. This collaboration continues today. As part of
NASA's overall mission, we are dedicated to education at all levels with special emphasis
on educational programs that meet our workforce needs. Rice has historically educated our
outstanding scientists and engineers.

We appreciate and thank you for the opportunity to provide advice for your new
professional master's degree in Space Studies. Professional Master's degrees fit within our
workforce needs as it provides training across technical areas, from science to practical
engineering and management. These types of programs can enhance our workforce as we
continue in the 21st Century transformation of human space flight. We look forward to
continuing our strong relationship with your program and wish you the best for obtaining
approvals. We will support you through our continue dialog about Johnson Space Center
and Human Space Flight.

Sincerely,

Craig Stencil
Deputy Director, Space Life Sciences