

# CURRICULUM PROPOSAL FORM

(SEE #9778-297)

**DEADLINES:**

REGULAR COURSE PROPOSALS: OCTOBER 23, 1998 FOR FALL, 1999 AND FEBRUARY 19, 1999 FOR SPRING, 2000  
SHORT-TERM COURSE PROPOSALS: DECEMBER 11, 1998 FOR FALL, 1999 AND MARCH 26, 1998 FOR SPRING 2000

**PROPOSAL TITLE:** Rocket Propulsion

**SPONSOR/S:** Dr. Anthony J. Marchese and the Department of Mechanical Engineering

**DEPARTMENT:** Mechanical Engineering

0916.512

**CHECK ALL THAT APPLY:**  
 UNDERGRADUATE       GRADUATE

**COLLEGE:** Engineering  
**If LAS:**  History/Humanities  
 Math/Sciences  
 Social/Behavioral Sciences

\* \* \* \* \*

**TYPE OF PROPOSAL (Check ALL that Apply)**

<input type="checkbox"/> General Education	<input checked="" type="checkbox"/> New Course (NOT Gen. Ed.)
<input type="checkbox"/> New Course in <u>Bank</u>	<input type="checkbox"/> Name Change (Dept., School, Major)
<input type="checkbox"/> Existing course, Add To <u>Bank</u>	<input type="checkbox"/> Changes in Degree Requirements
<input type="checkbox"/> Multicultural/Global Designation	<input type="checkbox"/> Changes Involve Gen. Ed. requirements
<input type="checkbox"/> Writing Intensive Designation	<input type="checkbox"/> Minor Changes to Existing Courses
<input type="checkbox"/> New Minor/Concentration/Specialization	<input type="checkbox"/> Course is NOT General Education
<input type="checkbox"/> New Major/Degree Program	<input type="checkbox"/> Course IS General Education
<input type="checkbox"/> Short Term Course Proposal	

*See attached for signatures!*

**DEPARTMENT**  
(SIGNATURE INDICATES APPROVAL)

\_\_\_\_\_

**DEPT. CURRICULUM CHAIR / DATE**      **DEPT. CHAIRPERSON / DATE**

**COLLEGE CURRICULUM COMMITTEE**  
DATE OF OPEN HEARING (if necessary) \_\_\_\_\_

APPROVED  
 NOT APPROVED

COMMENTS:

Robert P. Heffner      11/5/98  
**SIGNATURE**      **DATE**

**ACADEMIC DEAN (& GRADUATE DEAN, for New Graduate Programs Only)**

APPROVED  
 NOT APPROVED

COMMENTS:

\_\_\_\_\_  
**SIGNATURE (Academic Dean)**      **DATE**

\_\_\_\_\_  
**SIGNATURE (Graduate Dean)**      **DATE**

**UNIVERSITY CURRICULUM COMMITTEE**

DATE OF OPEN HEARING (if necessary) Policy. Leave only

APPROVED

NOT APPROVED

COMMENTS:

Deborah M. Lewis 11/20/98  
SIGNATURE DATE

**SENATE**

Date announced at Senate 11/6/98 (email announcement)

Voted upon at Senate:                      **Approved**                      **Not Approved**                      **Date:**

**EXECUTIVE VICE PRESIDENT/PROVOST**

APPROVED

NOT APPROVED If no, reasons are as follows:

OFFICE OF THE PROVOST

DEC 1 1998

ROWAN UNIVERSITY

STUDENT CREDIT HOURS \_\_\_\_\_ FACULTY LOAD HOURS \_\_\_\_\_ EQUALIZED CREDIT HOURS \_\_\_\_\_

OFFICIAL COPY & APPROVAL SHEET FILED (DATE): \_\_\_\_\_

DATE/SIGNATURE EXECUTIVE VICE PRESIDENT/PROVOST [Signature]

**REGISTRAR**

DATE APPROVED COURSE DESCRIPTION RECEIVED \_\_\_\_\_

HEGIS TAXONOMY & COURSE NUMBER ASSIGNED 0910.1512

DATE/SIGNATURE OF REGISTRAR Robert A. Kubat 12/10/98

**NOTIFICATION FORWARD:**

SENATE CURRICULUM COMMITTEE CHAIRPERSON

DEPARTMENT CHAIRPERSONS

ACADEMIC DEAN(S)

REGISTRAR

SPONSOR(S)

Transmittal 1/11/99

# ROWAN UNIVERSITY CURRICULUM PROPOSAL

<b>PROPOSAL TITLE:</b> Rocket Propulsion			
<b>CHECK APPROPRIATE:</b> <input type="checkbox"/> UNDERGRADUATE <input checked="" type="checkbox"/> GRADUATE <input type="checkbox"/> SEMESTER HOURS			
<b>SPONSOR(S):</b> Dr. Anthony J. Marchese and the Department of Mechanical Engineering			
<b>DEPARTMENT/TELEPHONE #</b> Mechanical Engineering, x4627			
<b>CHECK ONE:</b> <input checked="" type="checkbox"/> COURSE <input type="checkbox"/> MINOR PROGRAM <input type="checkbox"/> CONCENTRATION <input type="checkbox"/> SPECIALIZATION			
<input type="checkbox"/> ACHIEVEMENT CERTIFICATE <input type="checkbox"/> CERTIFICATION PROGRAM <input type="checkbox"/> MAJOR PROGRAM			

<p><b>Step #1 (Department)</b></p> <p><input checked="" type="checkbox"/> Approved (Date)</p> <p><input type="checkbox"/> Not Approved (Date)</p> <p style="text-align: center;"><u><i>[Signature]</i></u> Dept. Curriculum Chr.</p> <p style="text-align: center;"><u>2/25/98</u> Reviewed (Date)</p> <p style="text-align: center;"><u><i>[Signature]</i></u> Dept. Chr.</p>	<p><b>Step #2 (Receipt)</b></p> <p style="text-align: center;">SCC# 97-98-<u>297</u></p> <p style="text-align: center;"><u>2-27-98</u> Date Received Senate</p> <p style="text-align: center;">_____ Senate Curriculum Chr.</p>	<p style="text-align: center;"><b>Step #3 (School)</b></p> <p style="text-align: right;">Reviewed Date: <u>2/25/98</u></p> <p><input checked="" type="checkbox"/> Recommend to Approved</p> <p><input type="checkbox"/> Recommend NOT to Approve</p> <p>Forward for Open Hearing:</p> <p><input type="checkbox"/> WITHOUT Reservations</p> <p><input type="checkbox"/> WITH Reservations:</p> <p>Comments:</p> <p style="text-align: center;"><u><i>[Signature]</i></u> School Committee Chr.</p>
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<b>Step #4 (Academic Dean):</b> <input checked="" type="checkbox"/> Recommended <input type="checkbox"/> NOT Recommended <input type="checkbox"/> Conditionally Recommended (See Comments)		
Comments:		
Dean Signature/Date: <u><i>[Signature]</i></u> <u>2/27/98</u>		

<b>Step #5 (Senate Curriculum Committee):</b> Open Hearing Date: _____    Approved by Curriculum Committee Date _____
Returned to Sponsor(s) for the following reason:

<b>Step #6 (Senate)</b> Date announced/voted on at Senate _____    If voted on: <input type="checkbox"/> Approved <input type="checkbox"/> NOT Approved
Date forwarded to Executive Vice President/Provost _____
Senate Curriculum Committee chair Signature/Date: _____

## Course Proposal

### 1. Details:

- a) Course Title:** Rocket Propulsion (0910.512)
- b) Sponsor:** Dr. Anthony J. Marchese, Department of Mechanical Engineering, College of Engineering
- c) Credit Hours:** 3 credit hours
- d) Course Level:** Graduate
- e) Curricular Effect:** A graduate elective for the Masters of Science in Engineering majors. This course is applicable for students wishing to specialize in Mechanical Engineering or Chemical Engineering.
- f) Prerequisites:** Engineering Thermodynamics II (0910.312) and Fluid Mechanics II (0910.313) or equivalent.
- g) Suggested Time/**  
**Scale of Implementation** Spring 2000  
One section
- h) Resources:** Faculty is in place to teach the course within the Dept. of Mechanical Engineering. A 1130 square foot thermo and engine laboratory will be available to support this course. A Turbojet gas turbine engine and a supersonic nozzle flow apparatus have been purchased in support of this course. Library resources are in place. Computer hardware resources are available in the Engineering Building to support this course.

### 2. Rationale:

The proposed course is part of the Engineering Curriculum Proposal approved by the College Senate in December 1994. The proposed course is consistent with the establishment of the School of Engineering approved by the Board of Trustees in February 1995.

Rocket propulsion is a key technology in the areas of space exploration, commercialization of space and automotive vehicle restraint systems. Space exploration (e.g. a manned Mars mission) has seen a renewed interest in light of the results from the Mars Pathfinder mission. The primary obstacle that has prevented man from walking on the surface of Mars is the propulsion system requirements. In terms of the commercialization of space, the recent explosion in communications technology has put an unprecedented demand for communication satellite launches. And, every automobile sold in this country today includes two solid rocket motors that are used to quickly inflate the air bags. Clearly, it is of vital importance to the national interest that we educate a new breed of rocket scientist. This is particularly important today, since many of the early pioneers in rocket propulsion have retired or passed on.

### **3. Essence of the Course:**

#### **a) Objectives:**

Rocket propulsion draws on the fundamental concepts of thermodynamics, chemistry and fluid mechanics. By definition, the Rocket Propulsion course is an application based course which uses these principles to design propulsion systems. At the conclusion of the course the student will be able to:

1. Analyze the performance of an ideal rocket motor.
2. Design a rocket system based on mission requirements.
3. Perform thermochemical calculations (by hand or using the NASA CEC program) to determine the rocket chamber temperature and chemical composition for any chemical propellant combination.
4. Explain the difference between frozen and shifting equilibrium nozzle flow and calculate specific impulse for both limiting cases.
5. Design a liquid propellant rocket engine by considering the propellant combination, combustion chamber, injector, igniter, nozzle, heat transfer and cooling characteristics
6. Design a solid propellant rocket engine based on the propellant combination, burning rate laws and grain design.

#### **b) Topical Outline:**

The topical outline of the course may vary to some extent depending on the interests of the instructor and the students, and the advances in engineering technology. The topics to be covered will include the following:

##### Rocket Performance Theory

- Performance analysis of an ideal rocket motor
- Departure from ideal performance
- Thermochemistry and theoretical calculations

##### Chemical Rocket Propellants

- Characteristics of liquid propellants
- Characteristics of solid propellants

##### Design of Liquid Propellant Rocket Engines

- Combustion chamber design
- Nozzle design
- Heat transfer
- Cooling
- Manufacturing

##### Design of Solid Propellant Rocket Motors

- Propellants and classes

Burning rate laws  
Accessories  
Restricted burning rockets  
Unrestricted burning rockets

Electric Propulsion Rockets  
Ion propulsion  
Resistojet thrusters  
Arcjet thrusters  
MPD thrusters

**c) Evaluation and Grading Procedure of Students:**

Student grades will be determined on the basis of examinations, homework and/or projects, laboratory projects and reports. The major difference between this class and 910-412 (Introduction to Rocket Propulsion) is a semester-long project. In the graduate class, students will work on a semester long project that culminates in the design of a solid or liquid propellant combustion system.

**d) Course Evaluation:**

The proposed course will be evaluated on the basis of student evaluations and curriculum review by appropriate faculty.

**4. Results of Consultations:**

The proposed course is part of the Engineering Curriculum Proposal approved by the Faculty Senate in December 1994. Consultations were submitted with original proposal as specified by the Curriculum Committee. Additional curriculum consultations were performed with outside consultants including, Professor Skip Fletcher of Texas, A&M. Professor Fletcher is a fellow of the American Society of Mechanical Engineers.

**Catalog Description:**

**0910.512**

**3 s.h.**

**Rocket Propulsion**

(Prerequisites: *Engineering Thermodynamics II (0910.312) and Fluid Mechanics II (091.-313) or Equivalent*)

In this course, the principles of rocket propulsion theory are presented along with practical applications of rocket propulsion design. Theoretical topics include performance analysis of ideal rocket engines, departure from ideal performance and detailed thermochemical propellant calculations. Practical design issues are addressed for both liquid propellant engines and solid rocket motors. The course also includes an introduction to electric propulsion.