Master of Science in Aerospace Engineering (MSAE):
- Space Systems Engineering
- Aircraft Systems Engineering
- Aerodynamics & Computational Fluid Dynamics (CFD)
- Aerospace Structures and Materials

Master of Science in Mechanical Engineering (MSME):
- Dynamics, Vibration and Controls
- Fluid and Thermal Sciences
- Materials
- Mechanics
- Design and Manufacturing

College of Engineering Programs:

Master of Science in Engineering (MSE) - with an area concentration in:
- Management Engineering
- Interdisciplinary Engineering

Ph.D. in Engineering and Industrial Applied Mathematics

All graduate program information and course descriptions can be found on the Mechanical & Aerospace Engineering web site @ http://www.csulb.edu/colleges/coe/mae/
## FACULTY

**Eric Besnard, Ph.D., Claremont Graduate University/CSULB**
Computational Fluid Dynamics (CFD), Design/Optimization, Propulsion  
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**Hsin-Piao Chen, Ph.D., Georgia Institute of Technology**
Structures and Analysis of Composite Materials, Manufacturing and Testing of Composites  
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**Mihir Das, Ph.D., University of Birmingham, England**
Manufacturing, Engineering Management, Innovative Design, TQM  
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**Simon DeSoto, Ph.D., P.E., University of California, Los Angeles**
Thermodynamics, Information Theory and Thermodynamics, Heat Transfer, Turbomachinery, Compressible Fluid Mechanics (high speed flow), Impact of Technology on Society  
ECS-642  (562) 985-4283

**Ramin Esfandiari, Ph.D., University of California, Santa Barbara**
Optimal Control Theory, Optimization, Vibrations, Applied Mathematics  
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C. Barclay Gilpin, Ph.D., P.E., Carnegie-Mellon University
CAD/CAM, Manufacturing, Materials, Finite Element Analysis, Mechanics, Biomedical Devices
ECS-632  (562) 985-5117  gilpin@csulb.edu

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Manufacturing
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Abdelkader Khattab, MSME, California State University, Long Beach
Computational Fluid Dynamics (CFD)
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Ernest Mijares, M.S., P.E., University of Southern California
ECS-631  (562) 985-5120  mijares@csulb.edu

Ortwin Ohtmer, Dr.-Ing., Technical University of Braunschweig, Germany
Finite Element Methods, Computer-Aided Design (CAD), Rapid Prototyping, 3-D Scanning, Solid Modeling, and Optimization Techniques
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Naval Architecture, Ocean Engineering, Mechanics of Materials, Numerical Methods, Internet Applications
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Manufacturing, Quality Assurance
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Combustion Processes, Air Pollution, Internal Combustion Engines
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Jalal Torabzadeh, Ph.D., University of Southern California
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Reservoir Engineering and Characterization, and Enhanced Oil and Gas Recovery
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Mechanics
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Hung Vu, Ph.D., University of Michigan
ECS-633  (562) 985-1524  hvu@csulb.edu

Parviz Yavari, Ph.D., University of Southern California
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Hsien-Yang Yeh, Ph.D., University of Southern California
Composite Materials, Fracture Mechanics, and Failure Analysis
ECS-626  (562) 985-4611  hyyeh@csulb.edu
1. **Program Educational Objective**

   The Master of Science in Mechanical and Aerospace Engineering programs have been created to educate students in subjects relevant to the requirements of industry and in deductive reasoning which will benefit them and the community. These programs are unique in their emphasis on practical applications and intimate interactions with industry. They involve the most modern computational and experimental methods and provide the essential information permitting students to acquire knowledge and skills of immediate practical importance. This knowledge is communicated in the courses and used in the conduct of a thesis or research project to be carried out with participation from industry.

   This handbook is intended to provide a general overview of the Mechanical and Aerospace Engineering graduate degree programs. All material contained herein is subject to change without prior notice. The current CSULB Catalog and CSULB Schedule of Classes are the final authorities regarding classes offered, admission requirements to the university, faculty, and various policies, procedures, and deadlines. Both publications are available from the CSULB Bookstore. It is the responsibility of each student to read and to know the requirements and to satisfy them in a timely manner.

   After acceptance to CSULB, graduate students must meet with their respective program’s graduate advisor, to establish a program and subsequently to ensure that all degree requirements are being met.

2. **Application and Admission**

   We strongly encourage students to apply to CSULB on the Internet by visiting the CSU Mentor web site at: [http://www.csumentor.edu](http://www.csumentor.edu). If you do not have access to the Internet, you can request an admissions application booklet by calling the automated application line at (562) 985-1655 or (562) 985-4145. You are encouraged to apply during the initial filing period for priority consideration. The university may stop accepting applications at any time after the initial filing period. Deadlines are posted on the University’s web site at: [http://www.csulb.edu/depts/enrollment/html/application_status.html](http://www.csulb.edu/depts/enrollment/html/application_status.html).

   The CSULB Office of Enrollment services (Admissions & Records) receives applications for admissions. The application processing fee is $55.00 (nonrefundable). The GRE Examination is not required for MAE graduate programs. Students who have their undergraduate degrees from countries where English is not the common language must receive a minimum TOEFL score of 550. CSULB requires two sets of transcripts from graduate applicants: one set is sent directly to Enrollment Services, the second set is sent to the department.

   International students should obtain an International Admissions Application package from the Center for International Education (562/985-5476,
Admission Requirements

For the Master of Science in Aerospace Engineering and the Master of Science in Mechanical Engineering: prospective students require a bachelor’s degree from an accredited curriculum in mechanical, aerospace, or other related engineering disciplines with a minimum GPA of 2.70 (in the last 60 semester or 90 quarter units). Applicants with a lower GPA may be admitted subject to successful completion of appropriate deficiencies.

If an applicant meets the minimum requirements for admission to CSULB, his/her application will be forwarded to the department for review by the graduate advisor. The graduate advisor will review the student’s application and transcripts to identify any deficiencies that may exist in the student’s undergraduate preparation. CSULB has an automated phone system which students may use to check the status of their application: (562) 985-1887.

Application Deadlines

- Fall Semester – October 1st through April 1st
- Spring Semester – August 1st through December 1st

3. Deficiencies

Deficiencies are not determined in advance. After a student arrives at CSULB and submits complete copies of all transcripts (of previous college work), the graduate advisor will decide if any deficiencies are required, and how many.

The minimum GPA requirement for admission to the MSAE degree program is 2.7 in the last 60 semester (or 90 quarter) units completed. For the MSME and MSE degree programs, the minimum GPA requirement is 2.5 in the last 60 semester (or 90 quarter) units. The entire semester in which the 60 units began is used in the calculation of the GPA. If the student has the required minimum GPA, but does not have a Bachelor’s degree in Aerospace Engineering (for the MSAE) or Mechanical Engineering (for the MSME), the department may admit him/her as a “conditionally classified” graduate student, and the graduate advisor may assign deficiency courses. Any assigned deficiency courses will not count towards the fulfillment of the MSAE, MSME or MSE degree requirements, they are simply to remedy any deficiencies in undergraduate preparation. The graduate advisor is the final authority on deficiencies.

4. Graduation Writing Assessment Requirement (GWAR)

Graduate Students

In order to obtain a degree or certificate from CSULB, all students must demonstrate upper-division competence in academic writing in English. The student is responsible for developing the skills necessary to demonstrate this competence.

A. As a requirement for advancement to candidacy for a master’s or doctoral degree, all graduate students must demonstrate writing competence by:
   1. Passing an approved CSULB assessment of writing competence (GWAR),
2. Having already passed an assessment of writing competence (GWAR) while matriculated at another CSU campus, or
3. Earning a CSULB-approved passing score on the writing portion of an approved standardized graduate admissions test, such as the Graduate Record Examination or the Graduate Management Aptitude Test.

B. Assessments of writing competence from non-CSU campuses will be evaluated by the GWAR Coordinator as a fulfillment of the GWAR, on an articulation basis if possible or on a case-by-case basis if necessary.

C. Students with degrees from non-CSU campuses must either provide proof of meeting the requirement with adequate scores on a CSULB-approved standardized test or attempt to satisfy the GWAR by the end of their first semester of matriculation at CSULB.

Master's candidates must attempt the WPE (or departmental alternative) during their first semester of attendance, or a hold will be placed on their records and they will not be allowed to register for classes until after the test is completed. The WPE must be passed prior to Advancement to Candidacy. Certificate candidates must pass the WPE as a requirement for completion of the program. University policy now recognizes a score of 4 or higher on the essay portions of both the GMAT and the GRE as WPE equivalents at the graduate level. Students must take their score reports to Enrollment Services, Room 123.

Introducing English 301B to Satisfy the Graduation Writing Assessment Requirement (GWAR)

The Graduation Writing Assessment Requirement (GWAR) is the California State University policy that requires all students to demonstrate English writing proficiency before graduation from CSULB. The WPE is the simplest way for students to satisfy the GWAR. Please visit the Office of Testing and Evaluation Services website: www.csulb.edu/testing for complete WPE and GWAR information. The Office of Testing and Evaluation Services is located in Brotman Hall, room 216 (BH-216), phone: 562-985-4007.

Course Description, English 301B

Beginning fall semester 2005, CSULB is offering an advanced English writing course with a portfolio option to satisfy the GWAR. The course is: ENGL 301B. Within this course students will complete writing assignments, some in-class under timed conditions. Selected assignments will be assembled into a portfolio for review by a committee which will include WPE faculty evaluators.

5. Advancement to Candidacy

1. In order to be Advanced to Candidacy, you must have
   a) satisfactorily fulfilled the GWAR requirement.
   b) completed six or more semester units in residence satisfactorily and earned a 3.0 GPA or greater.
2. In the PLAN I (Thesis) Option, meet with the Department’s Graduate Advisor to review your proposed Graduate Program formulated with assistance from your proposed Thesis Chair.
3. In the PLAN II (Directed Research) Option, you will work with the Department’s Graduate Advisor to develop your proposed Graduate Program and Advancement to Candidacy.
4. The Advancement to Candidacy form must be approved by the appropriate graduate coordinator, the Department Chair, and the Associate Dean of Instruction for the College of Engineering.

5. Once your Graduate Program (Advancement to Candidacy) has been approved, changes in the Graduate Program require(s) the same signatures as those appearing on the graduate program of record (on a Change of Program form).

6. Once your Graduate Program has been approved, you will receive a letter from the College's Associate Dean/Graduate Dean indicating the semester you were Advanced to Candidacy as well as the semester the master's degree must be finished in order not to lose credit for courses completed earlier in your program.

7. Following approval of your Graduate Program, file a Request for Graduation form with the Office of Enrollment Services (BH-Ground Floor Courtyard) and pay the associated fee.

8. You must be Advanced to Candidacy before you can initiate research for the Thesis (Plan I) or Directed Research (Plan II).

9. Policies and degree requirements (catalog rights) applicable to the candidate are those in effect at time you are Advanced to Candidacy (instead of time of admission).

10. You must be advanced to candidacy at least one semester prior to completion of your degree program.

5. **Grade Point Average (GPA)**

   1. Graduate students are required to possess at least a "B" or 3.0 GPA.
   2. Graduate students without a minimum 3.0 GPA will be placed on Probation and must achieve a 3.0 GPA or higher usually within the following two semesters. Students unable to achieve the 3.0 GPA will be disqualified from the graduate program. The University does not have an undeclared status for graduate students.
   3. Graduate students with less than a 3.0 GPA may enroll in University College and Extension Services for courses, but are subject to limitation of units transferable to a master's degree program (Policy 92-10).
   4. Graduate students do not qualify for "repeat deletes."

6. **PLAN I - THESIS**

   An engineering thesis is the written product of the systematic study of a significant problem. It identifies the problem, states the major assumptions, explains the significance of the undertaking, sets forth the sources for and methods of gathering information, analyzes the data, and offers conclusions and recommendations. The finished product evidences scientific originality which makes contributions to the field of study, critical and independent thinking, and appropriate organization and format, and thorough documentation. In general, the investigation results in a refereed technical publication or a presentation at a professional meeting. Students shall be held responsible for understanding the definition of a graduate engineering thesis or project as outlined above and must follow the appropriate format guidelines to complete them.

   Students in the MSAE, MSME, and MSE/ME programs who elect Plan I are required to complete a thesis (six units of MAE 698). A student may enroll for Thesis only when that student has been advanced to candidacy for the degree or when advancement to candidacy will occur in the semester of initial enrollment in Thesis. A
Thesis is a written product of systematic study of a significant problem. It clearly identifies the problem, states the major assumptions, explains the significance of the undertaking, sets forth the sources for and methods of gathering information, analyzes the data, and offers a conclusion or recommendation. The finished product evidences originality, critical and independent thinking, appropriate organization and format, and thorough documentation. Students are responsible for understanding the definition of a graduate thesis as outlined above and must follow the format guidelines prescribed by the University and the Department in which the thesis is completed.

A student’s thesis committee shall consist of at least three members qualified in the areas relating to the thesis. At least two shall be full-time faculty members at CSULB, one of whom must be tenured or tenure-track. The chair of the thesis committee must be a tenured or a tenure-track faculty member from a department authorized to offer a graduate degree. Remember, faculty are not expected to be available during certain periods of the semester nor expected to be in residence during academic recesses or the summer. Candidates need to plan accordingly and check on the availability of Committee members.

All theses must be acceptable for deposit in the University Library. The Thesis Office in the University Library will verify that each thesis meets the format criteria prescribed by the department or degree program and by the University and that it meets all University procedural requirements for theses.

**Theses may only be submitted to the Thesis Office within the following dates:**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Submission Period*</th>
<th>For Thesis/Project Reports Dated</th>
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<tbody>
<tr>
<td>Fall 2005</td>
<td>9/19/05 - 10/28/05</td>
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<tr>
<td>Winter 2005/06</td>
<td>12/1/05 - 1/6/06</td>
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<td>Spring 2006</td>
<td>2/21/06 - 3/30/06</td>
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<td>Summer 2006</td>
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<tr>
<td>Winter 2007</td>
<td>12/1/06 - 1/5/07</td>
<td>January 2007</td>
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*Theses submissions received by the University Thesis Office after the semester's submission date will not be accepted. Theses will be accepted only during the published thesis submission periods. No late submissions will be accepted.

After the thesis has been submitted to the University Thesis Office, the review and approval process will require approximately six to eight weeks after the deadline date.
Corrections must be completed within 2 weeks of the initial review. Candidates should be aware of this review period when planning vacations or relocations.

Please be sure the most recent version of the University Style and Format Guidelines for Master's Theses and Project Reports is used to prepare the thesis or project report for submission. If there is uncertainty about which version to use, check with either the Campus Copy Center or the University Thesis Office.

Deans'/Department Chairs' Signature Blocks for Thesis/Project Report Approval Page:

Master of Science in Aerospace Engineering
Designee: Hamid Hefazi, Ph.D.
Department Chair, Department of Mechanical and Aerospace Engineering

Master of Science in Engineering
Designee: Sandra Cynar, Ph.D.
Associate Dean, College of Engineering

Master of Science in Mechanical Engineering
Designee: Hamid Hefazi, Ph.D.
Department Chair, Department of Mechanical and Aerospace Engineering

7. PLAN II - DIRECTED RESEARCH

An engineering project (for Directed Research) is a significant undertaking appropriate to professional fields. It evidences originality and independent thinking, appropriate form and organization, and a rationale. It is described and summarized in a written report that includes an abstract and the project’s significance, objectives, methodology, and a conclusion and recommendation. Students shall be held responsible for understanding the definition of a graduate engineering thesis or project as outlined above and must follow the appropriate format guidelines to complete them.

Students in the MSAE, MSME, and MSE/ME programs who elect Plan II are required to complete a directed research project (six units of MAE 697). A student may enroll for MAE 697 only when that student has been advanced to candidacy for the degree or when advancement to candidacy will occur in the semester of initial enrollment in MAE 697. The directed research project is a written product of systematic study of a significant problem. It clearly identifies the problem, states the major assumptions, explains the significance of the undertaking, sets forth the sources for and methods of gathering information, analyzes the data, and offers a conclusion or recommendation. The finished product evidences originality, critical and independent thinking, appropriate organization and format, and thorough documentation.

8. Graduation

The normal deadline dates to submit applications for graduation (Request to Graduate) are September 15 for students who plan to graduate during the Spring Semester and February 1 for students who plan to graduate during the Fall Semester. Check the University Catalog for exact requirements and check the University Schedule of Classes for fees and deadlines. Students must be currently enrolled in the University during the semester in which they officially graduate. If all other courses have been completed, students may enroll in GS 700 (through UCES).
Please note that you may file the Request to Graduate as soon as you have advanced to candidacy. It is advisable to file both forms at the same time, to avoid any delays when it is time to graduate.

9. Maintaining Enrollment

A student who has been admitted to graduate standing in the University and accepted in a MAE degree program is normally expected to maintain continuous enrollment. This means you must be registered for one or more courses each semester until completion of the academic program. Registration in Summer Session or Winter Session is NOT required to maintain continuous enrollment.

10. Educational Leave

1. If it is necessary for you to take a leave from the University, it is strongly advised that you complete and file a Request for Educational Leave before leaving the University. This will exempt you from an application fee when you apply for readmission.
2. An educational leave will request your reason(s) for seeking the leave and an indication of when you expect to resume at CSULB.
3. The completed form must be approved by the program's Graduate Advisor and filed with Office of Enrollment Services.
4. Students returning after an approved one-semester educational leave will not be required to submit an application form. Students on leave longer than one semester must apply for readmission to the University, but an application fee will not be required.
5. Students returning from an absence without filing an approved educational leave must reapply for admission and pay the reapplication fee.
6. Students who plan to enroll for credit at another institution of higher education during the leave period must obtain prior approval from the program's graduate advisor, department chair, and the College Dean or designee for the transfer of course credit to the student's graduate program.

11. Readmission to the University

If a student's enrollment has been interrupted, an application for readmission must be filed with the University Admissions Office and a fee paid. Students who have been advanced to candidacy must also be reinstated (by the Graduate Advisor and Dean of Graduate Studies).

12. Graduate Studies 700 (GS 700)

1. Students enroll in GS 700 only when they have been advanced to candidacy and completed all course work for their master's degree program.
2. Students must enroll in GS 700:
   a) each semester they utilize any of the University's resources (including but not limited to faculty, staff, library, or other facilities/services).
   b) once each calendar year when they are not utilizing any of the University's resources.
   c) the semester they are submitting their thesis to the University's Thesis Office, or graduating; and they are not enrolled in any other courses at the University.
13. Time Limit

All requirements for the degree must be completed within seven (7) years of the date the student’s program was initiated. Once a course has “expired” due to the seven-year rule, additional replacement courses must be taken or a petition made to recertify and revalidate the older courses. An extension of time beyond the limit may be granted by the Dean of Graduate Studies if warranted by individual circumstances and if the outdated work is validated by comprehensive examination in the relevant course or subject field, or such other demonstration of competence as may be prescribed by the department and/or college.

14. Procedure for Enrolling in Supervision Courses (MAE 691, 697, 698, 795, 797, 798)

1. Obtain the permission form for the appropriate course from the MAE Department Office (ECS-635) or download from the MAE website [http://www.csulb.edu/colleges/coe/mae/views/forms.shtml].
2. Complete the permission form and obtain the signature of the faculty supervisor.
3. Bring approved form to ECS-635 to obtain the course code and permit to register.
4. Follow through by adding the course through MyCsulb.edu (online) or VRR (Voice Response Registration). If the class is not added prior to the last day to add online or by VRR, students will need to use an Add form signed by the faculty supervisor.
15. **MS Checklist**

### Application & Admission

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### Take WPE

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<td>Get graduate program plan approved by Thesis Chair (I) or Graduate Advisor (II)</td>
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#### Thesis (Plan I)

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#### OR Project (Plan II)

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### Graduation

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</table>
The Master of Science in Aerospace Engineering program has been created to educate graduate students in subjects relevant to the requirements of industry and in deductive reasoning which will benefit them and the community. This program is unique in its emphasis on practical applications and intimate interaction with the aerospace industry. It involves the most modern computational and experimental methods and provides the essential information permitting the students to acquire knowledge and skills of immediate practical importance. This knowledge is communicated in the courses listed below and used in the conduct of a thesis project to be carried out with participation from industry.

Area Specializations:

- **Space Systems Engineering:** This emphasis focuses on space systems, such as launch vehicles and spacecraft. Advanced topics include: spacecraft attitude determination and control, astrodynamics, heat transfer, rocket and spacecraft propulsion and a space vehicle design course in which students define a mission and conduct the preliminary design of their spacecraft. The program benefits from the on-going California Launch Vehicle Education Initiative (CALVEIN), which provides students with opportunities to extend their knowledge with the development and testing of space systems technologies.

- **Aircraft Systems Engineering:** This emphasis is for engineers and managers interested in the engineering of aeronautical systems. The program is designed to give breadth of knowledge in all relevant disciplines. Advanced topics include: stability and control, propulsion, avionics, aerodynamics and structures. The systems engineering approach is addressed in a separate course and all disciplines are integrated in an aircraft design course.

- **Aerodynamics and Computational Fluid Dynamics (CFD):** This program emphasizes the study of (a) applied aerodynamics and aerodynamic design in various speed regimes and (b) computational methods and tools for fluid dynamics. Advanced topics include: hypersonic flow, computational fluid dynamics I & II, advanced fluid dynamics I & II, and aerelasticity. Students have the opportunity to get involved with state-of-the-art research projects such as aerospike nozzle design, ship hydrodynamics, laminar flow control, aerelastic analysis, and aircraft deicing.

- **Aerospace Structures and Materials:** This emphasis focuses on aircraft and spacecraft structures, aerospace materials, and the design of various structural components. The program is designed to provide students with advanced knowledge in all relevant courses, along with today’s modern computational technology employed to solve real problems. Topics include: analysis and design of composite materials, structural stability, structural design optimization, advanced aerospace structures, and computational mechanics.

**Requirements for Admission**

A bachelor’s degree in an accredited curriculum in Aerospace or Mechanical Engineering with a minimum grade point average of 2.70 in the last 60 (semester) units
attempted. Applicants with lower GPA may be admitted subject to successful completion of
appropriate deficiencies.

A bachelor’s degree in engineering, mathematics, science or other appropriate
discipline with the requirement that essential undergraduate prerequisites in engineering be
satisfied.

Graduate students must consult with the graduate advisor, Dr. Hsin-Piao Chen, for
information concerning procedures and requirements for appropriate approval of their courses
of study prior to enrolling in their graduate programs.

**PLAN I**

Completion of a minimum of 30 units beyond the bachelor’s degree in upper-division
and graduate courses approved by the student’s Department Graduate Study Committee, including:

1. Eighteen units of 500- and/or 600-level courses in mechanical and aerospace
   engineering;
2. Six units of electives selected from approved upper-division or graduate courses from
   appropriate areas;
3. Completion of six units of MAE 698, and submission of a written thesis.

**PLAN II**

Completion of a minimum of 36 units beyond the bachelor’s degree in upper-division
and graduate courses approved by the student’s Department Graduate Study Committee, including:

1. Twenty-four units of 500- and/or 600-level courses in mechanical and aerospace
   engineering;
2. Six units of electives selected from approved upper-division or graduate courses from
   appropriate areas;
3. Completion of six units of MAE 697.

**Advancement to Candidacy**

Prerequisites for advancement to candidacy are:

1. Classified status.
2. An approved program of studies for the Master of Science in Aerospace Engineering.
3. Satisfactory completion of the CSULB Writing Proficiency Examination (WPE). Information
   is available in the Testing Office (BH-216). This requirement can also be met by evidence
   that the student passed the WPE while an undergraduate at CSULB or at certain CSU
   campuses.
4. Be enrolled in regular session.
5. Application for Advancement to Candidacy must be completed prior to or concurrent
   with enrollment in MAE 698-Thesis.

**MSAE GRADUATE ADVISOR:**

Dr. Hsin-Piao Chen
ECS-652
(562) 985-1504
hsinchen@csulb.edu
Faculty: Eric Besnard, Hsun-Hu Chen and Hsin-Piao Chen

This is a two-year program in which two or more courses are planned to be offered each semester.

Undergraduate Background

A background in the following courses will be helpful:

MAE 381, Spacecraft Systems Engineering
MAE 452, Propulsion
MAE 465, Aerospace Structures II
MAE 483, Space Flight and Orbital Mechanics

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

(1) A minimum of four (4) courses in the area of Space Systems Engineering (4 x 3 = 12 units).
(2) A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
(3) A minimum of two (2) technical elective courses (2 x 3 = 6 units) for PLAN I, or a minimum of four (4) technical elective courses (4 x 3 = 12 units) for PLAN II, selected from approved upper division or graduate courses.
(4) Completion of a thesis (6 units of MAE 698) for PLAN I or completion of a directed research project (6 units of MAE 697) for PLAN II.

The following are core courses in the Space Systems Engineering Program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 508, Systems Engineering and Integration (Every semester)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 565, Advanced Aerospace Structures</td>
<td>3</td>
<td>Besnard</td>
</tr>
<tr>
<td>MAE 581, Space Vehicle Design</td>
<td>3</td>
<td>H.P. Chen</td>
</tr>
<tr>
<td>MAE 582, Rocket and Spacecraft Propulsion</td>
<td>3</td>
<td>Besnard</td>
</tr>
<tr>
<td>MAE 583, Astrodynamics</td>
<td>3</td>
<td>Besnard</td>
</tr>
<tr>
<td>MAE 585, Spacecraft Attitude Determination and Control</td>
<td>3</td>
<td>Besnard</td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may be taken (offered on demand)

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 522, Composite Materials</td>
<td>3</td>
<td>H.P. Chen</td>
</tr>
<tr>
<td>MAE 631, Thermal Radiation</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 633, Hypersonic Flow</td>
<td>3</td>
<td>H.H. Chen</td>
</tr>
<tr>
<td>EE 455, Space Electric Power Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EE 484, Satellite Communications</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
CALIFORNIA STATE UNIVERSITY, LONG BEACH
MASTER OF SCIENCE IN AEROSPACE ENGINEERING (MSAE)

**Program: Aircraft Systems Engineering**

Faculty: Eric Besnard, Hsun Hu Chen, Hsin-Piao Chen and Hamid Rahai

This is a two-year program in which two or more courses are planned to be offered each semester.

**Undergraduate Background**
A background in the following courses will be helpful:

- MAE 350, Flight Mechanics
- MAE 434, Aerodynamics II
- MAE 465, Aerospace Structures II

**Requirements**
Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

1. A minimum of four (4) courses in the area of Aircraft Systems Engineering (4 x 3 = 12 units).
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses (2 x 3 = 6 units) for PLAN I, or a minimum of four (4) technical elective courses (4 x 3 = 12 units) for PLAN II, selected from approved upper division or graduate courses.
4. Completion of a thesis (6 units of MAE 698) for PLAN I or completion of a directed research project (6 units of MAE 697) for PLAN II.

The following are core courses in the Aircraft System Engineering Program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 452, Propulsion</td>
<td>3</td>
<td>Kendall</td>
</tr>
<tr>
<td>MAE 508, Systems Engineering and Integration (Every semester)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 537, Advanced Fluid Dynamics I</td>
<td>3</td>
<td>Rahai, H.H. Chen</td>
</tr>
<tr>
<td>MAE 551, Aircraft Preliminary Design &amp; Performance</td>
<td>3</td>
<td>Schaufele</td>
</tr>
<tr>
<td>MAE 553, Stability and Control of Aerospace Vehicles</td>
<td>3</td>
<td>Kendall</td>
</tr>
<tr>
<td>MAE 565, Advanced Aerospace Structures</td>
<td>3</td>
<td>H.P. Chen</td>
</tr>
<tr>
<td>MAE 586, Avionics Systems</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may be taken (offered on demand):

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 522, Composite Materials</td>
<td>3</td>
<td>H.P. Chen</td>
</tr>
<tr>
<td>MAE 535/635, Computational Fluid Dynamics I &amp; II</td>
<td>3</td>
<td>H.H. Chen</td>
</tr>
<tr>
<td>MAE 572, Structural Design Optimization</td>
<td>3</td>
<td>H.P. Chen</td>
</tr>
<tr>
<td>MAE 637, Advanced Fluid Dynamics II</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 642, Aeroelasticity</td>
<td>3</td>
<td>H.H. Chen, H.P. Chen</td>
</tr>
</tbody>
</table>
Program: Aerodynamics and Computational Fluid Dynamics (CFD)

Faculty: Hsun Chen, Eric Besnard, Hamid Hefazi, and Hamid Rahai

This is a two-year program in which one or two courses are planned to be offered each semester.

Undergraduate Background

A background in the following courses or equivalents will be required:

MAE 305, Numerical Methods in Mechanical Engineering
MAE 330, Engineering Thermodynamics
MAE 333, Engineering Fluid Mechanics
MAE 334, Aerodynamics I

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

1. A minimum of four (4) core courses in the area of Aerodynamics and CFD (4 x 3 = 12 units).
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses (2 x 3 = 6 units) for PLAN I, or a minimum of four (4) technical elective courses (4 x 3 = 12 units) for PLAN II, selected from approved upper division or graduate courses.
4. Completion of a thesis (6 units of MAE 698) for PLAN I, or completion of a directed research project (6 units of MAE 697) for PLAN II.

The following are core courses in the Aerodynamics and CFD Program

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 533: Gas Dynamics</td>
<td>3</td>
<td>H.H. Chen</td>
</tr>
<tr>
<td>MAE 535: Computational Fluid Dynamics I</td>
<td>3</td>
<td>H.H. Chen</td>
</tr>
<tr>
<td>MAE 537: Advanced Fluid Dynamics I</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 633: Hypersonic Flow</td>
<td>3</td>
<td>H.H. Chen</td>
</tr>
<tr>
<td>MAE 635: Computational Fluid Dynamics II</td>
<td>3</td>
<td>H.H. Chen</td>
</tr>
<tr>
<td>MAE 637: Advanced Fluid Dynamics II</td>
<td>3</td>
<td>Rahai, Toossi</td>
</tr>
<tr>
<td>MAE 638: Engineering Calculation Methods for Turbulent Flow</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 639: Turbulence</td>
<td>3</td>
<td>Rahai</td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may be offered, based on demand, and counted as electives.

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 530: Measurement Techniques in Fluid Mechanics and Heat Transfer</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 531: Advanced Heat Transfer</td>
<td>3</td>
<td>Rahai, Toossi</td>
</tr>
<tr>
<td>MAE 536: Statistical Thermodynamics</td>
<td>3</td>
<td>Toossi</td>
</tr>
<tr>
<td>MAE 551: Aircraft Preliminary Design and Performance</td>
<td>3</td>
<td>Besnard</td>
</tr>
<tr>
<td>MAE 582: Rocket and Spacecraft Propulsion</td>
<td>3</td>
<td>Besnard</td>
</tr>
<tr>
<td>MAE 642: Aeroelasticity</td>
<td>3</td>
<td>H.H. Chen, H.P. Chen</td>
</tr>
</tbody>
</table>
Program: Aerospace Structures and Materials

Faculty: Hsin-Piao Chen, Ortwin Ohtmer, Hsien-Yang Yeh

This is a two-year program in which one or two courses are planned to be offered each semester.

Undergraduate Background

A background in the following courses will be helpful:

MAE 371: Analytical Mechanics II - Dynamics
MAE 373: Mechanics of Deformable Bodies
MAE 365: Aerospace Structures I
MAE 465: Aerospace Structures II

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor's degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

(1) A minimum of four (4) courses in the area of Aerospace Structures and Materials (4 x 3 = 12 units).
(2) A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
(3) A minimum of two (2) technical elective courses (2 x 3 = 6 units) for PLAN I, or a minimum of four (4) technical elective courses (4 x 3 = 12 units) for PLAN II, selected from approved upper division or graduate courses.
(4) Completion of a thesis (6 units of MAE 698) for PLAN I or completion of a directed research project (6 units of MAE 697) for PLAN II.

The following are core courses in the Aerospace Structures and Materials Program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 522: Composite Materials</td>
<td>3</td>
<td>H.P. Chen, Yeh</td>
</tr>
<tr>
<td>MAE 529: Structural Analysis of Composite Laminates</td>
<td>3</td>
<td>H.P. Chen, Yeh</td>
</tr>
<tr>
<td>MAE 563: Linear Finite Element Analysis</td>
<td>3</td>
<td>Ohtmer</td>
</tr>
<tr>
<td>MAE 565: Advanced Aerospace Structures</td>
<td>3</td>
<td>H.P. Chen</td>
</tr>
<tr>
<td>MAE 567: Advanced Mechanics of Deformable Bodies</td>
<td>3</td>
<td>Yeh, H.P. Chen</td>
</tr>
<tr>
<td>MAE 572: Structural Design Optimization</td>
<td>3</td>
<td>H.P. Chen</td>
</tr>
<tr>
<td>MAE 669: Design of Composite Structures</td>
<td>3</td>
<td>H.P. Chen, Yeh</td>
</tr>
</tbody>
</table>

In addition to the suggested courses, the following courses may be offered, based on demand.

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 568: Creep and Fatigue</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td>MAE 576: Engineering Vibrations</td>
<td>3</td>
<td>Vu</td>
</tr>
<tr>
<td>MAE 642: Aeroelasticity</td>
<td>3</td>
<td>H.H. Chen, H.P. Chen</td>
</tr>
<tr>
<td>MAE 663/763: Nonlinear Complex Structures and Mechanisms</td>
<td>3</td>
<td>Ohtmer</td>
</tr>
<tr>
<td>MAE 672: Stress Analysis in Design</td>
<td>3</td>
<td>H.P. Chen, Yeh</td>
</tr>
<tr>
<td>MAE 673: Theory of Elasticity and Plasticity</td>
<td>3</td>
<td>H.P. Chen, Yeh</td>
</tr>
</tbody>
</table>
The Department of Mechanical and Aerospace Engineering at California State University, Long Beach offers a graduate program leading to the Master of Science in Mechanical Engineering (MSME) degree.

The MSME degree is built upon broad and basic undergraduate instruction, with the goal of graduate students developing competence in the fields of: design and manufacturing, dynamics, vibrations and controls, materials and composites, mechanics and finite element methods, and thermal systems.

Modern laboratories in the following areas are maintained for undergraduate and graduate instruction and graduate research: computer-aided design (CAD), fluid power and mechanics, heat power, control systems, manufacturing, plastics, design, thermodynamics, heat flow, metallurgy and mechanical properties of materials.

This document is intended to provide a general overview of the Master of Science in Mechanical Engineering degree program. All material contained herein is subject to change without prior notice. The current CSULB Catalog and Schedule of Classes are the final authorities regarding class offerings, admission requirements to the University, and various deadlines, policies, and procedures. Both publications may be purchased from the University Bookstore. For further information and complete degree requirements, contact the Mechanical and Aerospace Engineering Department at (562) 985-1563.

The current graduate coordinator is Dr. Hamid Rahai. Advising appointments may be scheduled during the academic year by contacting the MAE Department Office (562-985-1563).

Area Concentrations

- **Dynamics, Vibrations and Controls:** This emphasis is for students with an interest in engineering vibrations and control systems. The program provides advanced knowledge of linear, nonlinear and random vibrations, control of mechanical systems, and dynamics with robot applications. Topics include: (a) engineering vibrations I & II (discrete models and continuous models); (b) random and nonlinear vibrations; (c) advanced control of mechanical systems; (d) advanced dynamics with robot applications; (e) engineering acoustics; and (f) modal analysis.

- **Fluid and Thermal Sciences:** The curriculum is designed to give the student advanced knowledge across a broad range of fluid and thermal sciences. Advanced topics include: convection, combustion, porous media, fluid and radiation. This area benefits from facilities such as several subsonic wind-tunnel and advanced computational resources used for various graduate research projects.

- **Materials:** This program focuses on the study of materials, including metals, plastics, ceramics, and composites. Classes and research activities are related to: (a) understanding and applying advanced materials science to developing new and improved materials; (b) developing applications of newer materials to the design and manufacture of advanced biomedical devices, improved sporting equipment, motor vehicles, and aerospace vehicles.

- **Mechanics:** This emphasis is designed to give students advanced knowledge across a broad range of mechanics. Advanced topics include: linear finite element analysis, nonlinear complex structures and mechanisms, creep and fatigue, advanced mechanics of deformable bodies, design of composite structures, stress analysis in design, theory of elasticity and plasticity, and digital simulation in engineering. The program benefits from advanced experimental and computational resources.
• **Design and Manufacturing**: This emphasis focuses on “Integrated Design and Advanced Manufacturing based on Solid Modeling as the core communication cornerstone of concurrent engineering”. Topics include: software application for 3-D modeling, finite element analysis, materials sciences and mechanics. Projects range from modeling and analysis of single machine components to complex assemblies. The program benefits from state-of-the-art equipment such as Rapid Prototyping, 3-D scanning, computer-controlled machining tools, as well as software such as NASTRAN, SOLIDWORKS, IDEAS and ProE.

**Prerequisites**

1. A bachelor’s degree in an accredited curriculum in mechanical engineering, with a minimum GPA of 2.70; or
2. A bachelor’s degree in engineering with a minimum GPA of 2.70, a natural science or other appropriate discipline with the requirement that essential undergraduate prerequisites in mechanical engineering must be satisfied;
3. Graduate students must consult with the graduate advisor for information concerning procedures and requirements for appropriate approval of their courses of study, prior to enrolling in their graduate programs;
4. The Writing Proficiency Examination (WPE) must be taken and passed during the first semester in residence. Failure to pass the WPE will prevent registration in engineering courses in subsequent semesters. Courses taken after the semester, without having passed the WPE, will not be counted towards any graduate engineering degree.

**Advancement to Candidacy**

1. Removal of all undergraduate deficiencies as determined by the Department Graduate Advisor;
2. Students may, at the discretion of the Department Graduate Advisor, be required to take examinations in their chosen areas.

**Requirements**

**PLAN I**
Completion of a minimum of 30 units beyond the bachelor’s degree in upper division and graduate courses approved by the student’s Department Graduate Study Committee, including:
1. Eighteen units of 500- and or 600-level courses in mechanical and aerospace engineering;
2. Six units of electives selected from approved upper-division or graduate courses from appropriate areas;

**PLAN II**
Completion of a minimum of 36 units beyond the bachelor’s degree in upper division and graduate courses approved by the student’s Department Graduate Study Committee, including:
1. Twenty-four units of 500- and/or 600-level courses in mechanical and aerospace engineering;
2. Six units of electives selected from approved upper-division or graduate courses from appropriate areas;
3. Completion of six units of MAE 697.

**MSME GRADUATE ADVISOR:**
Dr. Hamid Rahai
ECS-648
(562) 985-5132
rahai@csulb.edu
Program: DYNAMICS, VIBRATION AND CONTROL

Faculty: Drs. Ramin Esfandiari, Bei Lu, Hung Vu, and Hillar Unt

This is a two-year program in which one or two courses are planned to be offered each semester.

Undergraduate Background

Background in the following courses will be helpful:

MAE 305, Numerical Methods in Mechanical Engineering
MAE 371, Analytical Mechanics II - Dynamics
MAE 373, Mechanics of Deformable Bodies
MAE 375, Kinematics and Dynamics of Mechanisms
MAE 376, Modeling and Analysis of Dynamic Systems
MAE 490, Special Topics in Mechanical Engineering:
  MAE 490A, CAD/CAM
  MAE 490B, Robotics Principles
  MAE 490C, Environmental Engineering and Atmospheric Science
  MAE 490D, Hybrid Electrical Vehicles System Design
  MAE 490E, HVAC Systems Design and Equipment

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

(1) A minimum of four (4) courses in the area of Dynamics, Vibrations and Controls (4 x 3 = 12 units).
(2) A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
(3) A minimum of two (2) technical elective courses selected from approved upper division or graduate courses (2 x 3 = 6 units).
(4) Completion of a thesis (6 units of MAE 698) for PLAN I or completion of a directed research project (6 units of MAE 697) for PLAN II.

The following are core courses in the Dynamics, Vibrations and Controls Program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 573, Advanced Control of Mechanical Systems (F&lt;sup&gt;odd&lt;/sup&gt;)</td>
<td>3</td>
<td>Esfandiari</td>
</tr>
<tr>
<td>MAE 575, Advanced Dynamics with Robot Applications (S&lt;sup&gt;odd&lt;/sup&gt;)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 576, Engineering Vibrations I (F&lt;sup&gt;even&lt;/sup&gt;)</td>
<td>3</td>
<td>Vu</td>
</tr>
<tr>
<td>MAE 671, Random and Nonlinear Vibrations (S&lt;sup&gt;even&lt;/sup&gt;)</td>
<td>3</td>
<td>Esfandiari</td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may also be offered, based on demand.

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 579, Engineering Acoustics</td>
<td>3</td>
<td>Unt</td>
</tr>
<tr>
<td>MAE 675, Modal Analysis</td>
<td>3</td>
<td>Esfandiari, Vu</td>
</tr>
<tr>
<td>MAE 676, Engineering Vibrations II</td>
<td>3</td>
<td>Esfandiari, Vu</td>
</tr>
</tbody>
</table>
The Fluids and Thermal Systems Engineering concentration is a two-year program in which one or two courses are planned to be offered each semester.

Undergraduate Background
Students must have the required background course or equivalents:

- CE 335, Fluid Mechanics
- MAE 305, Numerical Methods in Mechanical Engineering
- MAE 330, Engineering Thermodynamics I
- MAE 409B, Introduction to Computational Fluid Dynamics and Heat Transfer
- MAE 431, Heat Transfer Systems Design

Requirements
Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

1. A minimum of four (4) courses in the area of Fluids and Thermal Systems (4 x 3 = 12 units).
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses selected from approved upper division or graduate courses (2 x 3 = 6 units).
4. Completion of a thesis (6 units of MAE 698 for PLAN I) or a directed research project (6 units of MAE 697 for PLAN II).

The following are core courses in the Fluids and Thermal Systems Program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 531, Advanced Heat Transfer (S&lt;sub&gt;odd&lt;/sub&gt;)</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 532, Combustion I (S&lt;sub&gt;even&lt;/sub&gt;)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 536, Statistical Thermodynamics (F&lt;sub&gt;odd&lt;/sub&gt;)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 537, Advanced Fluid Dynamics I (F&lt;sub&gt;even&lt;/sub&gt;)</td>
<td>3</td>
<td>Rahai</td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may also be offered based on demand.

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 490C, Environmental Engineering &amp; Atmospheric Sciences</td>
<td>3</td>
<td>Toossi</td>
</tr>
<tr>
<td>MAE 490E, HVAC Systems Design and Equipment</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 430/530, Measurement Techniques in Fluid Mechanics and Heat Transfer</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 438/538, Heating, Ventilating, Air Conditioning and Refrigeration</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 533, Gas Dynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 534, Transport Processes in Porous Media</td>
<td>3</td>
<td>Torabzadeh</td>
</tr>
<tr>
<td>MAE 435/535, Computational Fluid Dynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 536, Statistical Thermodynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 537, Advanced Fluid Dynamics I</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 631, Thermal Radiation</td>
<td>3</td>
<td>Toossi</td>
</tr>
<tr>
<td>MAE 632, Combustion II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 637, Advanced Fluid Dynamics II</td>
<td>3</td>
<td>Rahai</td>
</tr>
<tr>
<td>MAE 638, Engineering Calculation Methods for Turbulent Flow</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 639, Turbulence</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 635/735, Computational Fluid Dynamics II</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Faculty: Drs. Hsin-Piao Chen, Barclay Gilpin, Min-Ten Jahn, and Hsien-Yang Yeh

The Materials Engineering concentration is a two-year program in which one or two courses are planned to be offered each semester. The goal of this program is to develop competence in the design and processing of engineering materials, including metals and alloys, composites, plastics, and biomaterials. Properties and applications of materials are emphasized. Also, to enhance methods and skills for research development and innovation.

Undergraduate Background

Students enrolled in the materials program must have taken the following required courses or equivalents:

- MAE 322, Engineering Materials and Materials Processes
- MAE 323, Engineering Metallurgy I Laboratory
- MAE 361, Materials and Properties Laboratory
- MAE 373, Mechanics of Deformable Bodies
- MAE 374, Mechanical Properties of Materials Laboratory

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

1. A minimum of four (4) courses in the area of Materials Engineering (4 x 3 = 12 units).
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses selected from approved upper division or graduate courses (2 x 3 = 6 units).
4. Completion of a thesis (6 units of MAE 698 for PLAN I) or a directed research project (6 units of MAE 697 for PLAN II).

The following are core courses in the Materials Engineering Program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 521, Engineering Metallurgy II (S_odd)</td>
<td>3</td>
<td>Jahn</td>
</tr>
<tr>
<td>MAE 527, Metals and Plastics Manufacturing Processes (F_odd)</td>
<td>3</td>
<td>Jahn</td>
</tr>
<tr>
<td>MAE 529, Structural Analysis of Composite Laminates (F_even)</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td>MAE 568, Creep and Fatigue (S_even)</td>
<td>3</td>
<td>Yeh</td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may also be offered based on demand.

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 424/524, Engineering Principles and Properties of Plastics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 567, Advanced Mechanics of Deformable Bodies</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 572, Structural Design Optimization</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 669, Design of Composite Structures</td>
<td>3</td>
<td>Yeh</td>
</tr>
</tbody>
</table>
CALIFORNIA STATE UNIVERSITY, LONG BEACH
MASTER OF SCIENCE IN MECHANICAL ENGINEERING (MSME)

**Program: MECHANICS**

Faculty: Drs. Barclay Gilpin, Karl Grote, Ortwin Ohtmer, and Hsien-Yang Yeh

The Mechanics concentration is a two-year program in which one or two courses are planned to be offered each semester.

**Undergraduate Background**

Students must have the required background courses or equivalents:

- MAE 305, Numerical Methods in Mechanical Engineering
- MAE 371, Analytical Methods II (Dynamics)
- MAE 373, Mechanics of Deformable Bodies
- MAE 409A, Finite Element Methods I
- MAE 490A, CAD/CAM
- MAE 471, Analysis and Design of Machine Components
- MAE 472, Design of Mechanical Engineering Systems

**Requirements**

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor's degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

1. A minimum of four (4) courses in the Mechanics area (4 x 3 = 12 units).
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses selected from approved upper division or graduate courses (2 x 3 = 6 units).
4. Completion of a thesis (6 units of MAE 698 for PLAN I) or a directed research project (6 units of MAE 697 for PLAN II).

The following are core courses in the Mechanics program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 563, Linear Finite Element Analysis (f Even)</td>
<td>3</td>
<td>Ohtmer</td>
</tr>
<tr>
<td>MAE 567, Advanced Mechanics of Deformable Bodies (f Odd)</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td>MAE 568, Creep and Fatigue (s Even)</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td>MAE 663/763, Nonlinear Complex Structures and Mechanisms (s Odd)</td>
<td>3</td>
<td>Ohtmer</td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may also be offered based on demand.

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 669, Design of Composite Structures</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td>MAE 672, Stress Analysis in Design</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 673, Theory of Elasticity and Plasticity</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td>MAE 677/777, Digital Simulation in Engineering</td>
<td>3</td>
<td>Ohtmer</td>
</tr>
</tbody>
</table>
Faculty: Drs. Mihir Das, Barclay Gilpin, Karl Grote

The Mechanical Engineering Design and Manufacturing concentration is a two-year program in which one or two courses are planned to be offered each semester.

Undergraduate Background

Students must have the required background courses or equivalents:
- MAE 172, Engineering Design Graphics
- MAE 272, Introduction to Manufacturing Processes
- MAE 322, Engineering Materials and Materials Processes
- MAE 375, Kinematics and Dynamics of Mechanisms
- MAE 425, Chemical and Electrochemical Manufacturing Processes
- MAE 471, Analysis and Design of Machine Components
- MAE 472, Design of Mechanical Engineering Systems

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

1. A minimum of four (4) courses in the area of Mechanical Engineering Design and Manufacturing area (4 x 3 = 12 units).
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses selected from approved upper division or graduate courses (2 x 3 = 6 units).
4. Completion of a thesis (6 units of MAE 698 for PLAN I) or a directed research project (6 units of MAE 697 for PLAN II).

The following are core courses in the Mechanical Engineering Design & Manufacturing program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 512/612, Computer Aided Design in Mechanical Engineering (Seven)</td>
<td>3</td>
<td>Gilpin</td>
</tr>
<tr>
<td>MAE 527, Metals &amp; Plastics Manufacturing Processes (FOdd)</td>
<td>3</td>
<td>Jahn</td>
</tr>
<tr>
<td>MAE 574/474, Computer Aided Manufacturing (FEven)</td>
<td>3</td>
<td>Gilpin</td>
</tr>
<tr>
<td>MAE 595/495, Rapid Product Development (SOdd)</td>
<td>3</td>
<td>Ohtmer</td>
</tr>
</tbody>
</table>

In addition to the core courses, the following courses may also be offered based on demand.

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 511, Advanced Manufacturing Management Systems</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td>MAE 669, Design of Composite Structures</td>
<td>3</td>
<td>Yeh</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
The College of Engineering offers graduate study programs for the Master of Science in Engineering degree. Typical tasks and responsibilities undertaken by students in the curriculum are those that would not fall within one of the traditional specialties in engineering, e.g., aerospace, chemical, civil, electrical, mechanical, or computer engineering and computer science. The student may pursue an interdisciplinary program, approved by a Graduate Advisor, by selecting courses from the various departments of engineering. Additional information concerning the programs, special facilities, laboratories, and research possibilities, may be obtained from the College of Engineering.

This document is intended to provide a general overview of the Master of Science in Engineering degree program. All material contained herein is subject to change without prior notice. The current CSULB Catalog and Schedule of Classes are the final authorities regarding class offerings, admission requirements to the University, and various deadlines, policies, and procedures. Both publications may be purchased from the Forty-Niner Bookstore.

The current graduate coordinator is Dr. Hamid Rahai. Advising appointments may be scheduled during the academic year by contacting the MAE Department Office (562-985-1563).

**MSE Area Concentrations:**

- **Management Engineering:** This emphasis is an alternative to pursuing an MBA, and is for experienced engineers who want to pursue a career in engineering management. Topics include: quantitative methods for engineering managers, management of engineering technology and innovation, engineering project management and system engineering and integration. The program benefits from faculty with extensive industry experience who teach and supervise student theses and projects.

- **Interdisciplinary Engineering:** This emphasis is for students with engineering degrees other than the BSAE or BSME, who still want to pursue one of the concentrations in these disciplines, or those interested in an interdisciplinary area within the college of engineering. Students should meet the pre-requisites and/or deficiencies as determined by the corresponding graduate advisor and come up with a plan of studies before enrolling in graduate classes.

**Prerequisites**

1. A bachelor's degree in an accredited curriculum in mechanical or aerospace engineering, with a minimum GPA of 2.5 in the last 60 semester units (or 90 quarter units); or
2. A bachelor's degree in engineering with a minimum GPA of 2.50 in the last 60 units, a natural science or other appropriate discipline with the requirement that essential undergraduate prerequisites in mechanical or aerospace engineering are satisfied;
3. Graduate students must consult with the graduate advisor for information concerning procedures and requirements for appropriate approval of their courses of study prior to enrolling in their graduate programs;
4. The Writing Proficiency Examination (WPE) must be taken and passed during the first semester in residence. Failure to pass the WPE will prevent registration in engineering courses in subsequent semesters. Courses taken after the first semester, without having passed the WPE, will not be counted towards any graduate engineering degree.
Advancement to Candidacy

1. Removal of all undergraduate deficiencies as determined by the Department’s Graduate Advisor;
2. Students may, at the discretion of the Department Graduate Advisor, be required to take examinations in their chosen areas.

Requirements

PLAN I

Completion of a minimum of 30 units beyond the bachelor’s degree in upper division and graduate courses approved by the student’s Department Graduate Study Committee, including:
4. Eighteen units of 500- and or 600-level courses in mechanical and aerospace engineering;
5. Six units of electives selected from approved upper-division or graduate courses from appropriate areas;

PLAN II

Completion of a minimum of 36 units beyond the bachelor’s degree in upper division and graduate courses approved by the student’s Department Graduate Study Committee, including:
4. Twenty-four units of 500- and/or 600-level courses in mechanical and aerospace engineering;
5. Six units of electives selected from approved upper-division or graduate courses from appropriate areas;
6. Completion of six units of MAE 697.

Students interested in pursuing the MSE degree should consult with a graduate advisor before submitting an application to this degree program.

MSME/ MSE GRADUATE ADVISOR:

Dr. Hamid Rahai
ECS-648
(562) 985-5132
rahai@csulb.edu
Program: MANAGEMENT ENGINEERING

Faculty: Drs. Barclay Gilpin and Hillar Unt (Coordinator), and Mr. Don Stouder

The Master of Science in Engineering (MSE), with an emphasis in Management Engineering, primarily admits students with a traditional engineering background and a minimum of three years of work experience. It emphasizes the management of engineering based endeavors and does not require undergraduate business coursework as prerequisites for graduate work. One or two core courses are planned to be offered each semester.

Undergraduate Background

- A bachelor’s degree in an ABET accredited curriculum in engineering, with a minimum GPA of 2.5; or
- A bachelor’s degree with a minimum GPA of 2.5 in engineering, mathematics, or a natural science, or other discipline, with the requirement that essential undergraduate prerequisites be satisfied.

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor’s degree in graduate courses approved by the Department’s Graduate Studies Committee, including:

1. PLAN I - A minimum of 18 units in 500 and/or 600 level courses in engineering
   PLAN II - A minimum of 24 units in 500 and/or 600 level courses in engineering.
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses selected from approved upper division or graduate courses (2 x 3 = 6 units).
4. Completion of a thesis (6 units of MAE 698 for PLAN I) or a directed research project (6 units of MAE 697 for PLAN II).

The following are core courses in the Management Engineering program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 505, Quantitative Methods for Engineering Managers</td>
<td>3</td>
<td>Stouder</td>
</tr>
<tr>
<td>MAE 506, Management of Engineering Technology and Innovation</td>
<td>3</td>
<td>Stouder</td>
</tr>
<tr>
<td>MAE 507, Engineering Project Management</td>
<td>3</td>
<td>Stouder</td>
</tr>
<tr>
<td>MAE 508/408, Systems Engineering and Integration</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Description of the Curriculum

The curriculum for the program in Management Engineering has been specifically developed to meet the needs expressed by industry leaders for effective managers who are knowledgeable in management engineering principles and practices.

In order to provide the educational background and skills necessary to meet these needs, the following topics can be addressed in this curriculum:

- Management Engineering Techniques
- Interpersonal Concepts and Skills
- Organizational Design
- Engineering Economics
- Project Engineering
- Manufacturing Resource Planning
- Decision Analysis and Forecasting
- Technology Assessment
- Entrepreneurial Engineering
- Management Engineering Systems
- Critical Organizational Interfaces
- Engineering Contracts/Negotiations
- CAD/CAM and Automation tools
- Production/Operations Engineering
- Engineering Probability and Statistics
Program: INTERDISCIPLINARY ENGINEERING

Faculty: Drs. Mihir Das (Coordinator) and Hillar Unt

The Master of Science in Engineering (MSE), with emphasis on Systems Engineering, has been developed for qualified individuals with specific work experience and work assignments in complex aerospace programs.

Undergraduate Background

- A bachelor's degree from an ABET-accredited curriculum in engineering, with a minimum GPA of 2.5; or
- A bachelor's degree with a minimum GPA of 2.5 in engineering, mathematics, or a natural science, or other discipline, with the requirement that essential undergraduate prerequisites will be satisfied.

Requirements

Completion of a minimum of 30 (for PLAN I) or 36 units (for PLAN II) beyond the bachelor's degree in graduate courses approved by the Department's Graduate Studies Committee, including:

1. PLAN I - A minimum of 18 units in 500 and/or 600 level courses in engineering
   PLAN II - A minimum of 24 units in 500 and/or 600 level courses in engineering.
2. A minimum of two (2) advanced engineering mathematics courses beyond basic calculus, basic differential equations, and linear algebra (2 x 3 = 6 units).
3. A minimum of two (2) technical elective courses selected from approved upper division or graduate courses (2 x 3 = 6 units).
4. Completion of a thesis (6 units of MAE 698 for PLAN I) or a directed research project (6 units of MAE 697 for PLAN II).

The following are some suggested courses in the Systems Engineering program:

<table>
<thead>
<tr>
<th>Course Number and Title</th>
<th>Units</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE 501, Engineering Analysis I</td>
<td>3</td>
<td>Esfandiari</td>
</tr>
<tr>
<td>MAE 502, Engineering Analysis II</td>
<td>3</td>
<td>Esfandiari</td>
</tr>
<tr>
<td>MAE 506, Management of Engineering Technology and Innovation</td>
<td>3</td>
<td>Stouder</td>
</tr>
<tr>
<td>MAE 508/408, Systems Engineering and Integration</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MAE 511, Advanced Manufacturing Management Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGR 532B, Logistics Principles and Practices</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
The Ph.D. in Engineering and Industrial Applied Mathematics, offered jointly by the College of Engineering at California State University, Long Beach and The Claremont Graduate University, allows students to pursue doctoral programs in most areas of engineering and applied mathematics.

The College of Engineering at California State University, Long Beach (CSULB) has the primary responsibility for the engineering portion of the program, and the Department of Mathematics at The Claremont Graduate University (CGU) has the primary responsibility for the applied mathematics portion. The program of study for each Ph.D. candidate is carefully integrated to ensure the interdisciplinary nature of each student’s research.

Program Description

Students enrolled in the Joint Ph.D. program arrange with the Program Committee (comprised of faculty from both institutions) for an advisor in mathematics at CGU and an advisor in engineering at CSULB. The two advisors confer periodically regarding the student’s progress, and the Program Committee monitors the student’s overall performance. In collaboration with the two advisors, the student develops an individualized program of study. To complete the program, the following requirements must be met.

Course Work

The Ph.D. in Engineering and Industrial Applied Mathematics requires a minimum of 72 semester units of course work, independent study, and research beyond the bachelor’s degree. Students may transfer a maximum of 24 units of related graduate-level course work, with the approval of the Program Committee.

Residency

Of the required 72 semester units, a minimum of 24 units must be completed in the graduate engineering program at CSULB, and a minimum of 24 units must be taken in the mathematics program at CGU.

Preliminary Examinations

After completing the required 24 units of course work at each institution (including transfer units), the student is required to pass a three-hour preliminary examination in each of four areas: two areas in engineering and two areas in mathematics. The two engineering examinations are taken during the same month, and the two mathematics examinations are likewise taken during the same month. A student who fails either set of examinations may retake that set once, after petitioning the Program Committee.

Research Tools

Students in the Joint Doctoral Program must demonstrate proficiency in problem-solving ability using computer programs. This demonstration must prove that the student has used an appropriate computer language and algorithmic methods to solve an engineering problem.
Research Proposal

After successfully completing the preliminary examinations, the student chooses a
Doctoral Committee, comprised of at least two faculty members from CGU and at least two
from CSULB. The Doctoral Committee supervises the student’s research preparation and assists in
defining the research proposal for the Ph.D. dissertation.

Qualifying Examination

The qualifying examination consists of an oral presentation of the dissertation proposal to
the Doctoral Committee. Upon approval from the committee, the student embarks on research
and thesis writing.

Dissertation and Final Oral Examination

After completing his or her research, the student prepares the dissertation in accordance
with the CGU regulations. The final oral examination consists of a defense of the dissertation in
front of the full Doctoral Committee.

A more complete description of the Joint Ph.D. Program in Engineering and Industrial
Applied Mathematics can be found in the CSULB Catalog
[http://www.csulb.edu/Academics/Cats-Skeds/cats-skeds.html], under the College of
Engineering section.

For further information, and/or to request an application package for the Joint Doctoral
Program, please contact the following campus coordinators:

Dr. Mihir K. Das  
CSULB/COE Ph.D. Coordinator  
CSULB College of Engineering  
1250 Bellflower Boulevard  
Long Beach, CA 90840  
Phone: (562) 985-5257  
Fax: (562) 985-7561  
E-Mail: mdas@csulb.edu

Dr. Ellis Cumberbatch  
Program in Mathematics  
Claremont Graduate University  
Phone: (909) 621-8080  
E-Mail: EllisCumberbatch@cgu.edu
GRADUATE COURSES (From the 2005/2006 CSULB Catalog)

501. Engineering Analysis I
502. Engineering Analysis II
505. Quantitative Methods for Engineering Managers
506. Management of Engineering Technology and Innovation
507. Engineering Project Management
508/408. Systems Engineering and Integration
511. Advanced Manufacturing Management Systems
512/612. Computer Aided Design in Mechanical Engineering
521. Engineering Metallurgy II
524/424. Engineering Principles and Properties of Plastics
527. Metals and Plastics Manufacturing Processes
529. Structural Analysis of Composite Laminates
530/430. Measurement Techniques in Fluid Mechanics and Heat Transfer
531. Advanced Heat Transfer
532. Combustion I
533. Gas Dynamics
534. Transport Processes in Porous Media
535/435. Computational Fluid Dynamics I
536. Statistical Thermodynamics
537. Advanced Fluid Dynamics
538/438. Heating, Ventilating, Air Conditioning and Refrigeration
551/451. Aircraft Preliminary Design and Performance
553/453. Stability and Control of Aerospace Vehicles
563. Linear Finite Element Analysis
565. Advanced Aerospace Structures
567. Advanced Mechanics of Deformable Bodies
568. Creep and Fatigue
572. Structural Design Optimization
573. Advanced Control of Mechanical Systems
574/474. Computer-Aided Manufacturing
575. Advanced Dynamics with Robot Applications
576. Engineering Vibrations
579. Engineering Acoustics
581. Space Vehicle Design
582. Rocket and Spacecraft Propulsion
585. Astrodynamics
586/486. Avionics Systems
590/490. Advanced Topics in Mechanical and Aerospace Engineering
595/495. Rapid Product Development
599/499. Mechanical and Aerospace Engineering Seminar
612/512. Computer-Aided Design in Mechanical Engineering
631. Thermal Radiation
632. Combustion II
633. Hypersonic Flow
635/735. Computational Fluid Dynamics II
637. Advanced Fluid Dynamics II
638. Engineering Calculation Methods for Turbulent Flow
639. Turbulence
642. Aeroelasticity
663/763. Nonlinear Complex Structures and Mechanisms
669. Design of Composite Structures
671. Random and Nonlinear Vibrations
672. Stress Analysis in Design
673. Theory of Elasticity and Plasticity
675. Modal Analysis
676. Engineering Vibrations II
677/777. Digital Simulation in Engineering
690/590. Advanced Topics in Mechanical and Aerospace Engineering
691. Directed Studies
697. Directed Research
698. Thesis
735/635. Computational Fluid Dynamics
763/663. Nonlinear Complex Structures and Mechanisms
777/677. Digital Simulation in Engineering
795. Advanced Directed Studies
797. Advanced Directed Research
798. Doctoral Dissertation