

**JOINT DOCTORAL PROGRAM
IN
ENGINEERING AND
INDUSTRIAL APPLIED MATHEMATICS**

**Conducted by
California State University, Long Beach,
and Claremont Graduate University**



STUDENT HANDBOOK

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Joint Doctoral Program in Engineering and Industrial Applied Mathematics

Introduction

The doctoral program in Engineering and Industrial Applied Mathematics is a joint program between the College of Engineering (COE) at California State University, Long Beach (CSULB), and the School of Mathematical Sciences at Claremont Graduate University (CGU). This program was approved by the CSULB Senate in 1987 and granted its first doctoral degree in 1995.

The Joint Doctoral Program was created with two educational goals that continue to be pertinent today:

- Develop a doctoral program that seeks to judiciously combine the applied mathematics field with one or more branches of engineering at both the academic and research level.
- Draw upon the synergistic expertise of the research faculty at both institutions to offer an interdisciplinary degree that integrates advanced techniques of mathematical analysis with advanced engineering coursework and research.

The program's key objective is to facilitate an individually designed program for each student in an interdisciplinary setting for advanced study and research. The College of Engineering at CSULB has the primary responsibility for the engineering portion of the program; the School of Mathematical Sciences at 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.

Degree Designation

In accordance with an agreement between CGU and CSULB, the degree is designated the ***Doctorate of Philosophy in Engineering and Industrial Applied Mathematics*** and is granted at Claremont Graduate University in the name of the two universities. The diploma indicates the dual nature of the degree and specifies that it is granted only when requirements have been satisfied in both subject areas as specified by the collaborating institutions.

Program Supervision

Overall program supervision is the responsibility of the **Program Committee**, consisting of the directors of the Joint Doctoral Program (JDP) from each institution, the Dean of Mathematics at CGU, and the Dean of Engineering at CSULB.

Admission Requirements

Students must be admitted to both institutions jointly. Admission will be granted to a limited number of qualified students; therefore, application should be made as early as possible. Applications are encouraged from both men and women, particularly from

members of minority groups or individuals with disabilities. Completed applications must be received by **April 1 for the fall semester** or **October 1 for the spring semester**, although late applications are allowed at the discretion of the Program Committee. The Program Committee is responsible for making admission decisions consistent with campus regulations (see Application Procedure in this booklet).

To be admitted to the Joint Doctoral Program, an applicant must have received a bachelor's or master's degree in science, engineering, or mathematics from an accredited institution. Moreover, he or she must have attained scholastic records and present confidential recommendations which indicate that he or she is well qualified to pursue, with distinction, advanced study and research. Be advised that admission may be refused solely on the basis of limited facilities in the option desired.

GRE Requirement

The analytical, verbal, and quantitative portion of the General Record Examination (GRE) is required before admission. GRE subject examinations (mathematics and engineering) are not required. Applicants whose first or native language is **not** English are required to have a **current** minimum score of 550 (213 on the new scale) on the *Test of English as a Foreign Language* (TOEFL); however, this requirement is waived for students with a bachelor's or master's degree from an accredited U. S. university.

Registration and Enrollment

It is important that students register and enroll in classes each semester either at CGU or CSULB. Failure to enroll at any given semester will be considered leave without permission (discontinued enrollment) and the student will be dropped from the program.

Program Planning and Supervision

At CSULB, an initial engineering advisor is assigned to the student at the time of admission. At CGU, the student needs to arrange with the program director, within the first semester of study, for a mathematics advisor. The student's program of study is arranged individually in collaboration with their advisors; the two advisors confer periodically regarding the student's progress. The Program Committee monitors the student's overall performance.

Course Work and Examinations

A minimum 72 units of course work, independent study, and research (including transfer credit) must be completed. Transfer credit of up to 24 units of related courses at the master's level is permissible on approval of the Program Committee; this course work must have been completed with at least a grade of B or above, at an accredited institution, and must be directly related to the joint program and the student's goals. Of the 72 units, a minimum of 24 units must be completed in the graduate engineering program at CSULB and a minimum of 24 in the graduate mathematics program at CGU. Both sets of 24 units must conform to the area requirements of the relevant institution and **must be approved by the Program Committee**. All degree requirements must be

completed within seven years (or six with the transfer of 24 units according to CGU regulations) from the time a student begins graduate study.

CSULB Course Requirement

The only specific CSULB course requirement is four units of **Engineering 796: Doctoral Seminar (1)**. The remaining 20 units, for students who have received transfer credit, may include courses needed for the Preliminary Examinations (see the Preliminary Examination section of this handbook), Doctoral Dissertation, Advanced Special Topics, and Advanced Directed Studies. Presently, students are permitted to count the following courses in addition to the regular graduate courses, offered by the five engineering departments, towards meeting the CSULB 24-unit course requirement.

- ENGR 790: Advanced Special Topics in Engineering (8 units allowed)
- ENGR 795 or MAE 795: Advanced Directed Studies (8 units allowed)
- ENGR 796: Doctoral Seminar (4 units required)
- ENGR 798 or MAE 798: Doctoral Dissertation (4 units allowed)

Minimum Student Load per Semester

It is **highly recommended** that doctoral students enroll in at least 9.0 units per semester in order to demonstrate progress towards the degree. The CSULB director of the program, in consultation with the doctoral advisor, **may require** that a student take at least 9.0 units per semester if the student is not showing adequate progress.

These courses may include the following:

- ENGR 797A: Preparation for Ph.D. Preliminary Examinations
- ENGR 797B: Preparation for Ph.D. Qualifying Examination

Students may take from 4.0 to 12.0 units of ENGR 797A or ENGR 797B each semester, though these courses may not be used to fulfill the 72-unit course work. Both of these courses are offered on Credit/No Credit bases and are designed to formally recognize the students' efforts towards the program.

Residency Requirements

Doctoral students must complete their program within a period of seven years (or six with the transfer of 24 units) according to CGU regulations (see below). During this time, a minimum of 72 units of course work, independent study, and research (including transfer credit) must be completed. Normally no more than 16 units per semester may be credited toward the degree. No more than 12 units per summer session may be credited toward the degree. The transfer of credit form is available on the CGU website. The Program Committee will consider petitions for extensions and/or exemptions.

All degree requirements must be completed within seven years from the time a student begins graduate study. Work for which transfer credit is granted will be counted as part of the seven years, e.g., if transfer credit of 24 units (one year) is granted, the time limit will be six years.

The residency requirements for the Ph.D. may be met either by two semesters of full-time study in a 24-month period or by the completion of 48 units of course work within a 48-month period (including work in the summer session).

Students who receive transfer credit for 12 units or less may meet the residence requirement either by completing two full-time semesters of course work within a 24-month period or by completing 36 units within a 48-month period. Those receiving transfer credit for 13 to 24 units may meet the residence requirement by completing 24 units within a 36-month period. The seven-year maximum time period for the Ph.D. degree is reduced by six months for 12 units or less of transfer credit and by 12 months for 13 to 24 units of transfer credit.

Plan of Study

After consultation with their advisors, students are **required**, before the end of the first year, to prepare and file with the Program Committee a Plan of Study for completing the course requirements for the degree. The purpose of the Plan of Study is to ensure that the student is aware of the requirements for the degree. The Plan of Study should indicate the areas of study that the student will be taking in preparation for the preliminary examinations. In consultation with the student's advisor and Program Committee, the Plan of Study may be altered at a subsequent time by petition.

If a student withdraws from the program after completing a substantial portion of the course work, a master's degree at either or both institutions is still possible by satisfaction of the appropriate requirements. Both CGU and CSULB require 31-36 semester units of course work for master's degrees.

Preliminary Examinations

The student is required to pass written preliminary examinations. These examinations consist of four examination areas: **two in engineering** and **two in mathematics**. These examinations should be taken **immediately** after completion of the relevant course work at each institution. These examinations are given two or three times a year at the discretion and under the control of the Program Committee. Should a student fail an examination, they may petition the Program Committee for one retake.

Before taking the first preliminary examination, the student **is required** to complete the Preliminary Examination Permission Form (available at the CSULB website, www.csulb.edu/colleges/coe, or at the CGU site, www.cgu.edu/math). This form requires the student to specify the four areas of the Preliminary Examination; the student's intended dissertation advisor and the directors of the Joint Doctoral Program must sign it. The purpose of this form is to certify that the student and dissertation advisor are in agreement on the set of examinations. If, in the course of time, this set of examinations and/or the advisor is amended, the form must be resubmitted. The preliminary examinations are considered completed when the four examinations specified on the student's form have been successfully passed.

CSULB College of Engineering Preliminary Examinations

The College of Engineering requires a minimum of **two graduate courses** (graded B or above) as a basis for each Preliminary Examination. With the consent of their dissertation advisor, students may select **two topics from the list below**. With the permission of their dissertation advisor and the CSULB director of Joint Doctoral Program, they may also designate other topics for their Preliminary Examination.

Chemical Engineering Topics:¹

- Chemical Engineering Science (minimum of two courses)
 - CHE 510: Multiphase Flow and Interfacial Phenomena
 - CHE 530: Advanced Reactor Kinetics
 - CHE 565: Biochemical Engineering
 - CHE 585: Air Pollution
- Applied Engineering Mathematics (minimum of two courses)
 - CHE 520: Advanced Transport Phenomena
 - CHE 560: Advanced Chemical Process Control
 - CHE 580: Theoretical Methods in Chemical Engineering

Civil Engineering Topics:²

- Construction Engineering Management (minimum of two courses)
 - CE 573: Engineering Specifications, Law and Contracts
 - CE 574: Method Analysis and Design of Construction Operations
 - CE 576: Construction Organization and Management
- Environmental Engineering (minimum of two courses)
 - CE 562: Water and Wastewater Treatment Design
 - CE 565: Environmental Waste Engineering
 - CE 566: Unit Operations in Environmental Engineering
- Geotechnical Engineering (minimum of two courses)
 - CE 546: Theory and Design of Foundation Structures
 - CE 547: Soil Dynamics
 - CE 740: Mathematical Modeling in Geotechnical Engineering

¹ CHE 697, Directed Research, may be used as a substitute with the permission of the doctoral advisor.

² CE 504, Advanced Topics in Civil Engineering, may be used as a substitute with the permission of the doctoral advisor.

- Structural Engineering (minimum of two courses)
 - CE 502: Finite Element Methods II
 - CE 555: Seismic Design II
 - CE 557: Advanced Structural Analysis
- Transportation Engineering (minimum of two courses)
 - CE 526: Pavement Engineering
 - CE 529: Traffic Engineering
 - CE 629/729: Traffic Operations
- Water Resources (minimum of two courses)
 - CE 536: Urban Surface Water Management
 - CE 538: Hydraulic Engineering Design II
 - CE 630: Mathematical Modeling in Hydraulic Engineering

Computer Engineering and Computer Science Topics:³

- Computer Architecture (minimum of two courses)
 - CECS 630: Advanced Computer Architecture
 - CECS 631: Advanced Computer Architecture II
 - CECS 646: Fault Tolerant Computer Systems
- Software Engineering (minimum of two courses)
 - CECS 643: Advanced Software Engineering
 - CECS 644: Software Testing and Verification
 - CECS 645: Software Architecture
- Networking and Distributed Systems
 - CECS 672: Advanced Computer Networking
 - CECS 673: Topics in Distributed Computer Systems
- Operating Systems
 - CECS 626: Advanced Operating Systems
 - CECS 670: Concurrent Parallel Programming
- Artificial Intelligence (minimum of two courses)
 - CECS 650: Pattern Recognition Using Artificial Intelligence
 - CECS 651: Advanced Artificial Intelligence

³ CECS 690, Special Topics in Computer Science, may be used as a substitute with the permission of the doctoral advisor.

- CECS 653: Machine Vision
- Algorithms and Computer Science Theory
 - CECS 628: Advanced Analysis of Algorithms
 - CECS 690: Special Topics in Computer Science
- Simulation and Modeling
 - CECS 628: Advanced Analysis of Algorithms
 - CECS 652: Computer Simulation and Modeling

Electrical Engineering Topics:⁴

- Analog and Mixed-Signal Electronics
 - EE 532/632: Analog Signal Processing
 - EE 534: Mixed-Signal IC Design
- Biomedical Systems
 - EE 506/606: Theory and Practice of Biomedical Instrumentation
 - EE 507/607: Advanced Biomedical Systems
- Communication Systems (minimum of two courses)
 - EE 580: Statistical Communication Theory
 - EE 581: Satellite Communication Systems
 - EE 582: Spread Spectrum Communication Systems
- Controls and Robotics (minimum of two courses)
 - EE 511: Linear Systems Analysis
 - EE 574: Robot Dynamics and Control
 - EE 675: Non-Linear Control Systems
- Digital Signal Processing (minimum of two courses)
 - EE 527: Digital Filter Design and Audio Processing
 - EE 585/685: Advanced Digital Signal Processing
 - EE 586: Real-time Digital Signal Processing
- Digital Signal Processing— Speech (minimum of two courses)
 - EE 528: Speech Signal Processing
 - EE 576: Neural Networks and Fuzzy Logic
 - EE 591: Adaptive Systems

⁴ EE 590, Special Topics in Electrical Engineering, may be used as a substitute for appropriate topics with the permission of the doctoral advisor.

- Digital Signal Processing— Image (minimum of two courses)
 - EE 568/668: Wavelet Theory and Applications
 - EE 569D/669D: Data Compression
 - EE 583/683: Digital Image Processing
- Digital Communication Networks and Systems (minimum of two courses)
 - EE 540: Advance Digital System and Computer Architecture
 - EE 545: Computer Communication Networks
 - EE 548: Wireless and Mobile Networks and Security
- Digital Electronics
 - EE 531: CMOS Analog Design
 - EE 535: VLSI Design
- Systems Engineering
 - EE 502: Engineering Modeling and Simulation
 - EE 511: Linear Systems Analysis
- Networks and Filters
 - EE 509: Network Theory
 - EE 510: Circuit Synthesis
- Optical Electronics (minimum of two courses, must include EE 533/633)
 - EE 533/633: Quantum and Optical Electronics
 - Physics 540A: Graduate Electricity and Magnetism
 - Physics 550A: Quantum Mechanics I
- Power Systems and Power Electronics (minimum of two courses)
 - EE 551: Theory and Applications of DC/DC Converters
 - EE 552: Electric Machines and Robotic Applications
 - EE 553: Protection of Power Systems

Engineering Topics:

- Systems Engineering (minimum of two courses)
 - CECS 552/652: Computer Simulation and Modeling
 - EE 502: Engineering Modeling and Simulation
 - MAE 505: Quantitative Methods for Engineering Managers
 - MAE 507: Engineering Project Management

- Transportation and Logistics (minimum of two courses)
 - CE 629/729: Traffic Operations
 - EE 502: Engineering Modeling and Simulation
 - ENGR 532: Logistics Principles and Practice

Mechanical and Aerospace Engineering Topics:⁵

- Aerodynamics and Computation Fluid Dynamics (minimum of two courses)
 - MAE 633: Hypersonic Flow
 - MAE 635/735: Computational Fluid Dynamics II
 - MAE 637: Advanced Fluid Dynamics
- Aerospace Structures and Materials (minimum of two courses)
 - MAE 642: Aeroelasticity
 - MAE 669: Design of Composite Structures
 - MAE 672: Stress Analysis in Design
- Dynamics, Vibration and Control (minimum of two courses)
 - MAE 675: Modal Analysis
 - MAE 676: Engineering Vibrations II
 - MAE 671: Random and Nonlinear Vibrations
- Fluid and Thermal Sciences (minimum of two courses)
 - MAE 631: Thermal Radiation
 - MAE 632: Combustion II
 - MAE 637: Advanced Fluid Dynamics II
- Materials, Mechanics and Design and Manufacturing (minimum of two courses)
 - MAE 612: Computer Aided Design in Manufacturing
 - MAE 663: Nonlinear Optimized Structure
 - MAE 672: Stress Analysis in Design
 - MAE 673: Theory of Elasticity and Plasticity

⁵ MAE 690, Advanced Topics in Mechanical and Aerospace Engineering, may be used as a substitute with the permission of the doctoral advisor.

CGU School of Mathematical Sciences Preliminary Examinations

Preliminary examinations in mathematics for the joint program may be chosen from single courses of sufficiently advanced level. These include Math 273, Math 282, and courses numbered 3XX. It is also possible for a preliminary examination to be based on material from two courses at a beginning graduate level, e.g. Math 251/252 or Math 251/256.

Research Tool

Students in the Joint Doctoral Program must demonstrate proficiency in problem-solving ability using computer programs. This demonstration may take different forms depending on the student's engineering sub-discipline, but must include evidence that the student has used an appropriate computer language and an algorithmic method to solve a problem from an engineering discipline.

Research and Dissertation

Upon completion of at least 48 units of course work (including transfer units), the preliminary examinations, and the research tool requirement, a student embarks on the research phase of the Joint Doctoral Program. In preparation for the research phase, the student is expected to spend at least a semester in advanced graduate courses, seminars, or directed reading courses where exposure to research material is emphasized. From these and other sources, the student gains the ability to understand the motivation for research in engineering and applied mathematics and learns to apply research techniques.

Doctoral Committee

During entry to the program and through the period of the main body of course work at CGU and CSULB, the Program Committee will monitor the student's progress. Upon successful completion of the preliminary examinations, the student petitions the Program Committee to constitute the Doctoral Committee. The student chooses this committee with advice from the faculty advisor and with approval of the Program Committee. The committee must include at least **two faculty members each from CGU and CSULB**; it must also provide breadth and depth in mathematics and engineering in the chosen faculty members. The Doctoral Committee supervises the student's progress through research preparation and dissertation writing; it also administers the qualifying and oral examinations for the degree. The chair of the Doctoral Committee is the dissertation supervisor.

Research Proposal and Qualifying Examination

With these advanced courses as background, and with the guidance of the Doctoral Committee, the student defines an area of proposed research and prepares a written Dissertation Proposal containing an outline of the research to be undertaken and references to relevant source materials. **The Dissertation Proposal is presented to the Doctoral Committee at least two weeks prior to the Qualifying Examination.** The appropriate form under "Doctoral Degree Forms" can be obtained from the CGU

website www.cgu.edu (under Current Students, Registrar Information). The Qualifying Examination is an oral presentation to the Doctoral Committee describing the planned research. The student is expected to present evidence both as to the mathematical content and to the engineering application of the proposed research, supporting such evidence with references to previous research in both areas. The Doctoral Committee judges the fitness and quality of the Dissertation Proposal from this presentation and from the written proposal. It subsequently communicates its recommendations to the Program Committee. Only upon a positive recommendation may the student embark on a dissertation. In the event of failure, the qualifying examination may be retaken once after petition to the Program Committee.

Advancement to Candidacy

After successful completion of the Qualifying Examination and certification that all other requirements are fulfilled, the student is advanced to candidacy. The appropriate form under “Doctoral Degree Forms” may be obtained from the CGU website. This must occur at least six months before the Final Oral Defense.

Dissertation and Final Oral Examination

Upon completion of the research, the student will prepare the dissertation in accordance with CGU regulations. A final draft of the dissertation will be presented to each member of the Doctoral Committee at least three weeks prior to the final oral examination. The appropriate form under “Doctoral Degree Forms,” along with an abstract of the dissertation, must be filed with CGU’s Office of Admission and Records three weeks before the exam. This deadline is very strict and no exceptions will be made. Please see the CGU website under “Academic Calendar” for the final defense scheduling dates. The oral defense will normally be held on the campus of the dissertation supervisor.

Research in the CGU/CSULB Joint Doctoral Program

Research in the CSULB College of Engineering

The College of Engineering offers courses in Engineering, Chemical Engineering, Civil Engineering and Construction Engineering Management, Computer Engineering and Computer Science, Electrical Engineering, and Mechanical and Aerospace Engineering. Doctoral students may select courses from one or more of these departments as described later in the handbook.

Presently, the college has about sixty faculty members who teach and conduct research on a wide range of engineering and scientific areas including:

- Aerospace
- Artificial Intelligence
- Bio-engineering
- Circuit Design
- Communication Systems
- Control Systems
- Data Analysis and Systems
- Education
- Energy & Environment
- Forecasting
- Information Technology
- Information Security
- Materials and Structures
- Military Topics
- Occupational Management
- Operations Research Production & Manufacturing
- Quality
- Reverse Engineering
- Risk Analysis
- Systems Analysis
- Transportation & Logistic

- The College of Engineering also supports several research centers and programs:⁶
- Center for Aerospace Technology in Support of the Aerospace Industry (CATSAI)
- Center for the Commercial Deployment of Transportation Technologies (CCDoTT)
- Center for Electronic Design Automation (CEDA)
- Center for Advanced Logistics Management Systems (CALMS)
- Center for Energy and Environment Research and Services (CEERS)
- Center for Excellence in Construction (CEC)
- METRANS, a joint USC/CSULB center

⁶ For more information on these centers visit www.csulb.edu/colleges/coe/views/Research_Centers.html

CSULB Doctoral Faculty

Faculty	Area of Research	Contact Information
• Mahyar Amouzegar	Systems Engineering, Engineering Optimization, Transportation & Logistics	mahyar@csulb.edu (562) 985-8032
• Anastasios Chassiakos	Control Systems, Neural Networks, Structural Control, Structural Health Monitoring, Intelligent Control, Intelligent Transportation Systems, Port Operations	achassk@csulb.edu (562) 985-4278
• Hsin-Piao Chen	Finite Element Analysis, Aerospace Structures, Composite Structural Analysis & Design, Structural Design Optimization, Damage Detection, Structural Optimization, Genetic Algorithms, Neural Networks	hsinchen@csulb.edu (562) 985-1504
• Burkhard Englert	Distributed Systems, Computing Security, Cryptography, Distributed Algorithms	englert@cecs.csulb.edu (562) 985-7987
• Hamid Hefazi	Aerodynamics, Hydrodynamics, Manufacturing Technologies, Computational Fluid Dynamics, Optimization, Numerical Methods	hefazi@csulb.edu (562) 985-1502
• Rajendra Kumar	Communication Systems, Digital Signal Processing, Adaptive Systems, Global Positioning Systems, Simulation, Mathematical Modeling	kumar@csulb.edu (562) 985-1556
• Shui-Fung Lam	Network traffic analysis and performance modeling in computer clusters, Applied Scheduling, Computer Capacity Planning, Clustering Programming, Simulation, Optimization	lam@csulb.edu (562) 985-1552
• Dar-Biau Liu	Software Engineering and Ada Technology, Distributed Computer Systems and Networking, Dynamic Task Scheduling	liu@csulb.edu (562) 985-1594
• Tulin Mangir	Networks and Security, Dependable Systems, System on Chip (SOC), Networks on Chip (NOC), Mobile, Wireless, Adhoc Networks, Systems (Systems of Systems) Methodology	temangir@csulb.edu (562) 985-5774

CSULB Doctoral Faculty

Faculty	Area of Research	Contact Information
• Thinh Nguyen	Artificial Intelligence, Artificial Life, Pattern Recognition, Machine Vision, Image Analysis, Medical Imaging, Computer Architecture, Fault-Tolerant Computing	tnguyen@cecs.csulb.edu (562) 985-8701
• Ortwin Ohtmer	Finite Element Methods, 3D-Computer-Aided-Design (CAD), Optimization Techniques	orohtmer@csulb.edu (562) 985-1518
• Hamid R. Rahai	Renewable Energy, Pollution Control and Reduction, Mixing and Diffusion, Design Optimization	rahai@csulb.edu (562) 985-5132
• Alfonso Rueda	Quantum Vacuum and Its Applications	arueda@csulb.edu (562) 985-1514
• Tariq Shehab	Automation in Construction, Management Information Systems in Construction, Development of Intelligent Systems, Inspection, Rehabilitation and Construction of Infrastructure Facilities	shehab@csulb.edu (562) 985-1643
• Bahram Shahian	Flight Control, Digital Control & Filtering, Control Systems, Optimization, Game Theory	shahian@csulb.edu (562) 985-8041
• Chit-Sang Tsang	Communication Systems, Digital Signal Processing, Satellite Communication System, Speech Signal Processing, Neural Networks, Fuzzy Logic	ctsang@csulb.edu (562) 985-1517
• Colleen van Lent	Robotics, Planning System Search, Artificial Intelligence, Operations Research	vanlent@cecs.csulb.edu (562) 985-8583
• Mahmoud Wagdy	Microelectronic Circuits and Systems, Analog Signal Processing	wagdy@csulb.edu (562) 985-5110
• Henry Yeh	Digital Signal Processing, Digital Communication, Adaptive Beam-Forming, Real-Time DSP Implementation	heyeh@csulb.edu (562) 985-4899
• Hsien-Yang Yeh	Fracture Mechanics, Composite Materials, Reliable Design, Mathematical Modeling, Failure Analysis	hyeh@csulb.edu (562) 985-4611

Research in the CGU School of Mathematics

The graduate curriculum in mathematics is supported by the six mathematical departments in the Claremont Colleges Consortium: Claremont Graduate University, Claremont McKenna College, Harvey Mudd College, Pitzer College, Pomona College, and Scripps College. There are currently about fifty full-time faculty members in the six departments. A broad spectrum of courses in the mathematical sciences is offered, including: algebra, topology, geometry, analysis, numerical analysis, ordinary and partial differential equations, probability, statistics, and many specialty areas (see <http://www.cgu.edu/pages/628.asp> for a full list of courses).

Applied mathematics is the focus of much of the faculty and graduate student research; these topics include applications in physics (semi-conductors), engineering (continuum mechanics), financial engineering, computational molecular biology and bioinformatics, satellite navigation, and computational fluid dynamics. All aspects (modeling, analysis, numerical) are treated.

The School of Mathematical Sciences at CGU also supports

- The CGU Mathematics Clinic
- The Claremont Research Institute of Applied Mathematical Sciences (CRIAMS)

Both of these centers organize research projects for industrial clients.

CGU Doctoral Faculty

Faculty	Area of Research	Contact Information
• Ellis Cumberbatch	Modeling, PDEs, Asymptotics, Continuum Mechanics	ellis.cumberbatch@cgu.edu (909) 607-3369
• John Angus	Probability, Statistics, Mathematical Finance, Algorithms and Computational Science, Reliability and Fault Tolerance, Engineering Applications	john.angus@cgu.edu (909) 607-3376
• Ali Nadim	Applied Mathematics, Fluid Dynamics, Scientific Computing	ali_nadim@kgi.edu (909) 607-9413
• Alpan Raval	Computational Biology, Applied Differential Geometry, Stochastic Processes, Quantum Field Theory	alpan_raval@kgi.edu (909) 607-3352
• Henry Schellhorn	Mathematical Finance, Operations Research, Mathematical Economics	henry.schellhorn@cgu.edu (909) 607-4168

A complete listing of the Extended Faculty at the Claremont Consortium is available at www.cgu.edu/pages/321.asp

Policies and Procedures

1. Throughout their entire program of study, unit-taking students must be registered at **either** CGU or CSULB. Students, who intend not to take course work at either institution, including those who have finished their required units, must take the necessary steps to maintain continuous enrollment. **This is achieved by registering for Math 499 (Doctoral Study) at Claremont Graduate University or by registering for Engineering 798 (Doctoral Dissertation) at California State University, Long Beach.** At least two semesters of registration for Math 499 at CGU must be maintained during the last year prior to graduation. In order for the degree to be conferred, a student must meet all regulations as stated in the CGU Bulletin under “Degree Regulations.”

Requests for **leave of absence** must be submitted to each registrar’s office and approved by both institutions according to the standards of each; upon approval of leave the student should advise the math office at CGU and the office of the Joint Doctoral Program at CSULB. Students should contact each registrar’s office for leave of absence policies. If the student fails to advise the registrar at CGU of his/her leave granted by CSULB, he/she will be dropped from the program (CGU has no official arrangement for leaves). Upon return, the student will be required to pay CGU a reinstatement fee in addition to regular semester tuition.

2. International students registered for units at CSULB must provide the CGU International Student Advisor, Nusha Shishegar, with proof of registration within two weeks of the beginning of the semester at CGU. Proof of full-time registration (8 units minimum) is required to maintain immigration status. (In the circumstance of completion of units, registration in Doctoral Study, CGU Math 499, is required.)
3. Students should arrange for advisors, one in math at CGU and one in engineering at CSULB, at the earliest opportunity. The program committee will help provide advisors.
4. After consultation with their advisors, students must submit a plan of study, including a petition for transfer of credits, if applicable, during their first year of study. The Plan of Study must be approved and transfer of units recommended to the Registrar by the program committee.

Procedures for Student Admission⁷

1. Students must complete application forms for both CGU and CSULB. The completed application package must include official transcripts, three letters of reference (preferably on the forms supplied in the CGU package), a personal statement and a resume. Current, official GRE scores are required. Scores may not be older than 5 years.
2. The completed application package (including a separate Long Beach fee and application) must be submitted to the CGU Admissions Office, 160 East Tenth Street, Claremont, CA 91711-6163. Do not send application materials to CSULB as this will result in considerable delay. Both application fees are required
3. Online applications are acceptable for the Joint Program; however, consult the Program Advisors at CGU and CSULB for appropriate procedures.
4. The CGU director of the CSULB/CGU Joint Doctoral Program, Ellis Cumberbatch, reviews completed files. In the event of a negative review, a rejection letter is issued by CGU. In the event of a positive review, the application, along with a copy of the completed file, is forwarded to the CSULB director of the CSULB/CGU Joint Doctoral Program, Dr. Mahyar Amouzegar.
5. Results of the Long Beach review are transmitted back to CGU Math. Upon a positive review by CSULB, the application and fee are sent to the CSULB Admissions Office to be processed. A negative review initiates a rejection letter from CGU.
6. Upon admission to the program, CGU will generate two admission letters; one is mailed to the student and one is sent to CSULB. This letter includes a decision card and specifies a required \$200 tuition deposit that should be submitted to CGU if the student chooses to accept the offer of admission.
7. Students admitted to **provisional status** must provide the materials needed to complete their files before the end of their first semester of enrollment. Official scores for the GRE General Test are required of all students before admission to full graduate standing. The joint faculty program committee will review completed files for change of status.
8. The academic progress of students admitted to **conditional status** will be reviewed by the program committee prior to a decision about change of status.

⁷ Please note that only completed files are transmitted from CGU to CSULB. Information on the status of a file is available only from CGU's Office of Admission and Records. Their contact telephone number is (909) 607-0434; their e-mail is admiss@cgu.edu.