COLLEGE OF ENGINEERING

www.csupomona.edu/engineering

Edward C. Hohmann, Dean
Barbara A. Hacker, Associate Dean for Academic Personnel and Resources
Cordelia Ontiveros, Associate Dean for Academic Programs

Master of Science in Engineering

Master of Science in Civil Engineering

Master of Science in Electrical Engineering

Master of Science in Engineering Management

Master of Science in Mechanical Engineering

All undergraduate engineering programs are accredited by the Engineering Accreditation Commission of ABET. The programs in Engineering Technology are accredited by the Technology Accreditation Commission of ABET. The address, phone number, and URL of ABET are:

ABET, Inc.
111 Market Place, Suite 1050
Baltimore, MD 21202
(410) 347-7700
www.abet.org

ADMISSION TO THE PROGRAMS

An applicant for admission to a program must meet university criteria as specified in the Admission section of this catalog as well as the criteria outlined below. Applicants are advised that a reasonable proficiency in computer programming is necessary for successful completion. If the student is deficient in this area, he or she will be expected to remove the deficiency early in the program.

Successful applicants will be admitted to the programs either unconditionally or with conditions imposed on them. To receive unconditional admission, an applicant must satisfy at least these criteria:

1) The applicant must hold a baccalaureate degree in engineering from a program that has been accredited by the Accreditation Board for Engineering and Technology (ABET) and for which the accreditation was in effect at the time of award of the degree. The degree must have been granted within five years prior to the proposed beginning of the graduate program. A baccalaureate degree in engineering technology does not satisfy this criterion.
2) The applicant must have achieved a grade point average of at least 3.00 in all undergraduate upper division coursework in mathematics, science and engineering and, additionally, in all coursework attempted with graduate standing.
3) Additional requirements may be imposed by individual programs.

Conditional admission may be granted in cases in which the applicant's academic preparation for graduate study is such that criteria 1) and/or 2) above are not satisfied. In such cases, the applicant is required to submit recent test scores of the Graduate Record Examination, letters of recommendation, and other documents attesting to the applicant's aptitude for graduate studies. Applicants who do not satisfy criterion 1) may be required to take a limited number of preparatory courses with no degree credit. Criterion 3) above must be met. When an applicant is admitted conditionally, the conditions to be met and the time allowed for meeting them are stated in the letter of admission. If these conditions are not satisfied, the student may be disenrolled.

PROGRAM REQUIREMENTS

Admission to a program does not admit a student to candidacy for a degree. Advancement to Candidacy is granted a student upon the recommendation of the graduate faculty and implies a readiness to attempt the thesis or comprehensive examination. Students who are not candidates are not eligible to register for EGR 692 or 696.

In order to advance to candidacy for the Master of Science in Engineering degree, the Master of Science in Electrical Engineering degree, the Master of Science in Engineering Management degree, the Master of Science in Mechanical Engineering degree, or the Master of Science in Civil Engineering degree; the student must:

1) satisfy all admissions conditions, if any;
2) complete at least 32 units of graduate coursework with a grade point average of 3.0 or better;
3) satisfy the Graduation Writing Test; and
4) with the assigned advisor, develop and file a formal Program of Study with proper approval.

The program of study must be submitted for approval before the end of the second quarter of attendance.

At the time of filing of the program of study, the student must opt for publishing a thesis or performing a project as a culminating experience of his/her graduate education after completing the required coursework. The thesis effort is intended to involve independent research by the student with the goal of advancing knowledge in a specialized area. The thesis effort includes a defense of the effort by the student before a committee of faculty members. The project is a one-quarter case study or research, which concludes with a written report and an oral defense of the project conducted by a committee of faculty members. Information regarding the thesis and project is available at the Engineering Graduate Studies Office.

In addition, each student is responsible for satisfying all university requirements specified elsewhere in the catalog.

CURRICULAR REQUIREMENTS

General requirements for advanced degrees are found in the Graduate Scholastic Requirements section of this catalog. No more than 13 units of acceptable graduate credit may be transferred from another graduate institution. No more than 13 units taken through Extended University may be used on a contract. No more than 13 units of acceptable graduate credit may be petitioned by an undergraduate student. A total of 13 transfer, Extended University, or units petitioned for graduate credit, or any combination of 13 units, may be included on a master's contract. The stipulated time limit of 7 years applies to all of the above.

Technical specialty courses are chosen to emphasize an area that is a logical continuation of the student's undergraduate and graduate preparation. At most, one 400-level course may be included in this category, and a maximum of 4 transfer units can be used to satisfy this requirement.

The remainder of the courses in the student's program of study will be chosen in collaboration with an advisor to insure consistency with undergraduate preparation and graduate goals, and to assure an integrated educational experience. A course in the program of study may be taken only after the student has satisfied the course prerequisites for enrolling in the course. It is the student's responsibility to satisfy all prerequisites for a course before enrolling in the course.

Engineering graduate students may be granted graduate credit only for courses numbered 400 and above. A grade point average of 3.0 (B) or better must be maintained in all upper-division and all graduate courses. Candidates must be enrolled in the university during the quarter of graduation.

ENGINEERING GRADUATE COURSE DESCRIPTIONS

EGR 509 Advanced Differential Equations for Engineers (4)

An advanced course in applied differential equations. Multi-disciplinary engineering models are developed and solved. Analytical and numerical techniques for solving differential systems with either a single independent variable or multiple independent variables are used. 4 lectures/problem-solving. Prerequisite: Undergraduate course in differential equations.

EGR 510 Engineering Probability and Statistics (4)

Mean square estimation, introduction to stochastic processes, time averages and ergodicity, continuous testing and estimation, confidence intervals, significance, applications in thermodynamics, machine design, systems analysis, and reliability. 4 lectures/problem-solving. Prerequisite: Undergraduate course in probability theory.

EGR 511 Numerical Modeling (4)

Advanced interpolation and approximation methods. Advanced integration concepts. Solution of ordinary differential equations. systems of differential equations, statistical methods. Applications to electrical networks, transport phenomena, structural systems, dynamic systems, etc. 4 lectures/problem-solving. Prerequisite: Undergraduate course in numerical analysis or consent of instructor.

EGR 512 Vector Analysis and Complex Variables (4)

Vector and scalar fields. Gradient, divergence, curl. Green's and Stokes' theorems. Complex functions and conformal mapping. Applications in electrodynamics, heat transfer, fluid dynamics and aerodynamics. 4 lectures/problem-solving. Prerequisite: Mathematics equivalent to ABET-accredited curriculum.

EGR 513 Engineering Tensor Analysis (4)

Vector-tensor notation and operations. Generalized coordinate systems. Tensor algebra and calculus. Transport and conservation laws in continuum mechanics. Formulation and modeling of engineering phenomena. 4 lectures/problem-solving. Prerequisite: Mathematics equivalent to ABET-accredited curriculum.

EGR 514 Variational Methods in Engineering (4)

Calculus of variations. Approximate methods. Applications in fluid dynamics, heat transfer, dynamics, structures. 4 lectures/problem-solving. Prerequisite: Mathematics equivalent to ABET-accredited curriculum.

EGR 515 Matrix Methods in Engineering (4)

Application of matrix methods in engineering analysis. Matrix algebra. Eigenvalues and eigenvectors. Energy techniques. Transformations. Applications in classical mechanics, analysis of structures, circuit analysis, vibrations, heat transfer and fluid dynamics. 4 lectures/problem-solving. Prerequisite: Mathematics equivalent to ABET-accredited curriculum.

EGR 524L Advanced Aerospace Vehicle Design (2)

Preliminary design of aerospace systems. Interdisciplinary concepts in design. System analysis and integration. Design optimization. Design compromise in multidisciplinary systems. Trades study evaluations. Verbal and written presentation of system design. Individual and team projects. 2 three-hour laboratories. Prerequisite: completion of 24 units of graduate level coursework.

EGR 528 Hypersonic Aerodynamics (4)

Two- and three-dimensional flow fields. Hypersonic small disturbance and Newtonian impact theories and application. Boundary layer interaction with the inviscid flow field. Real gas phenomena. Blunt body and conical flow fields; minimum drag bodies; aerodynamic analysis of complete configurations. 4 lectures/problem-solving. Prerequisite: Upper-division course in supersonic aerodynamics.

EGR 537 Polymer Fluid Dynamics (4)

The structure, flow phenomena, and material functions for polymeric fluids. Constitutive equations available to solve polymeric fluid dynamics problems. Applications in plastics manufacturing, performance of lubricants, processing of food-stuffs, and movement of biological fluids. 4 lectures/problem-solving. Prerequisites: Upper-division courses in heat transfer, fluid mechanics, and EGR 513.

EGR 538 Advanced Engineering Economy (4)

Engineering economic decision criteria and models for evaluating capital investment proposals and engineering projects. Replacement studies, risk and uncertainty, tax effects, intangibles, probabilistic models, computer techniques. 4 lectures/problem-solving. Prerequisite: 3 quarter units of undergraduate engineering economy.

EGR 539 Advanced Human Factors in Engineering Design (4)

Methods and research techniques in engineering design of optimum man-machine systems. Designing systems with the objective of developing optimum combinations of physical and human components. Effects of environment on human performance. Man-machine dynamics. 4 lectures/problem-solving. Prerequisite: Upper-division course in human engineering principles.

EGR 540 Systems Theory (4)

Application of matrix theory and linear vector spaces to the mathematical representation of systems. Analysis of the state equations for linear, time varying and invariant, continuous and discrete systems, controllability and observability for linear systems. 4 lectures/problem-solving. Prerequisite: EGR 515. (Some previous exposure to Laplace Transforms is recommended.)

EGR 546 Heterogeneous Phase Equilibria (4)

Applied phase equilibria. A development of theoretical and empirical principles for understanding complex multiphase behavior in multicomponent chemical systems. 4 lectures/problem-solving. Prerequisite: Upper-division course in engineering thermodynamics.

EGR 547 Process Modeling and Analysis (4)

Mathematical modeling of physical and chemical processes. Analytical and numerical solutions for steady and unsteady state problems. Design project based on results of modeling. 4 lectures/problem-solving. Prerequisite: Baccalaureate degree in Chemical Engineering or consent of the instructor.

EGR 549 Advanced Methods in Operations Research (4)

Methodology of operations research and algorithms for system and subsystem optimization; emphasis on methods yielding practical numerical procedures. Linear programming and extension, dynamic and integer programming, queuing theory, network analysis, game theory and decision theory. 4 lectures/problem-solving. Prerequisite: Upper-division course in operations research.

EGR 553 Computer Simulation of Engineering Systems (4)

Systems theory as foundation for engineering analysis and synthesis of complex systems. Numerical methods and simulation models using digital computers. Optimization of engineering systems design and performance. Applications to engineering systems problems. 4 lectures/problem-solving. Prerequisite: Undergraduate course in programming.

EGR 572 Total Quality Management in Engineering (4)

Introduction to the principles and practices of Total Quality Management (TQM). The course will also cover the tools and techniques for understanding and implementing TQM. A practical state-of-the-art approach will be used. Applications in service, manufacturing, government, military, construction, education, small business, health care, and nonprofit organizations will be presented. 4 lectures/problem-solving. Prerequisite: consent of instructor.

EGR 573 Advanced Operations Planning and Control Systems (4)

Operations analysis of integrated production systems; mathematical and computer models for planning, scheduling, and control of production and service systems. Statistical techniques in forecasting; optimization of resources utilization. 4 lectures/problem-solving. Prerequisite: Upper-division course in operations research.

EGR 574 Advanced Facilities Planning (4)

Planning, analyzing, justifying, controlling, and evaluating physical facilities. Long- and short-range facilities plans, decision criteria, authorization and control procedures, post completion audits. Resource allocation, optimization, simulation, and computer techniques. Technical, economic, ecological, safety, and intangible factors. Case studies. 4 lectures/problem-solving. Prerequisite: Undergraduate course in engineering economy.

EGR 575 Inlet Design (4)

Subsonic, supersonic and hypersonic inlet design. Subsonic inlets: friction loss, diffusion, plenum chambers, pressure recovery. Transonic effects: pre-entry flow, separation, shock-boundary layer interaction. Supersonic compression: external, internal, boundary layer bleed. Cowl design. Additive drag. Flow distortion. Matching and control. Applications to aircraft and helicopters. 4 lectures/problem-solving. Prerequisites: Undergraduate courses in gas dynamics and propulsion.

EGR 577 Aerodynamics of Wings and Bodies (4)

Three-dimensional wings; steady, subsonic flow; supersonic flow. Lifting line theory: span-wise lift distribution, induced drag, twist, sweepback. Introduction to lifting surface theory: planar, nonplanar, interference. Transonic small-disturbance flow. Unsteady flow. Conical flows. 4 lectures/ problem-solving. Prerequisite: Undergraduate course in aerodynamics.

EGR 578 Aircraft Stability (4)

General equations of unsteady motion. Stability derivatives. Stability of uncontrolled motion; longitudinal, lateral. Response of the vehicle to actuation of the controls. Flight in turbulent air. Automatic stability and control. Specialization to missiles. Simulation. Transfer functions. 4 lectures/problem-solving. Prerequisite: Undergraduate course in stability and control.

EGR 579 Vibration and Flutter (4)

Two- and three-dimensional flutter theory. Structural damping. Aerodynamics forces. Flutter stability. Non-linear characteristics. Aspect ratio and compressibility effects. Empennage vibration and flutter analysis. Wing torsional divergence, aileron reversal and effectiveness. Modeling concepts. 4 lectures/problem-solving. Prerequisites: Upper-division courses in aerodynamics, structures and dynamics and EGR 515.

EGR 580 Materials for Electronics (4)

Preparation techniques for materials used in electronic devices. Structure and purity control. Crystal growth, epitaxy, vapor deposition, magnetic domains, and solid state phase transformations. Current problems concerning Si and III-V compound device production and research. 4 lectures/problem-solving. Prerequisite: An undergraduate course in materials science.

EGR 583 Aerodynamic Heating (4)

Fundamental equations. Laminar and turbulent boundary layer properties. Laminar and turbulent skin friction. Recovery temperature. Reference enthalpy method. Slip flow. Free molecule flow. Stagnation point heat transfer. Mass transfer cooling. Calculation of skin temperature. 4 lectures/problem-solving. Prerequisites: Undergraduate courses in heat transfer and gas dynamics.

EGR 595 Boundary Layer Concepts (4)

Treatment of Newtonian and non-Newtonian fluids in the laminar and turbulent regimes. Positive and negative pressure gradients. Development of the thermal boundary layer. Some exact and inexact solutions. Wedge flow. 4 lectures/problem-solving. Prerequisite: ME 535 or EGR 535 or consent of instructor.

EGR 596 Research Methods (2)

Introduction to research methods with emphasis on preparing an engineering thesis problem statement. This course prepares engineering graduate candidates for writing theses and independent research papers. Writing problem statements; research questions; experimental and non-experimental design; sampling; instrument design. 2 discussions. Prerequisite: completion of all required breadth courses on contract.

EGR 599/599A/599L Special Topics for Graduate Students (2-4)

Selected topics comprising new or experimental courses not otherwise offered. Each offering identified in the current schedule and on the student's transcript. Prerequisite: consent of instructor.

EGR 624L Advanced Aerospace Vehicle Design (2)

Completion of the design of an interdisciplinary aerospace vehicle system. Preparation of a final report on the project together with an oral briefing to an industrial design review panel. 2 three-hour laboratories. Prerequisite: EGR 524. Unconditional standing required.

EGR 691 Directed Study (1–2)

Case study or investigation of selected engineering problems under the direction of a graduate faculty member. May be repeated as needed for a maximum of 6 units. Students must register through the Engineering Graduate Studies Office. The study should be in the student's emphasis area and should conclude with a written report. May be combined with EGR 692. Unconditional standing required.

EGR 692 Master's Degree Project (2)

Independent study leading to successful completion of a graduate project in the student's emphasis area. The topic of study must be pre-approved by a graduate faculty committee. The study should conclude with an individual report and an oral defense of the project. Prerequisite: advancement to candidacy.

EGR 696 Master's Degree Thesis (2)

Independent investigation intended to be an extension of an existing body of knowledge into an area not thoroughly investigated before, directed by a committee of graduate faculty members, and resulting in a published thesis. Must be repeated as appropriate. Students must register through the Engineering Graduate Studies Office. Credit assigned upon successful completion of entire thesis and approval of the committee. Total credit, 4, 6 or 8 units. Advancement to Candidacy required.

EGR 699 Master's Degree Continuation (0)

Enrollment in this course allows candidates that have enrolled in the maximum number of thesis or project units to maintain resident status in order to receive university services. Approval of Dean or designee is required to register for this class. Advancement to candidacy is required. This course is graded on a mandatory credit/no credit basis.

AEROSPACE ENGINEERING

Master of Science in Engineering with Emphasis in Aerospace Engineering

In the Department of Aerospace Engineering, College of Engineering

www.csupomona.edu/aro

Ali R. Ahmadi, Chair and Graduate Coordinator

The practice-oriented Master of Science in Engineering with emphasis in Aerospace Engineering (MSE_AE) program builds upon an undergraduate education and facilitates more advanced study in aerospace engineering.

MISSION STATEMENT

The Master of Science in Engineering with emphasis in Aerospace Engineering (MSE_AE) program is intended to serve both full-time and part-time graduate students who have a BSAE or a closely-related undergraduate degree in order to strengthen their knowledge and understanding of aerospace engineering principles and practices. The program is primarily intended for students who currently are, or intend to become, practicing aerospace engineers, and thus focuses on the application of these principles and practices to real-world problems encountered by professional aerospace engineers.

Another purpose of the program is to facilitate applied research on relevant aerospace engineering topics. Such research should 1) serve societal needs by addressing contemporary issues, 2) contribute to the professional development of both students and faculty and 3) provide preparation for further academic study and research for those students who wish to pursue a Ph.D.

EDUCATIONAL OBJECTIVES

Graduates of the Master of Science in Engineering with emphasis in Aerospace Engineering program shall have:

- Knowledge of aerospace engineering principles, in aerodynamics, aerospace structures, flight mechanics, orbital mechanics, aerospace propulsion and aerospace vehicle design.
- The ability to conduct engineering analyses and to develop and implement designs and problem solutions.
- An understanding of the various technical and non-technical factors that impact the feasibility and implementation of aerospace engineering projects.
- The foundation needed to develop engineering judgment via professional practice, and to effectively identify, consider and account for multiple and competing objectives.
- The technical knowledge and skills needed to pursue life-long learning, with the ability to independently extend personal knowledge and understanding of engineering topics and practices by conducting literature searches, consulting with others, and using other similar techniques.

ADMISSION TO THE PROGRAM

Applicants for unconditional admission are generally expected to have a B.S. in Aerospace, Mechanical or a closely related field of engineering from an ABET accredited (or equivalent) institution within the last 5 years.

GPA in upper-division undergraduate courses in Math, Science and Engineering must be 3.0 or higher.

Applicants with an undergraduate degree in other discipline, and those who do not fully satisfy other department or university graduate admission requirements may be considered for possible conditional admission. These conditions may include additional coursework, minimum scholarship, or other requirements.

Conditionally admitted students must satisfy the specified conditions before being advanced to unconditional standing. Those who do not satisfy these conditions will be dismissed from the program.

Applicants with an upper- division GPA less than 3.0 in Math, Science and Engineering, or a B.S. degree from a non-ABET institution, or a degree received prior to 5 years ago, must submit GRE test score (quantitative plus verbal) of at least 1,100. Letters of recommendation are not required, but will be considered.

REQUIREMENTS

A minimum of 46 quarter units (equivalent to about 30 semester units) is required for the Master of Science in Engineering with emphasis in Aerospace Engineering (MSE_AE). The specific requirements are described below. All students must complete a Master's Degree Project.

Each student must, in consultation with their academic advisor, prepare a Program of Study that outlines the coursework required to complete the program. This program of study should be prepared as early as possible, and must be submitted no later than the end of the second quarter of residency.

To attain Advancement to Candidacy for the degree, the student must satisfy all of the following:

1. Complete all conditions of admission, including any preparatory courses that may have been specified.
2. Have an approved Program of Study on file.
3. Completion of at least 32 units of graduate-level coursework with a grade point average of at least 3.0.
4. Pass the graduation writing test or receive a waiver.

CURRICULUM

Required Courses (28 units)

Numerical Modeling	EGR	511	(4)
Vector Analysis and Complex Variables	EGR	512	(4)
Aerodynamics of Wings and Bodies	EGR	577	(4)
Aerospace Structures	EGR	599	(4)
Airbreathing Propulsion Systems	EGR	599	(4)
Aircraft Stability	EGR	578	(4)
Astronautics	EGR	599	(4)
Master's Degree Project	EGR	692	(2)

Electives (16 units)

Select at least 8 units from the following list:

Missile Engineering	EGR	599	(4)
Aircraft and Spacecraft Design	EGR	599	(4)
Hypersonic Aerodynamics	EGR	528	(4)
Computational Fluid Dynamics	ME	632	(4)
Finite Element Analysis	CE	526	(4)
Structural Dynamics	CE	521	(4)

Elective courses may include up to 8 units of approved 400-level courses that are relevant to the program of study, so long as these or equivalent courses have not already been used for credit toward an undergraduate degree. Approved courses are:

Aircraft Stability and Control	ARO	405	(4)
Rocket Propulsion	ARO	414	(4)
Mechanics of Composite Materials	ARO	436	(4)

CIVIL ENGINEERING

Master oF Science in Civil Engineering

In the Department of Civil Engineering, College of Engineering

www.csupomona.edu/ce

Donald P. Coduto, Chair
Lisa Yunxia Wang, Graduate Coordinator

The practice-oriented Master of Science in Civil Engineering (MSCE) program builds upon an undergraduate education and facilitates more advanced study in one of the branches of civil engineering. Students must select one of three emphasis areas: Geotechnical Engineering, Structural Engineering, and Transportation Engineering.

MISSION STATEMENT

The Master of Science in Civil Engineering (MSCE) program is intended to serve both full-time and part-time graduate students who have a BSCE or closely-related undergraduate degree in order to strengthen their knowledge and understanding of civil engineering principles and practices. The program is primarily intended for students who currently are, or intend to become, practicing civil engineers, and thus focuses on the application of these principles and practices to real-world problems encountered by professional civil engineers.

Another purpose of the program is to facilitate applied research on relevant civil engineering topics. Such research should 1) serve societal needs by addressing contemporary issues, 2) contribute to the professional development of both students and faculty and 3) provide preparation for further academic study and research for those students who wish to pursue a Ph.D. degree.

EDUCATIONAL OBJECTIVES

Graduates of the Master of Science in Civil Engineering program shall have:

- Knowledge of engineering principles sufficient to understand the bases and applicability of standard analysis, design, and implementation practices within their emphasis area.
- The ability to conduct engineering analyses and to develop and implement designs and problem solutions that conform to applicable codes and standards of practice.
- An understanding of the various technical and non-technical factors that impact the feasibility and implementation of civil engineering projects, including technical feasibility, multi-party involvement, environmental assessment, financial-economic planning, owner-public works administration, owners' strategic plans, and socioeconomic-equity issues.
- The foundation needed to develop engineering judgment via professional practice, and to effectively identify, consider and account for multiple and competing objectives.
- The technical knowledge and skills needed to pursue life-long learning, with the ability to independently extend personal knowledge and understanding of engineering topics and practices by conducting literature searches, consulting with others, and using other similar techniques.
- The ability to apply knowledge in a specialized area related to civil engineering as defined in the American Society of Civil Engineers body of knowledge requirements.
- Knowledge and skills necessary to pass specialty license examinations in their respective areas, including the examinations required for registration as a Structural Engineer, Geotechnical Engineer and Traffic Engineer.

ADMISSION TO THE PROGRAM

Applicants for unconditional admission are generally expected to have a BSCE degree from an ABET accredited (or equivalent) civil engineering program, with a GPA of at least 3.0 in their upper-division engineering courses. Additional qualifications, such as EIT or PE license, professional experience, or other noteworthy accomplishments may be listed in the application's statement of purpose and will be considered. Also see the university graduate admission requirements in the graduate studies section of this catalog.

Applicants with an undergraduate degree in another discipline, and those who do not fully satisfy other department or university graduate admission requirements, may be considered for possible conditional admission. These conditions may include additional coursework, minimum academic performance, or other requirements.

Conditionally admitted students must satisfy the specified conditions before being advanced to unconditional standing. Those who do not satisfy these conditions will be dismissed from the program.

Applicants with an overall undergraduate GPA less than 3.0 or an upper-division engineering GPA less than 3.0 must submit GRE (general) scores. Letters of recommendation are not required, but will be considered.

REQUIREMENTS

A minimum of 45 quarter units (equivalent to 30 semester units) is required for the Master of Science in Civil Engineering degree. The specific requirements for each emphasis area are described below. All students must complete either a Master's project or a Master's thesis.

Each student must, in consultation with their academic advisor, prepare a program of study that outlines the coursework required to complete the program. This program of study should be prepared as early as possible, and must be submitted no later than the end of the second quarter of residency.

To attain Advancement to Candidacy for the degree, the student must satisfy all of the following:

1. Completion of all conditions of admission, including any preparatory courses that may have been specified.
2. Have an approved program of study on file
3. Completion of at least 32 units of graduate-level coursework with a grade point average of at least 3.0
4. Passed the graduation writing test or received a waiver

Please check the Civil Engineering Department website for additional information.

CURRICULUM

All students must select one of the following emphasis areas:

The Geotechnical Engineering emphasis encompasses the interactions between civil engineering projects and the ground that supports them, and includes studies in foundations, earth and rock slopes, tunnels, earth retaining structures, groundwater, earthquakes, and other related topics.

The Structural Engineering emphasis includes methods of designing buildings and other structures from a wide range of building materials, and includes emphases on seismic design and other topics.

The Transportation Engineering emphasis covers transportation facility design, traffic flow and signalization, transportation planning and policy, public transit, pavement design, airport engineering, and intelligent transportation systems.

GEOTECHNICAL ENGINEERING EMPHASIS

Required Courses (25-29 units)

Applied Probability Concepts in CE	CE	502	(4)
Advanced Soil Mechanics I	CE	531	(4)
Advanced Soil Mechanics II	CE	532	(4)
Subsurface Exploration and Characterization	CE	533/L	(3/1)
Research Methods	CE	690	(1)
Master's Project	CE	695	(4)
or Master's Thesis	CE	696	(8)
Engineering Geology II	GSC	415/L	(3/1)

Electives (16–20 units)

Select from the following list:

Advanced Foundation Engineering	CE	534	(4)
Slope Engineering	CE	536	(4)
Rock Mechanics	CE	538	(4)
Earth Retaining Structures	CE	540	(4)
Geotechnical Earthquake Engineering	CE	542	(4)
Pavement Design	CE	588	(4)
Special Topics for Graduate Students	CE	599/A/L	(1-4)
Other approved coursework outside geotechnical engineering			(0-8)

Elective courses may include up to 4 units of approved 400-level courses that are relevant to the program of study, so long as these or equivalent courses have not already been used for credit toward an undergraduate degree. Approved courses include, but are not limited to, the following:

Foundation and Retaining Wall Design	CE	424	(4)

STRUCTURAL ENGINEERING EMPHASIS

Required Courses (29-33 units)

Advanced Engineering Mathematics	CE	501	(4)
Advanced Steel Design	CE	517	(4)
Structural Dynamics	CE	521	(4)
Advanced Reinforced Concrete Design	CE	522	(4)
Introduction to Finite Element Analyses	CE	526	(4)
Earthquake-Resistant Design of Structures	CE	528	(4)
Research Methods	CE	690	(1)
Master's Project	CE	695	(4)
or Master's Thesis	CE	696	(8)

Electives (12–16 units)

Select from the following list:

Stability of Structures	CE	518	(4)
Advanced Masonry Design	CE	519	(4)
Prestressed Concrete Design	CE	523	(4)
Advanced Foundation Engineering	CE	534	(4)
Earth Retaining Structures	CE	540	(4)
Geotechnical Earthquake Engineering	CE	542	(4)
Special Topics for Graduate Students	CE	599/A/L	(1-4)
Other approved coursework outside structural engineering			(0-8)

Elective courses may include up to 8 units of approved 400-level courses that are relevant to the program of study, so long as these or equivalent courses have not already been used for credit toward an undergraduate degree. Approved courses include, but are not limited to, the following:

Structural Design - Steel	CE	406	(4)
Structural Design – Reinforced Concrete	CE	421	(4)
Foundation and Retaining Wall Design	CE	424	(4)
Structural Design - Timber	CE	433/L	(2/1)
Masonry Design	CE	442	(4)
Bridge Design	CE	476	(4)
Computer Methods of Structural Analysis	CE	488	(4)

TRANSPORTATION ENGINEERING EMPHASIS

Required Courses (21-25 units)

Applied Probability Concepts in CE	CE	502	(4)
Design of Transportation Facilities	CE	580	(4)
Traffic Flow Analysis	CE	582	(4)
Transportation Administration and Policy	CE	584	(4)
Research Methods	CE	690	(1)
Master's Project	CE	695	(4)
or Master's Thesis	CE	696	(8)

Electives (20–24 units)

Select from the following list:

GIS Applications in Civil Engineering	CE	505	(4)
Public Transportation	CE	586	(4)
Pavement Design	CE	588	(4)
Signal Design, Operations, and Control	CE	590	(4)
Intelligent Transportation Systems	CE	591	(4)
Transportation Planning Analysis	CE	592	(4)
Airport Engineering	CE	594	(4)
Special Topics for Graduate Students	CE	599/A/L	(1-4)
Seminar in Transportation Economics	EC	659	(4)
Regional Transportation Planning and Policy	URP	535	(4)
Other approved coursework outside transportation engineering			(0-8)

Elective courses may include up to 8 units of approved 400-level courses that are relevant to the program of study, so long as these or equivalent courses have not already been used for credit toward an undergraduate degree. Approved courses include, but are not limited to, the following:

Urban Transportation	CE	428/L	(3/1)
or Urban Transportation Planning	URP	488/L	(3/1)
Traffic Engineering	CE	429/L	(3/1)
Advanced Highway Design	CE	480/L	(3/1)
Economics of Transportation	EC	433	(4)

GRADUATE COURSE DESCRIPTIONS

NOTE: For undergraduate prerequisite course descriptions, please see undergraduate section.

CE 501 Advanced Engineering Mathematics (4)

Matrices, eigenvalve problems, differential equations, partial differential equations, Fourier series and Fourier transforms. 4 lectures/problem solving. Prerequisites: MAT 214, and MAT 216 or MAT 224.

CE 502 Applied Probability Concepts in Civil Engineering (4)

Modeling uncertainty in civil engineering projects. Probability theory and statistical techniques. Temporal and spatial sampling and estimation. Utility theory. Stochastic processes including Markov process. Queue theory and models. Monte Carlo simulation. Reliability and reliability-based design. Applications of probability and statistics for risk assessment in civil engineering. 4 lectures/problem solving. Prerequisite: IME 301 or STA 309.

CE 505 GIS Applications in Civil Engineering (4)

Introduction to fundamental concepts and techniques of geographic information systems (GIS). GIS applications in transportation, environmental assessment, water resources management, geo-environmental analyses and other areas in civil engineering. 4 lecture/problem solving. Prerequisite: Graduate standing or instructor's approval.

CE 510 Theory of Plates and Shells (4)

Analysis of plates and shells; bending of thin plates, Fourier solution of simply supported rectangular plates, plates of various shapes and boundaries; plates subject to bending and in-plane membrane type forces; plates on elastic foundations, cylindrical shells, finite difference methods; finite element methods, SAP-2000 and its application to plates and shell-type structures. 4 lecture/problems solving. Prerequisites: CE 305 and CE 501.

CE 517 Advanced Steel Design (4)

Structural analysis and design of steel structures under static and earthquake loads. Ductility requirement on seismic design. Behavior and design of steel elements for global and local buckling. Plastic analysis and its application. Design code provisions for special moment resisting, braced, and eccentric braced frames. Design of composite beams. Design of connections. Load and resistance factor design (LRFD). 4 lectures/problem-solving. Prerequisite: CE 406.

CE 518 Stability of Structures (4)

Stability of beam columns; elastic and inelastic buckling of straight columns; torsional buckling of bars; lateral buckling of beams; local buckling of plate elements; stability of frames. 4 lectures/problem solving. Prerequisites: CE 305 and CE 501.

CE 519 Advanced Masonry Design (4)

Design and analysis of reinforced masonry structural elements including lintel beams, pilasters, and shear walls. Flexural strength, shear strength, stiffness, and ductility of reinforced masonry elements. Detailing of reinforcement and design of connections. Design for seismic loads. Procedures of both working stress design and strength design. 4 lectures/problem-solving. Prerequisite: CE 442.

CE 521 Structural Dynamics (4)

Concepts of the dynamics of elastic bodies. The free and forced vibration response of single and multi-degree-of-freedom systems. Duhamel's integral. Response spectra. Linearization of the equations of motion. Free- and forced- vibration response to continuous systems of longitudinal, transverse and torsional vibrations of structural elements including beams, membranes and plates. 4 lectures/problem-solving. Prerequisite: CE 501.

CE 522 Advanced Concrete Design (4)

Advanced design of building frame and shear wall structures. Design of slender columns and two-way slabs. Design of connections. Reinforced concrete system evaluation for seismic resistance including confinement and ductility requirement. Seismic design of shear walls. 4 lectures/problem-solving. Prerequisite: CE 421.

CE 523 Prestressed Concrete Design (4)

Design of prestressed concrete structures. Methods of prestressing. Pretensioning and post-tensioning techniques. Properties of concrete and prestressing steels. Design for flexure, shear, torsion, camber and deflections. Design considerations on anchorage/bonding of cables/wire. 4 lecture/problem solving. Prerequisite: CE 421.

CE 526 Finite Element Analysis (4)

Theory and application of finite element analysis, topics covered in this course are focused on the structural engineering aspects of the FEM, which are: 1D elements, bars and beams; 2D elements, plates and shells; 3D elements, isoparametric elements; static and dynamic analysis; linear and nonlinear analysis; modeling issues and considerations; and commercial software usage. 4 lectures/problem-solving. Prerequisite: CE 305 and CE 501.

CE 528 Earthquake–Resistant Design of Structures (4)

Introduction to fundamental concepts in seismic design of structures. Characterization of earthquakes for design. Time-history analysis. Response spectral analysis. Seismic performance of various structural systems. Basis for code design procedures. Force- and displacement-based design. 4 lectures/problem-solving. Prerequisite: CE 406, CE 421, CE 521.

CE 531 Advanced Soil Mechanics I (4)

Soil as an engineering material. Stresses in soil and elastic responses to loading. Groundwater and seepage in soil; consolidation, secondary compression, and soil improvement methods to control settlement. Use of finite element seepage analysis. 4 lectures/problem-solving. Prerequisite: CE 326 and CE 327L.

CE 532 Advanced Soil Mechanics II (4)

Shear strength of soils. Theories of lateral earth pressure. Use of numerical analysis software. 4 lectures/problem-solving. Prerequisite: CE 531.

CE 533/L Subsurface Exploration and Characterization/Laboratory (3/1)

Methods and techniques of exploring subsurface soil, rock, and groundwater conditions. Obtaining samples, in-situ and laboratory testing to determine engineering properties. Interpretation of field and laboratory results to develop engineering parameters for design. 3 lectures/problem-solving, one 3-hour laboratory. Prerequisite: CE 532.

CE 534 Advanced Foundation Engineering (4)

Analysis and design of mat foundations. Analysis and design of deep foundations to resist both vertical and lateral loads. Soil-structure interaction. 4 lectures/problem-solving. Prerequisite: CE 424.

CE 536 Slope Engineering (4)

General slope stability concepts. Soil strength and groundwater conditions. Slope stability analysis methods. Stability charts. Field investigation and instrumentation for landslide problems. Uncertainties in slope stability analysis and quantitative risk analysis. Slope stabilization methods. Earth dam analysis and design. 4 lectures/problem-solving. Prerequisite: CE 532.

CE 538 Rock Mechanics (4)

Properties of intact rock and discontinuities. Rock mass strength and deformability. In-situ rock stresses and their measurement. Groundwater flow in rock. Rock mass classification systems. Numerical methods. Analysis and design of rock slopes, tunnels, underground excavations, and rock foundations. Rock fall analysis and mitigation. Case histories in rock engineering. 4 lectures/problem-solving. Prerequisites: CE 326 and CE 327L.

CE 540 Earth Retaining Structures (4)

Lateral earth pressure. Analysis and design of retaining walls. Analysis and design of mechanically stabilized earth. Analysis and design of sheet pile walls both freestanding and anchored. Analysis and design of braced excavations and tiebacks. Analysis and design of cellular cofferdams. 4 lectures/problem-solving. Prerequisite: CE 531.

CE 542 Geotechnical Earthquake Engineering (4)

Introduction to seismology and earthquakes. Seismic hazard analysis. Wave propagation. Dynamic soil properties. Ground response analysis, local site effects, and design ground motions. Soil liquefaction. Seismic slope stability analysis. Seismic design of retaining walls. Remediation of seismic hazards. 4 lectures/problem-solving. Prerequisite: CE 532.

CE 580 Design of Transportation Facilities (4)

Advanced study of design of transportation facilities. It includes geometry, drainage, soils, materials, and other topics of streets and non-motorized facilities, highways, railroads, transit, and harbor/port facilities. 4 lectures/problem-solving. Prerequisite: CE 222 and CE223.

CE 582 Traffic Flow Analysis (4)

Analysis of properties and models of the flow of vehicles in freeway and network situations. Macroscopic and microscopic perspectives of traffic flow. Study of traffic flow phenomena. 4 lecture/discussion. Prerequisite: CE 222.

CE 584 Transportation Administration and Policy (4)

Examination of the institutions, legislation, and policies that govern transportation systems and their operations and development in the U.S. Federal, State, regional and local government involvement in transportation provision and protection. Public and private partnerships in support of transportation system development. Regulations, regulatory processes and mandates, and their effect on finance, system monitoring, environmental impact reviews, and other concerns. 4 lecture/discussion. Prerequisite: CE 223.

CE 586 Public Transportation (4)

Public transportation can be examined from three perspectives: system characteristics and technology, planning and operations, and management and finance. This course emphasizes the second aspect. Bus and rail transit are covered. Planning issues include stop and station location, routing and network design. Operational issues include scheduling, capacity, speed, dwell times, and others. 4 lecture/discussion. Prerequisite: CE 223.

CE 588 Pavement Design (4)

Pavement design: Layered elastic theory and stress distribution. Traffic loading and volume. Pavement materials. Drainage design. Pavement performance. Design of rigid pavement. Design of flexible pavements. Pavement preservation. Prerequisite: undergraduate soil mechanics course. 4 lecture/problem solving. Prerequisite: CE 326.

CE 590 Traffic Signal Control Design and Operations (4)

Introduction to traffic control systems. Types of traffic control methods. Warrants for placement of various intersection controls. Selection and placement of traffic control equipment. Signal system design and preparation of signal plans and specifications. Signal timing methods. Analysis of signalized intersection capacity and performance. Ramp metering. 4 lecture/problem-solving. Prerequisite: CE 582.

CE 591 Intelligent Transportation Systems (4)

Review of the history of ITS. Study of available ITS technologies and benefits of use. Assessment of ITS case studies. 4 lecture/problem-solving. Prerequisite: CE 582.

CE 592 Transportation Planning Analysis (4)

Transportation demand forecasting, including the traditional four-step process and activity-based methods. Analytical components of demand modeling. Demand modeling applications using computer software. Transportation and land use modeling, including the Lowry method and integrated approaches. Emissions analysis using the current version of the MOBILE model. Role of transportation planning methods in decision-making processes. 4 lecture/ problem-solving. Prerequisite: CE 223

CE 594 Airport Engineering (4)

Introduction of aviation systems. The principal topics to be covered include aircraft performances, airport master plans, as well as planning and design of airside and landside airport facilities. Two 2-hour lectures / problem-solving. 4 lecture/problem-solving. Prerequisite: CE 223; Corequisite: CE 480 or CE 580

CE 599/599A/599L Special Topics for Graduate Students (1–4)

Selected topics comprising new or experimental courses not otherwise offered. Each offering identified in the current schedule and on the student's transcript. Prerequisite: As announced.

CE 690 Research Methods (1)

Emphasis on how to do applied research in civil engineering. It covers the entire research process including: 1) identifying research problems or issues, 2) formulating strategies for solving problems, 3) writing proposals, 4) developing plans and schedules, 5) conducting research, and 6) writing papers and reports. It also discusses strategies and methodologies effective in each phase of the research process. 1 seminar. Prerequisite: Completion of 16 units of coursework applicable toward the MSCE degree and good academic standing.

CE 695 Master's Project (2)

Individual and independent work based on the project proposal, plan and scheduled approved by advisor. Regular meetings and discussions with advisor. May be repeated for up to 4 units total credit. Prerequisite: CE 690 and good academic standing and advancement to candidacy.

CE 696 Master's Thesis (2–3)

Individual and independent research work based on the project proposal, plan and scheduled approved by advisor. Regular meetings and discussions with advisor. Corequisite: CE 690 and advancement to candidacy. May be repeated for up to 8 units of credit.

CE 699 Master's Degree Continuation (0)

Continued work on a master's project or thesis once the student has completed CE 695 or CE 696. This course permits such students to remain in residency during the graduation quarter. Prerequisite: CE 695 or CE 696.

ELECTRICAL ENGINEERING

Master of Science in Electrical Engineering

In the Department of Electrical and Computer Engineering, College of Engineering

www.csupomona.edu/~ece

Salomón Oldak, Chair
Halima El Naga, Graduate Coordinator

The Master of Science in Electrical Engineering (MSEE) provides advanced studies for graduates willing to further their knowledge in electrical engineering. Students can specialize in one of three options: Communications and Signal Processing, Computer Engineering or Control and Robotics.

MISSION STATEMENT

The Master of Science in Electrical Engineering (MSEE) program offers state of the art instruction for BSEE, BSCpE or closely related graduates who intend to supplement their initial degree. The program is intended mainly for the practicing engineer. It can be used by those students interested in performing applied research or those willing to broaden their knowledge before pursuing higher studies.

Pursuant our BSEE and BSCpE, the emphasis of the program is on advanced studies with applied training and includes laboratory instruction. Most courses however, are dedicated to provide a rigorous theoretical background.

ADMISSION TO THE PROGRAM

Applicants for unconditional admission are generally expected to have a core upper-division GPA of 3.0 or higher BSEE or BSCE degree from an ABET accredited (or equivalent) engineering program and must also satisfy all other university graduate admission requirements in the graduate studies section of this catalog.

Applicants with core upper-division GPAs of 2.7 or more will be considered for conditional admission. All conditional applicants must submit GRE (general) scores prior to admission consideration. Minimum required scores are 650 in the quantitative part, 1100 in (quantitative + verbal) and 3.5 in the analytical writing measure part. Conditions may include but are not limited to minimum academic performance and/or additional coursework. Conditions will vary depending on the MSEE option chosen by the candidate, new conditions may apply if after admission a student decides to switch MSEE option.

Applicants with undergraduate degrees in related disciplines, and those who do not fully satisfy other department or university graduate admission requirements may be considered for possible conditional admission.

Conditionally admitted students must satisfy the specified conditions before being advanced to unconditional standing. Those who do not satisfy these conditions in a timely manner will be dismissed from the program.

REQUIREMENTS

The curriculum for the Master of Science in Electrical Engineering degree requires a minimum of 46 quarter units of coursework, of which at least 33 units must be in 500 and 600 level courses. Each program of study consists of at least 10 units of breadth and emphasis, a maximum of 32 units of electives, and either a Thesis (EGR 696, 4-6 units) or a Master's Degree Project consisting of EGR 691 (2 units) followed by EGR 692 (2 units). Breadth courses are intended to ensure that the student acquires a fundamental knowledge in advanced mathematics. The electives may be chosen from an extensive list of courses in electrical engineering and related areas of mathematics, science, and engineering.

Each of the MSEE Options has different requirements as described below.

Each student must, in consultation with their academic advisor, prepare a program of study that outlines the coursework required to complete the program. This program of study must be prepared when the student has achieved 12-16 units of graduate coursework.

To attain Advancement to Candidacy for the degree, the student must satisfy all of the following:

1. Completion of all conditions of admission, including any preparatory courses that may have been specified,
2. Have an approved program of study on file consistent with one of the MSEE options,
3. Completion 36 quarter units with a grade point average of at least 3.0,
4. Passed the graduation writing test or received a waiver

Please check the Electrical and Computer Engineering Department website for additional information.

CURRICULUM

All students must select one of the following Options:

The Communications and Signal Processing Option covers current communications techniques, signal processing schemes and provides the necessary theoretical basis for their understanding.

The Computer Engineering Option includes hardware system design, algorithms, performability, embedded systems and interfaces to other systems.

The Controls and Robotics Option involves time and frequency domain system design techniques and their applications, real-time systems,and embedded system control.

COMMUNICATIONS AND SIGNAL PROCESSING OPTION

Required Breath and Emphasis (14-16 units)

Stochastic Processes	ECE	543	(4)
Communication Theory	ECE	544	(4)
ECE 500 or 400 Laboratories			(2)
Directed Study and Master's Degree Project	EGR	691/692	(2/2)
or Master's Degree Thesis	EGR	696	(4-6)

Electives (30–32 units)

Option Electives

A minimum of 16 units select from the following list with advisor approval with no more than 4 units of 400 level courses:

Digital Communication Systems	ECE	409	(4)
Microwave Engineering	ECE	410/410L	(3-4)
Digital Signal Processing II	ECE	428	(4)
Optical Fiber Communications	ECE	436	(4)
R.F. Design/Laboratory	ECE	448/448L	(3-4)
Digital Image Processing	ECE	542	(4)
Communication Theory	ECE	544	(4)
Digital Signal Processing	ECE	551	(4)
Wavelet Theory and Applications	ECE	554	(4)

Information Theory and Coding	ECE	560	(4)
Advanced Microwave Engineering	ECE	562	4)
Solid State Devices and Circuits	ECE	563	(4)
Satellite Communication	ECE	586	(4)
Antenna Theory	ECE	589	(4)
Wireless and Digital Communication Lab	ECE	597L	(2)
Special Topics for Graduate Students	ECE	599/599L	(1-4)
Advanced Communication Systems	ECE	644	(4)
Advanced Signal Processing	ECE	651	(4)

Support Electives

A maximum of 12 units select from the following list with advisor approval:

Electromagnetic Fields and Applications	ECE	402	(4)
CMOS Analog Circuits	ECE	407	(4)
Digital Signal Processing/Lab	ECE	408/408L	(4)
Integrated Circuits: Devices and Modeling	ECE	412	(4)
Lasers	ECE	420	(4)
Numerical Modeling	EGR	511	(4)
Matrix Methods in Engineering	EGR	515	(4)
Microelectromechanical Devices and Systems	ECE	530	(4)
Systems Theory	EGR	540	(4)
Solid State Electronics	ECE	548	(4)
Introduction to Neural Networks	ECE	552	(4)
Computer Simulation of Engineering Systems	EGR	553	(4)
Microprocessor Based Control Systems	ECE	555	(4)
Computer Networks	ECE	559	(4)
Digital Integrated Circuit Design in VLSI	ECE	571	(4)
Materials for Electronics	EGR	580	(4)
Biological Control Systems	ECE	588	(4)
Microcontroller Applications Lab	ECE	592L	(2)
DSP Applications Lab	ECE	593L	(2)
FPGA Design Lab	ECE	594L	(2)
Research Methods	ECE	596	(2)
Special Topics for Graduate Students	ECE	599/599L	(1-4)
Systems Theory	EGR	640	(4)
Digital Control Systems	ECE	642	(4)
Optimal Control Systems	ECE	643	(4)
Nonlinear Control Systems	ECE	652	(4)
Appropriate 500/600 Math or CS classes			(3-4)

The allowed maximum transfer units are 13 units of coursework taken at other universities. This maximum includes classes at the 400 or 500 level (not previously used towards a degree) taken at Cal Poly Pomona. No more than 8 units of 599 numbered courses can be used towards the MSEE degree.

COMPUTER ENGINEERING OPTION

Required Breath and Emphasis (14-16 units)

Matrix Methods in Engineering	EGR	515	
or Stochastic Processes	ECE	543	(4)
Computer Organization	ECE	585	(4)
ECE 500 or 400 Laboratories			(2)
Directed Study and Master's Degree Project	EGR	691.692	(2/2)
or Master's Degree Thesis	EGR	696	(4-6)

Electives (32 units maximum)

Option Electives

A minimum of 20 units select from the following list with advisor approval:

Reliability and Performability Analysis	ECE	518	(4)
Network Security	ECE	520	(4)
Object Oriented Approach to Eng. Sftwr Design	ECE	541	(4)
Digital Image Processing	ECE	542	(4)
Digital Signal Processing	ECE	551	(4)
Computer Arithmetic	ECE	558	(4)
Computer Networks	ECE	559	(4)
Advanced Microprocessors	ECE	561	(4)
Digital Signal Testing	ECE	582	(4)
Advanced Computer Organization	ECE	685	(4)

Support Electives

A maximum of 12 units select from the following list with advisor approval:

ECE, CS or MAT 400/500/600 . . . . (3-4)

The allowed maximum transfer units are 13 units of coursework taken at other universities. This maximum includes classes at the 400 or 500 level (not previously used towards a degree) taken at Cal Poly Pomona. No more than 8 units of 599 numbered courses can be used towards the MSEE degree.

ROBOTICS AND CONTROL OPTION

Required Breath and Emphasis (20-22 units)

Matrix Methods for Engineering	EGR	515	(4)
Systems Theory	EGR	540	(4)
Stochastic Processes	EGR	543	(4)
Research Methods	EGR	596	(2)
ECE 500 or 400 Laboratories			(2)
Directed Study and Master's Degree Project	EGR	691/692	(2/2)
or Master's Degree Thesis	EGR	696	(4-6)

Electives (24–26 units)

Option Electives

A minimum of 12 units select from the following list with advisor approval:

Differential Equations for Engineers	EGR	509	(4)
Engineering Probability and Statistics	EGR	510	(4)
Numerical Modeling	EGR	511	(4)
Vector Analysis and Complex Variables	EGR	512	(4)
Microelectromechanical Devices and Systems	ECE	530	(4)
Digital Image Processing	ECE	542	(4)
Robust Control	ECE	545	(4)
Microprocessor Based Control Systems	ECE	555	(4)
Special Topics for Graduate Students	ECE	599/599L	(1-4)
Digital Control Systems	ECE	642	(4)
Optimal Control Systems	ECE	643	(4)
Nonlinear Control Systems	ECE	652	(4)

Support Electives

A maximum of 12 units select from the following list with advisor approval:

Digital Signal Processing	ECE	551	(4)
Computer Simulation of Engineering Systems	EGR	553	(4)
Wavelet Theory and Applications	ECE	554	(4)
Biological Control Systems	ECE	588	(4)
Microcontroller Applications Lab	ECE	592L	(4)
DSP Applications Lab	EGR	593L	(4)
Systems Theory	EGR	640	(4)
Advanced Signal Processing	ECE	651	(4)
Appropriate 500/600 Math or CS classes			(3-4)

with no more than 8 units from the following list:

Introduction to Filter Design	ECE	403	(4)
Robotics/Lab	ECE	404/404L	(3-4)
CMOS Analog Circuits	ECE	407	(4)
Digital Signal Processing	ECE	408/408L	(3-4)
Integrated Circuits: Devices and Modelling	ECE	412	(4)
Microprocessor Appl. in Process Control/Lab	ECE	414/414L	(3-4)
Integrated Circuits: Design and Fabrication	ECE	418	(4)
Advanced Control Systems	ECE	419/419L	(3-4)
Biomedical Instr. and Measurements/Lab	ECE	435/435L	(3-4)
Power Electronics/Lab	ECE	469/469L	(3-4)

The allowed maximum transfer units are 13 units of coursework taken at other universities. This maximum includes classes at the 400 or 500 level (not previously used towards a degree) taken at Cal Poly Pomona. No more than 8 units of 599numberred courses can be used towards the MSEE degree.

GRADUATE COURSE DESCRIPTIONS

NOTE: For 400-level and undergraduate prerequisite course descriptions, please see undergraduate section.

ECE 518 Performability Analysis (4)

General concept and advance techniques regarding dependability, performance, and the combined performability analyses. Theoretical background and fault-tolerant design techniques will be discussed. State-of-the-art modeling techniques and analysis tools will be used. 4 lectures/problem-solving.

ECE 530 Microelectomechanical Devices and Systems (4)

MEMS processes and structures. Applications of basic physical principles to microsystem design. Modeling methods for electromechanical structures. CAD for MEMS. Packaging. Prerequisites: Graduate standing or consent of the instructor. 4 lectures/problem-solving.

ECE 541 Object-oriented Approach to Engineering Software Design (4)

Essential object-oriented programming concepts: encapsulation, inheritance, and polymorphism, GUI development, multimedia software design, application modeling using unified modeling language. 4 lectures/problem-solving. Prerequisite: ECE 304 or equivalent, or consent of instructor.

ECE 542 Digital Image Processing (4)

Basic concepts in digital image processing such as point, algebraic, geometric operations, discrete Fourier transforms, and wavelet transforms, and applications such as image restoration, image compression, and pattern recognition. 4 lectures/problem-solving. Prerequisite: upper division courses in probability theory and digital signal processing.

ECE 543 Stochastic Processes (4)

Analysis of random phenomena associated with the transmission of digital and analog signals. Investigation of random binary signals, thermal noise, signal-to-noise ratios, and Markov processes. Applications include optimum filtering, estimation theory, and queuing theory. 4 lectures/problem-solving. Prerequisite: EGR 510 or equivalent.

ECE 544 Communication Theory (4)

Selected advanced topics in communication systems such as information theory for continuous and discrete channels; signal detection and recognition; coding for optimal communication nets. 4 lectures/problem-solving. Prerequisite: Upper-division course in communications systems.

ECE 548 Solid State Electronics (4)

Quantum theory and atomic structure. Classical and quantum statistics. Description of crystal structures. Lattice vibrations. Band theory of solids. Transport phenomena in semi-conductors and metals. 4 lectures/problem-solving. Prerequisite: Upper-division course in solid-state electronics.

ECE 551 Digital Signal Processing (4)

Analysis and design of multirate signal processing and its applications. Linear prediction filter design and implementation using FIR and lattice filters. Non-parametric, parametric, and eigensystem algorithms for power spectrum estimation. 4 lectures/problem-solving. Prerequisites: Upper-division courses in Fourier transforms and ECE 428, or equivalent.

ECE 552 Introduction to Neural Networks (4)

Theory and engineering applications of artificial neural networks. 4 lecture/problem solving sessions. Prerequisites: Basis Probability Theory and EGR 515.

ECE 554 Wavelet Theory and Applications (4)

Basic concepts in wavelet theory such as filters, downsampling and upsampling, filter banks, orthogonal filter banks, multiresolution analysis, wavelets, finite length signals, M-channel filter banks, and applications. 4 lectures/problem-solving. Prerequisite: Upper division course in digital signal processing.

ECE 555 Microprocessor-based Control Systems (4)

Typical computer control systems. Supervisory and DDC Control. Mathematics of sample-data control systems. Development of controller algorithms using Z-transforms and microprocessors. On-Line identification techniques, advanced control techniques. Typical microprocessor-based process control systems. 4 lectures/problem-solving. Prerequisites: Upper-division courses in microprocessor and control theory.

ECE 558 Computer Arithmetic (4)

System-level design. VHDL; data flow modeling, structural modeling, algorithmic modeling, and state machine modeling. PLD, CPLD, and FPGA. High speed addition, multiplication and division. Floating-point arithmetic. 4 lectures/problem solving.

ECE 559 Computer Networks (4)

Principles, Protocols, Architecture and Performance Analyses of Local Area Networks, Wide Area Networks, and Internetworking. Asynchronous transfer mode (ATM) networks. 4 lectures/problem solving. Prerequisites: ECE342 and ECE 405 or equivalent.

ECE 560 Information Theory and Coding (4)

Channel models, coding theorems, coding systems, statistical properties of information sources. 4 lectures/problem-solving. Prerequisite: Upper-division course in probability theory.

ECE 561 Advanced Microprocessors (4)

State of the art 32- and 64-bit microprocessors; assembly language and C programming; input/output techniques; system design and peripheral interfacing. 4 lectures/problem-solving. Prerequisite: ECE 432/432L or equivalent.

ECE 562 Advanced Microwave Engineering (4)

Analysis of microwave networks and components, waveguides, and cavities. Design and evaluation of solid state microwave oscillators, mixer circuits, control circuits and phase-shifters. New developments. 4 one-hour lecture/problem solving sessions. Prerequisite: Basic knowledge of electromagnetic theory, transmission line theory, microwave engineering and semiconductor devices.

ECE 563 Solid State Microwave Devices and Circuits (4)

Introduction to parameter matrices and microwave circuit design techniques. Microstrip lines. Design and evaluation of FET amplifiers, FET oscillators. Varactors, mixer diodes, control devices and their microwave circuit applications. Computer-aided design of microwave circuits. New developments. 4 lectures/problem-solving. Prerequisites: Upper-division courses in EM theory and linear active circuits.

ECE 571 Digital Integrated Circuit Design in VLSI (4)

Analysis and design of LSI and VLSI digital integrated circuits in CMOS technology. Combinational logic circuits. Sequential logis circuits. Static and dynamic operation of logic circuits. Arithmetic building blocks: adder, multiplier, shifter. The influence of parasitic capacitances, inductances, and resistances on the design performance, and approaches to cope with them. Timing issues in digital circuits. Optimizing speed, area, power. Designing memory and array structures. Physical layout design, layout design rule check, circuit extraction and simulation using CAD tools such as L-Edit, MAGIC, and Spice. 4 lectures/problem-solving. Prerequisite: upper division course in semiconductor materials and devices.

ECE 582 Digital System Testing (4)

Basic theories and techniques for testing digital systems. Test generation for combinational and sequential logic circuits. Testing and modeling for faults expected in digital systems. Testing for stuck faults. Design methods to improve system testability. Built-in-self-test (BIST). 4 lecture/discussions.

ECE 585 Computer Organization (4)

Memory Subsystems: Cache, virtual and interleaved memories. Instruction pipelines. Dynamic scheduling algorithms and principles of vector processing. Principles of pipeline processing. Arithmetic and instruction pipeline design. Pipeline scheduling and control. 4 lectures/problem-solving. Prerequisite: Upper division course in computer architecture.

ECE 586 Satellite Communication (4)

Introduction to satellite and wireless digital communication techniques. Link budget analysis. Baseband transmission systems. Power efficiency and spectrally efficient modulation techniques for linear and non-linear satellite channels. Coding for error detection and correction. Synchronization systems. Time division, frequency division, and code division multiple access techniques. Satellite transponders and earth stations. 4 lectures/problem-solving. Prerequisite: ECE 544 or equivalent, or consent of instructor.

ECE 588 Biological Control Systems (4)

Application of control systems analysis to biological control systems. Development of mathematical models of selected biological control systems and the application of computer techniques in simulation of these systems. 4 lectures/problem-solving. Prerequisite: Upper-division course in control systems.

ECE 589 Antenna Theory (4)

Dipole, loop and small antennas, arrays, wire, aperture, lens, horns, reflectors and other special antenna; currents and impedances; radiation and radiation patterns. 4 lectures/problem-solving. Prerequisites: Two upper-division courses in field theory.

ECE 592L Microcontroller Applications Laboratory (2)

Design and performance analysis of microcontroller systems. Experiments will include performance evaluation of design tools and microcontroller hardware. System level design and testing of individual student projects. Prerequisite: ECE 561.

ECE 593L DSP Applications Laboratory (2)

Design and performance analysis of DSP systems. Experiments will include performance evaluation of design tools and DSP hardware. System level design and testing of individual student projects. Prerequisite: Upper division course in computer architecture.

ECE 594L FPGA Design Laboratory (2)

Modeling digital hardware using Verilog HDL. Implementation of digital hardware using FPGA. 2 lecture/demonstrations. Prerequisite: ECE 585 or equivalent.

ECE 597L Wireless and Digital Communication Laboratory (2)

Design and performance analysis of digital communication systems including FSK, BPSK, QPSK, QAM, GMSK. Experiments will include performance evaluation of RF oscillators, amplifiers, mixers, modulators, transmitters, and digital receivers. Pseudo Noise (PN) codes. PN-coded spread-spectrum BPSK transmitter and receiver. System level testing will include wireless, optical and radar systems. Special experiments on BER and FDMA/TDMA/CDMA will be conducted depending on the availability of equipment and parts. Prerequisites: ECE 405, ECE 445, ECE 544, and ECE 586.

ECE 640 Systems Theory (4)

Pole-placement design using state-feedback for linear systems, observer (state-estimator) design. Introduction to nonlinear systems and perturbation theory; stability for linear and nonlinear systems using Liapunov methods. 4 seminars. Prerequisite: ECE 540. Unconditional standing required.

ECE 642 Digital Control Systems (4)

Basic theory of sampling, quantizing and modeling of the digital computer for computer controlled feedback systems. State-space and Z-transform representation. Time response stability and design using both classical and modern techniques. 4 seminars. Prerequisites: Upper-division course in control systems and ECE 540. Unconditional standing required.

ECE 643 Optimal Control Systems (4)

Selected topics in optimal control theory such as variational calculus; maximum principle; dynamic programming; state estimation and computational methods in optimal systems control. 4 seminars. Prerequisite: ECE 540. Unconditional standing required.

ECE 644 Advanced Communication Systems (4)

Selected advanced topics in communication systems such as spread spectrum systems, computer communications, optical communications and image processing. 4 lecture discussions. Prerequisite: ECE 544 or equivalent. Unconditional standing required.

ECE 651 Advanced Signal Processing (4)

Selected advanced topics in signal processing such as multi-rate signal processing, adaptive filtering, parametric spectrum estimation and signal analysis with higher order spectra. 4 lecture discussions. Prerequisite: ECE 551 or equivalent. Unconditional standing required.

ECE 652 Nonlinear Control Systems (4)

Numerical approximation methods in the solution of non-linear systems. Phase-plane techniques including method of isoclines, delta, and analysis of singular points. Describing function techniques, perturbation reversion, variation of parameters and harmonic balance methods. Liapunov stability methods. 4 seminars. Prerequisites: upper-division course in control-systems and ECE 540, or consent of instructor. Unconditional standing required.

ECE 685 Advanced Computer Organization (4)

Array processing. Multiprocessor architecture programming and control. Data flow computers and introduction to artificial neural networks. 4 lectures/problem-solving. Prerequisite: ECE 585. Unconditional standing required.

MECHANICAL ENGINEERING

Master of Science in Mechanical Engineering

In the Department of Mechanical Engineering, College of Engineering

www.csupomona.edu/me

Michael T. Shelton, Chair
Kevin R. Anderson, Graduate Coordinator

The practice-oriented Master of Science in Mechanical Engineering (MSME) program builds upon an undergraduate education and facilitates more advanced study in one of the branches of mechanical engineering.

MISSION STATEMENT

The Master of Science in Mechanical Engineering (MSME) program is a response to the increasing demand of mechanical engineers in the more advanced and rapidly developing fields such as Computer Aided Design using finite element methods, Computational Thermal and Fluid Sciences and the area of Energy Management. This program allows students to acquire specialized knowledge and research skills for the advanced work in their chosen area of concentration. Also, this program requires a student to complete an engineering project or a thesis that would demonstrate their capability to perform an independent research work. Thus, this requirement instills a great practical value into a student's graduate work at Cal Poly Pomona.

EDUCATIONAL OBJECTIVES

Graduates of the Master of Science program in Mechanial Engineering shall have:

- To provide a framework for working professionals, international students and undergraduates to

pursue graduate studies in the field of Mechanical Engineering

- To bridge the gap between applied engineering practice and rigorous theoretical treatments of

subject matter in the arenas of Thermal-Fluid Sciences and Advanced Mechanical Design

- To produce a student population possessing the skills required to either i) further pursue post-baccalaureate studies, or ii) work in the specialized technical fields of their study plan

ADMISSION TO THE PROGRAM

An applicant for admission to the program or Master of Science in Mechanical Engineering must meet university criteria as specified in the Admission section of this catalog as well as the criteria outlined below. Applicants are advised that a reasonable proficiency in computer programming is necessary for successful completion. If the student is deficient in this area, he or she will be expected to remove the deficiency early in the program.

Successful applicants will be admitted to the program either unconditionally or with conditions imposed on them. To receive unconditional admission, an applicant must satisfy these criteria:

1. The applicant must hold a baccalaureate degree Mechanical Engineering from a program that has been accredited by the Accreditation Board for Engineering and Technology (ABET) and for which the accreditation was in effect at the time of award of the degree. The degree must have been granted within five years prior to the proposed beginning of the graduate program.
2. The applicant must have achieved a grade point average of at least 3.00 in all undergraduate upper division coursework in mathematics, science and engineering and, additionally, in all coursework attempted with graduate standing.
3. The applicant must receive positive recommendations from the Director of Engineering Graduate Studies and the Chair of the Department of Mechanical Engineering and approval by the Dean of the College of Engineering.

Conditional admission may be granted in cases in which the applicant' s academic preparation for graduate study is such that criteria 1) and/or 2) above are not satisfied. In such cases, the applicant is required to submit recent test scores of the Graduate Record Examination, letters of recommendation, and other documents attesting to the applicant's aptitude for graduate studies. Applicants who do not satisfy criterion 1) may be required to take a limited number of preparatory courses with no degree credit. Criterion 3) above must be met. When an applicant is admitted conditionally, the conditions to be met and the time allowed for meeting them are stated in the letter of admission. If these conditions are not satisfied, the student may be disqualified from the program.

REQUIREMENTS

Admission to the program does not admit a student to candidacy for the degree. Advancement to Candidacy is granted a student upon the recommendation of the graduate faculty and implies a readiness to attempt the thesis or comprehensive examination. Students who are not candidates are not eligible to register for EGR 696 or 697.

In order to advance to candidacy for the Master of Science in Mechanical Engineering, the student must:

1. Satisfy all admissions conditions, if any;
2. complete at least 24 quarter units of graduate coursework with a grade point average of 3.00 or better;
3. pass the Graduation Writing Test; and
4. with the assigned advisor, develop and file a program of study and have it approved by the Mechanical Engineering Graduate Studies Committee, by the Graduate Studies Analyst, and by the Director of Engineering Graduate Studies.

A program of study must be submitted for approval before the end of the second quarter of attendance. At the time of filing of the program of study, the student must opt for publishing a thesis or conducting an independent study and passing a comprehensive examination as a culminating experience of his/her graduate education after completing the required coursework. The thesis effort is intended to involve independent research by the student with the goal of advancing knowledge in a specialized area. The thesis effort includes a defense of the effort by the student before a committee of faculty members. The independent study provides the student an opportunity to explore a practical and realistic industrial problem in his/her chosen field of specialization. The accompanying comprehensive examination is a test of the student's expertise in his/her areas of coursework concentration. Information regarding the thesis and the independent study with a comprehensive examination is available at the Graduate Studies Office.

In addition, each student is responsible for satisfying all university requirements specified elsewhere in the catalog.

CURRICULUM

General requirements for advanced degrees are found in the Graduate Scholastic Requirements section of this catalog. No more than 13 units of acceptable graduate credit may be transferred from another graduate institution. No more than 13 units taken through Extension may be used on the program of study. No more than 13 units of acceptable graduate credit may be petitioned by an undergraduate student. A total of 13 transfer, extension, or units petitioned for graduate credit, or any combination of 13 units, may be included on the program of study.

The curriculum for the Master of Science in Mechanical Engineering requires a minimum of 45 units of coursework, of which at least 36 units must be in 500 and 600 level courses. Each program of study consists of at least 12 units of breadth courses, at least 12 units of technical emphasis courses, at least 12 units of elective courses, and either EGR 696, thesis (4-9 units) or EGR 692, independent study with a comprehensive examination (4 units). The breadth courses must be chosen from the sequence EGR 509 through 515. These courses are intended to insure that the student acquires a fundamental knowledge in advanced mathematics. A minimum of 12 units of technical emphasis courses must be selected from an approved course list for the MSME program. No 400-level course may be included in this category of technical emphasis, and a maximum of 4 transfer units can be used to satisfy the 12 unit requirement. The rest of the emphasis courses and electives may be chosen from an extensive list of courses in engineering and related areas of mathematics and sciences. They should be chosen in collaboration with an advisor to insure consistency with graduate goals and to assure an integrated educational experience. A course in the program of study may be taken only after the student has satisfied the course prerequisites for enrolling in the course. It is the student's responsibility to satisfy all prerequisites for a course before enrolling in the course.

Engineering graduate students may be granted graduate credit only for courses numbered 400 and above. A grade point average of 3.0 (B) or better must be maintained in all upper-division and all graduate courses. Candidates must be enrolled in the university during the quarter of graduation

Breadth Courses (12 units minimum)

Adv. Differential Equations	EGR	509	(4)
Engr. Prob. and Statistics	EGR	510	(4)
Numerical Modeling	EGR	511	(4)
Vector Analysis and Complex Variables	EGR	512	(4)
Engineering Tensor Analysis	EGR	513	(4)
Variational Methods in Engineering	EGR	514	(4)
Matrix Methods in Engr	EGR	515	(4)

Technical Emphasis (12 units minimum)

Select from the following list:

Elasticity	ME	520	(4)
Conduction Heat Transfer	ME	532	(4)
Mechanical Metallurgy	ME	533	(4)
Advanced Fluid Dynamics	ME	535	(4)
Advanced Classical Dynamics	ME	536	(4)
Advanced Engineering Thermodynamics	ME	545	(4)
Advanced Mechanics of Materials	ME	556	(4)
Radiation Heat Transfer	ME	564	(4)
Convective Heat Transfer	ME	584	(4)

Technical Electives (12-16 units)

Select from the following list:

Fracture of Solids	ME	534	(4)
Advanced Transport Phenomena	ME	550	(4)
Analysis of Mechanical Designs	ME	557	(4)
Nonlinear Dynamics	ME	570	(4)
Combustion Theory	ME	576	(4)
Solar Energy Systems	ME	590	(4)
Direct Energy Conversion	ME	591	(4)
Computational Fluid Dynamics	ME	632	(4)
Special Topics	ME	599	(4)

Elective courses may include up to 8 units of approved 400-level courses that are relevant to the program of study, so long as these or equivalent courses have not already been used for credit toward an undergraduate degree.

Thesis or Independent Study Exam			(2 units)
Ind. Study with Comp. Exam	EGR	692	(2)
Master's Degree Thesis	EGR	696	(2)
Master's Degree Continuation	EGR	699	(2)

GRADUATE COURSE DESCRIPTIONS

NOTE: For undergraduate prerequisite course descriptions, please see undergraduate section.

ME 520 Elasticity (4)

Theory of stress and strain for continuous media. Stress-strain relations of elasticity. Plane stress and strain. Introduction to thermoelasticity. 4 lectures/problem-solving. Prerequisites: Upper-division courses in structural analysis and EGR 513, or consent of the instructor.

ME 532 Conduction Heat Transfer (4)

Application of principles of heat transfer and thermodynamics in solution of steady-state and transient heat transfer problems. Classical heat conduction theory. Derivation of Fourier equation and integration of various single and multidimensional problems. Detailed discussion of thermal conductivity. 4 lectures/problem-solving. Prerequisite: Upper-division course in heat transfer.

ME 533 Mechanical Metallurgy (4)

Study of the mechanical behavior of metals. Fundamental mechanisms controlling deformation phenomena, strain-hardening, creep, fatigue, and fracture. Strengthening mechanisms involving alloying and heat treatment. 4 lectures/problem-solving. Prerequisites: Undergraduate courses in strength of materials and materials science.

ME 534 Fracture of Solids (4)

Engineering and microscopic approaches, fracture of steels, creep and fatigue, stress corrosion cracking, and hydrogen embrittlement. 4 lectures/problem-solving. Prerequisite: Upper-division course in stress analysis.

ME 535 Advanced Fluid Dynamics (4)

Governing field laws: mass, momentum, energy. Reynolds' Transport Theorem: mass, momentum, energy. Cartesian tensor notation. Rotation, stress, rate-of-strain relations. Flow kinematics. Ideal fluid flow. Conformal transformations. Viscous flows: pipe, flat plate. 4

lectures/problem-solving. Prerequisite: Upper-division course in fluid mechanics or consent of instructor.

ME 536 Advanced Classical Dynamics (4)

Lagrange's equations, Hamilton's principle, variational principles, equations of motion in Eulerian angle systems, characteristic equation of inertia matrix, cuspidal motion and nutation. 4 lectures/problem-solving. Prerequisites: EGR 515 and upper-division course in dynamics, or consent of instructor.

ME 545 Advanced Engineering Thermodynamics (4)

Development of concept of equilibrium. Reversible and irreversible principles of thermodynamics, second law consequences; estimation and correlation of thermodynamic properties. Physical basis of conservation equations. Statistical foundations. 4 lectures/problem-solving. Prerequisite: Upper-division course in thermodynamics.

ME 550 Advanced Transport Phenomena (4)

Differential balances for momentum, heat, and mass transfer. Convective energy, mass, and momentum transfer; internal and external flow, exact and approximate solutions. Application for space vehicle re-entry, binary and multicomponent systems, nuclear reactor cooling, mass transfer and heat exchanger analysis. 4 lectures/problem-solving. Prerequisites: Upper-division courses in heat transfer and fluid mechanics.

ME 556 Advanced Mechanics of Materials (4)

Stress and strain analysis, 2-D elasticity problems, unsymmetrical bending, shear center, torsion of prismatic members, inelastic and plastic behavior in torsion and bending, topics from: micro-mechanics of composite materials, energy methods, failure theories, theory of plates, thick walled pressure vessels. 4 lectures/problem-solving. Prerequisite: Upper-division course in stress analysis.

ME 557 Analysis of Mechanical Designs (4)

Analysis of common machine elements. Relation to design decision making. Optimization, reliability, miniaturization, and statistical strength theory. 4 lectures/problem-solving. Prerequisite: Upper-division course in stress analysis.

ME 564 Radiation Heat Transfer (4)

Radiation properties of surfaces; radiant interchange among surfaces separated by radiatively non-participating media including the interchange among black and gray surfaces; radiant energy transfer through absorbing, emitting, and scattering media. 4 lectures/problem-solving. Prerequisite: Undergraduate course in heat transfer.

ME 570 Nonlinear Dynamics (4)

Complementary methods of nonlinear modeling of physical, chemical and fluid systems. Analytic, topologic and computational perspectives. Dimensions and fractals. Bifurcations and catastrophes. Deterministic chaos. Solitons. Applications to ecology, hydrodynamics, electrical and mechanical systems. 4 lectures/problem-solving. Prerequisite: EGR 536 or consent of the instructor.

ME 576 Combustion Theory (4)

Molecular structure and statistical thermodynamics. Real gases. Transport phenomena. Chemical reactions in gases. Reactive gas dynamics. Combustion phenomena and diffusion flames. Premixed gas flames; flame propagation, cellular flames, quenching. Aerodynamics of flames; flame shape, turbulent flames. Detonation. Applications. 4 lectures/problem-solving. Prerequisites: Undergraduate courses in thermodynamics and heat transfer.

ME 584 Convective Heat Transfer (4)

Conservation principles. Fluid stresses and flux laws. Laminar and turbulent boundary layers. Internal flow; noncircular cross sections, entry lengths, asymmetric heating. External flow; variable velocity, injection, specified temperature and heat flux distribution. Temperature dependent fluid properties. Computer solutions. 4 lectures/problem-solving. Prerequisite: Undergraduate course in heat transfer.

ME 590 Solar Energy Systems (4)

Analysis of advanced, hybrid solar collectors. Advanced solar energy storage. Design of solar energy systems. 4 lectures/problem-solving. Prerequisite: Upper-division course on solar energy or equivalent.

ME 591 Direct Energy Conversion (4)

Conversion of primary chemical, nuclear, solar and heat energy directly to electrical energy without intermediate mechanical elements. Fuel cells, solar cells, magnetohydrodynamic generators, and fusion plasma generators. 4 lectures/problem-solving. Prerequisite: Upper-division course in thermodynamics.

ME 632 Computational Fluid Dynamics (4)

Fundamentals of finite-difference methods: partial differential equations, difference representation, stability, errors. Dynamics of a body moving through a fluid medium. Inviscid fluid flows. Compressible fluid flows. Viscous fluid flows. Secondary flows and flow instabilities. Panel methods. 4 lectures/problem-solving. Prerequisites: EGR 509 and 535. Unconditional standing required.

ENGINEERING MANAGEMENT

Master of Science in Engineering Management

In the Department of Industrial and Manufacturing Engineering, College of Engineering

www.csupomona.edu/ime

Abdul B. Sadat, Chair and Graduate Coordinator

The Master of Science in Engineering Management is a unique program developed to meet industry need for highly qualified and well trained engineering managers. The program gives engineers advanced multidisciplinary training in manufacturing, production and operations management, business, and finance. It is such an interdisciplinary program to be offered by the College of Engineering in cooperation with the College of Business Administration. Most of the applicants to the program are expected to have work experience, to be working full-time, and to enroll as part-time students. The curriculum is structured so that the student can complete a course of study tailored to the student's unique talents and career goals. It culminates in an engineering management research experience that addresses students and industry needs. Students will be given the option of performing thesis research on individual topics or to join research teams sponsored by one of the programs' industry partners.

ADMISSION TO THE PROGRAM

All applicants for the Masters in Engineering Management must file an admission application on line at www.csumentor.edu. To receive unconditional admission to the MSEM program applicants must hold a baccalaureate degree in engineering, or engineering technology (Applicants holding engineering technology degrees may be required to take the GRE Test and/or some preparatory courses with no graduate credit) from an ABET-accredited program. In addition, the applicant must have attained a grade point average of at least 3.0 in all undergraduate upper division mathematics, science and engineering courses, and, likewise in all courses attempted with graduate standing. Conditional admission may be granted in cases in which the applicant does not satisfy the criteria for unconditional admission, but can demonstrate aptitude for graduate study by submitting test scores of the Graduate Record Examination, letters of recommendation and other relevant documents. A minimum GRE score of 1100 in the Quantitative and Verbal sections of the exam is required for admission to the program.

All applicants from foreign countries should contact the Office of Admissions at least one year in advance of application so that all required materials may be supplied in time for evaluation. Applicants whose native language is not English must submit the results of the Test of English as a Foreign Language (TOEFL) prior to admission.

PROGRAM REQUIREMENT

A minimum of 48 quarter units of course work is needed. This should include at least 24 units of graduate business administration (GBA) courses, and a minimum of 24 quarter units of engineering graduate (EGR) courses. A maximum of 8 quarter units at the 400 level may be accepted for graduate EGR or GBA courses. The program of study includes at least 16 quarter units of breadth courses and 20 quarter units of technical emphasis courses. The remaining units consist of at least 6 quarter units of electives, and an Independent Study with a Report. A grade point average of 3.0 or better must be maintained. During the first quarter each student will develop a program of study approved by Graduate Studies Committee. A total of 13 quarter units of transfer, Extended University or units petitioned for graduate study, or any combination of 13 units may be included in a Master's contract. The stipulated time limit of 7 years applies to all of the above.

Admission to the program does not admit a student to candidacy for a degree. Advancement to Candidacy is granted upon the recommendation of the graduate faculty and implies a readiness to attempt the thesis or independent study. Students who are not candidates are not eligible to register for EGR 691, 692, 696 or 699. In order to advance to candidacy the student must:

1. Satisfy all admissions conditions, if any.
2. Have an approved program of study
3. Complete at least 32 units of graduate coursework with a grade point average of 3.0 or better; and
4. Satisfy the Graduation Writing Test.

CURRICULUM

A minimum of 48 quarter units is required for the Master of Science in Engineering Management (MSEM) program. This should include at least 24 quarter units of engineering graduate (EGR) courses and a minimum of 24 units of graduate business administration (GBA) courses.

Core (20 units)

Select 5 from the following list:

Advanced Engineering Economics or	EGR	538	(4)
Advanced Human Factors	EGR	539	(4)
Advanced Methods in Operations Research	EGR	549	(4)
Total Quality Management in Engineering	EGR	572	(4)
Adv Operations Planning and Control Systems	EGR	573	(4)
Advanced Facility Planning	EGR	574	(4)

Take all from the following list:

Financial/Managerial Accounting	GBA	511	(4)
Managerial Statistics	GBA	514	(4)
Fundamentals of Financial Management	GBA	546	(4)
Project Management	GBA	636/637	(3/1)
Management Policies and Strategies	GBA	687/688	(3/1)

Electives (4-6 units minimum)

Select from the following list:

Research Methods	EGR	596	(2)
Directed Study	EGR	691	(2)
Essential of Marketing Management	GBA	517	(4)
Legal Environment of Business	GBA	530	(4)
Analysis of Federal Contracts	GBA	552	(4)
Personnel Management	GBA	562	(4)
Seminars in Organizational Behavior	GBA	615/616	(3/1)

Terminal Options

Choose Option I or II

Option I

Master's Degree Project	EGR	692	(2)

Option II

Master's Degree Thesis	EGR	696	(4-8)