Edwards Air Force Program

College of Engineering
and Computer Science

Master of Science in Engineering Program in cooperation with Edwards Air Force Base

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M.S. in Engineering

Options:

- Electrical Engineering
- Mechanical Engineering

The Program

California State University, Fresno in cooperation with the Air Force Flight Test Center's Education Services Branch, operates a master's degree program with options in electrical and mechanical engineering at Edwards Air Force Base (A.F.B.), California. All coursework, examinations, and degree requirements may be completed on the Base. Although sponsored by the Air Force, the program and courses are open to all qualified personnel in the area, without regard to employment affiliation. Courses are offered during off-duty hours at Desert High School, Edwards A.F.B. The program is offered on a part-time study basis for students pursuing a master's degree while working full time in their professions. The degree requires approximately three years to complete.

Program Goals

The Master of Science in Engineering program has the following goals: (1) to develop the students' advanced analytical skills by developing an in-depth understanding of major theoretical and practical engineering concepts; (2) to develop students' written and oral communication skills applied to technical areas; (3) to achieve an appropriate level of competence by the students in solving practical electrical or mechanical engineering problems; (4) to develop students' critical and creative thinking skills in mastering new topics required to understand and solve complex engineering problems; and (5) to allow the students to demonstrate a sufficient depth of knowledge in a substantive area of electrical or mechanical engineering to pursue advanced academic or industrial work.

Program Objectives

The program has the following objectives for each student: (1) to complete a minimum of 30 hours of graduate coursework, including six required courses in engineering mathematics (3 courses), linear control systems, applied electromagnetics (E E only), communications engineering (E E only), advanced dynamics (M E only), and compressible fluids (M E only); (2) to successfully pass a comprehensive examination which addresses all core course subjects; and (3) to enhance the students' career goals by increasing their theoretical, research, and problem-solving skills in applied engineering.

Program Requirements

The program consists of a common core (12 units), a set of required major courses (6 units), and approved elective courses (12 units), for a total of 30 units (semester hours) of coursework. In addition, a comprehensive examination is required. Up to nine semester hours of satisfactory graduate credit may be transferred into the program from other institutions if not used in completing another graduate degree program. (Undergraduate courses may be transferred if the courses were not used in completing another degree program and the total undergraduate upper division semester hours applied to this degree program do not exceed nine hours.)

The Graduate Record Examination (GRE) Aptitude Test is required of all students prior to advancement to candidacy status. The Advanced Test in Engineering may be required as detailed in the section titled *Admission to Graduate Standing.* (Call the coordinator for information.) The GRE is administered several times per year at Edwards A.F.B. A GRE information booklet and application forms are available in the resident coordinator's office or from the Division of Graduate Studies at California State University, Fresno.

All students must complete a written comprehensive examination before graduation. This examination will stress the material in the required major courses.

The program requires extensive use of a computer; therefore, students are expected to have their own computer or access to one 24 hours a day.

Faculty. All faculty are selected from the Fresno campus, from other CSU campuses, and from among qualified engineers in the Edwards A.F.B. area.

Admission to the University. Requirements for admission to California State University, Fresno are in accordance with Title 5, Chapter 1, Subchapter 3 of the *California Code of Regulations.*

Admission to Graduate Standing. Students who apply to the program are placed in one of the following categories:

1. Graduate Standing, Classified. Students with (a) an undergraduate degree in an appropriate engineering discipline from an ABET accredited program, (b) an undergraduate grade point average of 2.7, and (c) a minimum GRE quantitative score of 450 are eligible for classified (degree status) graduate standing. This constitutes full admission to the graduate program.

   Students who meet requirements (a) and (c) above with a GPA below 2.7 must take the GRE Advanced Test in Engineering and achieve a score above the 50th percentile. In addition, to achieve classified standing these students must take three courses chosen by the coordinator and the department chair and complete these courses with a grade of *B* or higher.
2. Graduate Standing, Conditionally Classified. Students from non-ABET accredited engineering programs, or with a degree in physical science or mathematics or a different engineering discipline, and who have not met the requirements of category 1, will be given conditionally classified graduate standing. Upon satisfactorily meeting any specified requirements, students will then be advanced to classified standing.

Degree Candidacy. The following requirements must be met prior to advancement to candidacy:

1. Classified graduate standing.
2. Completion at California State University, Fresno of at least 9 units of the proposed program with a 3.0 average on all completed work appearing on the program.
3. A minimum grade point average of 3.0 in all upper-division and graduate coursework from the date of commencing the first course of the proposed master's degree program.
4. Departmental recommendation for advancement to candidacy.
5. Satisfactory completion of the Graduate Writing Skills Requirement.

Nondegree students. Students with a bachelor's degree may take graduate courses through extension (concurrently with regular students) for extension credit or audit. Prior approval of the resident coordinator is required.

Curricula

Core Courses
(common to both programs)
Four courses are required:

ENGR 101	Applied ENGR Analysis I (3)
ENGR 102	Applied ENGR Analysis II (3)
ENGR 205	Computing in Engineering Analysis (3) *
ENGR 206	Probability Theory and Statistical Analysis (3) *
ENGR 210	Linear Control Systems (3)

*Either ENGR 205 or 206 may be taken to meet core course requirements.

Mechanical Engineering
Required Courses (both are required):

M E 211	Advanced Dynamics (3)
M E 220	Compressible Fluids (3)

Mechanical Engineering Electives:

ENGR 212	Advanced Control Systems (3)
M E 221	Incompressible Fluids (3)
M E 223	Jet Engine Propulsion (3)
M E 224	Rocket Propulsion (3)
M E 225	Heat Transfer (3)
M E 227	Advanced Thermodynamics (3)
M E 229	Advanced Gas Dynamics (3)
M E 230	Aircraft Stability and Control (3)
M E 232	Advanced Aircraft Stability and Control (3)
M E 241	Structural Analysis (3)
M E 243	Structural Dynamics (3)
M E 250	Astrodynamics (3)
M E 290	Independent Study (1-3)
M E 291T	Topics in Mechanical Engineering (1-3)

Electrical Engineering
Required Courses (both are required):

E E 241	Applied Electromagnetics (3)
E E 245	Communications Engineering (3)

Electrical Engineering Electives:

ENGR 212	Advanced Control Systems (3)
E E 243	Modern Methods in Synchronous Sequential Design (3)
E E 247	Modern Semiconductor Devices (3)
E E 249	Advanced Communications Engineering (3)
E E 251	Antennas and Propagation (3)
E E 253	Advanced Asynchronous Machine Design (3)
E E 255	Digital Signal Processing (3)
E E 257	Optical Communications and Lasers (3)
E E 259	Radar System Design (3)
E E 290	Independent Study (1-3)
E E 291T	Topics in Electrical Engineering (1-3)

Tuition Assistance. Eligible military personnel may apply for tuition assistance (T.A.) which pays 75 percent of tuition cost. The student pays the remaining 25 percent at the time of registration. Officers (but not enlisted personnel) incur a two-year noncumulative service commitment following use of T.A.

Civilian Personnel. Government civilian employees may be eligible to have tuition paid by their government agency, if it can be shown that the course content is work related. Also, many industrial firms have programs to reimburse employees for tuition paid for courses successfully completed. Contact your education development officer or training office for details.

G.I. Benefits. Eligible veterans and active duty personnel with more than 180 days in service may apply for educational benefits. Those with service prior to Jan. 1, 1977, receive benefits under the old G.I. Bill, which reimburses the full tuition cost. Those entering service after Jan. 1, 1977, may be eligible under the new G.I. Bill, which is a contributory plan. Application for V.A. educational benefits may be made in the office of the resident coordinator at the time of registration. The forms are processed through the Fresno campus Veterans Office.

Textbooks. Textbooks normally are available in the California State University, Fresno office at Edwards A.F.B. prior to the first class meeting. In most cases, the cost of textbooks is not reimbursed by the government. Students should be prepared to pay by check.

Enrollment and Registration

Enrollment in the program may be accomplished in the office of the California State University, Fresno Edwards resident coordinator. It is not necessary to visit the Fresno campus. Students who wish to enroll are highly encouraged to contact the Edwards resident coordinator for a counseling appointment. Registration for individual courses generally is accomplished during the week prior to the start of classes. Dates and times for registration are announced by fliers and in the various EAFB media.

COURSES

Engineering (ENGR)

101. Applied
Engineering Analysis I (3)
Covers selected topics in mathematical analysis, with emphasis on applications to engineering problems. Ordinary differential equations, the LaPlace transformation, matrices and determinants, Fourier series and integrals, partial differential equations.

102. Applied
Engineering Analysis II (3)
Covers selected topics in mathematical analysis with emphasis on applications to engineering problems. Vector Analysis, line and surface integrals, complex variables and integrals, conformal mapping, series, residues, potential theory, and special functions.

GRADUATE COURSES

(See *Course Numbering System.*)

Engineering (ENGR)

205. Computing in
Engineering Analysis (3)
Prerequisite: a first course in numerical analysis at the graduate level. Solution of engineering problems using digital computation. Modeling of engineering systems for numerical analysis.

206. Probability Theory
and Statistical Analysis (3)
A first course in probability theory and statistical analysis at the graduate level. Finite sample spaces, conditional probability and independence, one-dimensional random variables, functions of random variables, two- and higher-dimensional random variables, poisson and other discrete random variables, continuous random variables, moment-generating function, reliability theory, sums of random variables, samples and sampling distributions, estimation of parameters, testing hypothesis.

210. Linear Control Systems (3)
Prerequisite: ECE 155 or permission of coordinator. A first-year graduate course covering the analysis, synthesis, and performance of linear control systems. Partial fraction expansion, Routh's criterion, the impulse function. Basic servo characteristics and types, block diagrams, transfer functions. A detailed treatment of the root locus method for analysis and synthesis. Frequency response, logarithmic and polar plots, Nyquist's criterion, stability characteristics, phase margin and gain margin.

212. Advanced Control Systems (3)
Prerequisite: ENGR 210 or permission of coordinator. Describing function analysis of nonlinear control systems; phase-plane analysis; Liapunov stability analysis; discrete-time systems; z-transform-method; linear stochastic systems; application of statistical design principles; optimal and adaptive control systems; digital control systems.

Electrical Engineering (E E)

241. Applied Electromagnetics (3)
Prerequisite: ECE 136 or permission of coordinator. Electrostatic field boundary conditions, energy relations, and forces; multidimensional potential problems; magnetic field boundary conditions, scalar and vector potentials, and magnetization; Maxwell's equations for stationary and moving media; energy, force, and momentum in an electromagnetic field; plane waves; waves near metallic boundaries; inhomogeneous wave equation.

243. Modern Methods
in Synchronous Sequential Design (3)
Prerequisite: ECE 172 or permission of coordinator. Synchronous machine design with PLDs and FPGAs; algorithmic state machines; incompletely specified machines; maximum compatibility classes; partitioning of sequential machines; state merging and state splitting.

245. Communications Engineering (3)
Prerequisite: ECE 134 or permission of coordinator. Basic modulation concepts; statistical properties of signals; transmission systems optimization against noise; digital transmission and modulation methods; attenuation and phase distortion in analog and digital systems; intermodulation distortion; random multipath channels; intersystem interference.

247. Modern
Semiconductor Devices (3)
Prerequisite: ECE 114 or permission of coordinator. Crystal structures and elastic constants; lattice energy and vibrations; thermal and dielectric properties of solids; ferroelectric and magnetic properties of crystals; free electron model of metals; quantum statistics distributions; band theory; semiconductor crystals; superconductivity; photoconductivity and luminescence; dislocations.

249. Advanced
Communication Engineering (3)
Prerequisite: ECE 245 or permission of coordinator. The measure of information; noiseless coding; models of communication channels; channel capacity; discrete memoryless channels; error correcting codes; information sources; discrete channels with memory; continuous channels.

251. Antennas and Propagation (3)
Wave equation, plane waves, metallic boundary conditions; wave equation for the potentials Lorentz transformation; covariant formulation of electrodynamics; radiation from a moving charge; scattering and dispersion; Hamiltonian formulation of Maxwell's equations.

253. Advanced
Asynchronous Machine Design (3)
Asynchronous machine design; primitive flow tables; static/dynamic hazards; state assignment; covers; partitions; decompositions; state identification and fault detection experiments; pulse mode circuits; iterative networks; introduction to hardware description languages.

255. Digital Signal Processing (3)
Prerequisite: ECE 107 or permission of coordinator. Discrete-time signals; Fourier transforms; random discrete-time signals; filtered random signals; correlation functions; power-spectral-density estimation; cross-spectral estimates; detection of signals in noise; estimation of signals in noise; recursive estimation of time-varying signals.

257. Optical Communications
and Lasers (3)
Quantum measure of light, linear, elliptical, and circular polarization; optical waveguide equations, ray and mode theory; source and detector characteristics; attenuation, dispersion, and noise effects; correlation, spectral density, noise equivalent bandwidth, coding, modulation, multiplexing techniques; systems and link design.

259. Radar System Design (3)
The nature and history of radar, the radar equation, PRF and range considerations, CW and FM radars. MTI and pulse-Doppler radars, tracking radars. Radar power generation, antenna types and design considerations, receivers, detection of signals in noise, extraction of information from radar signals, propagation of radar wave, the effects of clutter, weather and interference. Examples of radar system engineering and design.

290. Independent Study
(1-3; max total 6)
Prerequisite: graduate status in engineering or permission of instructor. Approved for *SP* grading.

291T. Topics in Electrical Engineering (1-3; max total 6)
Prerequisite: graduate status in engineering or permission of instructor. Selected electrical engineering subjects not in current courses.

Mechanical Engineering (M E)

211. Advanced Dynamics (3)
Prerequisite: M E 134 or permission of coordinator. Dynamics of mechanical systems with emphasis on equations of motion. Kinematics of particles, energy and momentum methods, variational methods, LaGrange's method, kinematics and plane motion of rigid bodies, kinetics of rigid bodies in three dimensions, mechanical vibrations.

220. Compressible Fluids (3)
Prerequisite: M E 156 or permission of coordinator. Review of the foundations of fluid mechanics and thermodynamics. The velocity of sound, mach number and angle, differences between incompressible, subsonic, and supersonic flow. Isentropic flow, working charts and tables, choking, operation of nozzles. Normal shock waves, ducts, shock tube analysis. Fanno and Rayleigh analysis, oblique shock waves, the Prandtl-Meyer equation. Lift and drag on bodies in supersonic flow. Method of characteristics.

221. Incompressible Fluids (3)
Prerequisite: M E 156 or permission of coordinator. The kinematics of liquids and gases, the LaGrangian and Eulerian methods, streak lines, stream tubes. Geometry of the vector field, stokes, and Gauss's theorems, acceleration of a fluid particle, homogeneous fluids and the equation of continuity. Integration of Eutor's equation, Bernoulli's equation. Potential motion and potential functions, source and sink potentials, the stream function. Vortex theory, surfaces of discontinuity.

223. Jet Engine Propulsion (3)
First-year graduate course in mechanics and thermodynamics of jet engine propulsion. Thermodynamics of fluid flow and engines, boundary layer theory, subsonic and supersonic inlets, combustors, fans, compressors, turbines, nozzles, inlet distortion, fuel controls, noise reduction, ramjets and scramjets.

224. Rocket Propulsion (3)
First-year graduate course in mechanics and thermodynamics of rocket engine propulsion. Nozzle theory and thermodynamics, heat transfer, flight performance, chemical rocket propellant performance, liquid propellants, solid propellants, rocket testing, advanced propulsion concepts.

225. Heat Transfer (3)
Conduction, convection, and radiation. One and two dimensional steady-state conduction, LaPlace's equation, numerical techniques. Transient heat transfer. Heisler charts, multiple-dimensional systems, boundary layers, Reynold's analogy. Forced and natural convection radiation heat transfer, Kirchoff's and Wien's laws, radiation shields.

227. Advanced Thermodynamics (3)
Prerequisite: M E 156 or permission of coordinator. Review of classical thermodynamics, Maxwell relations, equations of state, nonideal gases, experimental methods. The molecular theory of gases, Clausius and Van der Waals equations of state, velocity distribution. LaGrange's method, the principle of equipartition. Maxwell-Boltzmann statistics, micro- and macro-states. Quantum statistics based on the Bose-Einstein, Maxwell-Boltzmann, and Fermi-Dirac statistics.

229. Advanced Gas Dynamics (3)
Review of supersonic flow. Vibrational and chemical rate processes, nonequilibrium chemical rate equations, rate equations for dissociation and recombination. Flow with vibrational or chemical nonequilibrium. Nonequilibrium kinetic theory; evaluation of collision cross sections. Flow with translational nonequilibrium. Radiative transfer in gases, and approximate solutions of the equation of radiative transfer.

230. Aircraft Stability and Control (3)
First-year graduate course covering analytical tools, system theory, reference frames, and transformations, equations of unsteady motion, longitudinal aerodynamics, lateral aerodynamics, stability of steady flight, and response to control actuation. All stability derivatives will be discussed in detail, and examples and problems based on actual airplanes will be used.

232. Advanced Aircraft Stability and Control (3)
Prerequisite: M E 230. Continuation of M E 230. Validity of small disturbance theory, nonlinear equations of motion, steady state and dynamic stability and control of elastic airplanes. Frequency response methods, response to turbulence. Automatic flight control analysis and design, the human pilot in the control loop, stability augmentation, digital flight control systems, state vector methods.

241. Structural Analysis (3)
Prerequisite: M E 134 or permission of coordinator. Graduate-level course in the principles of structural mechanics. Stress, strain and displacements, static and dynamic loads, energy methods, virtual work, discrete and continuous system analysis, finite element analysis, elastic beams, plates, and frames; single and multi degree-of-freedom modal analysis. (Formerly M E 233)

243. Structural Dynamics (3)
Prerequisite: M E 241 or permission of instructor. Continuation of M E 241. Von Karman theory, shear deformation, geometry and equilibrium of shells, theory of vibrations, vibrations of aircraft structures, coupling with the aerodynamic equations, flutter, ground and flight structural test techniques. (Formerly M E 231)

250. Astrodynamics (3)
Introductory course in astrodynamics. Two-body orbital mechanics, orbit determination, basic orbital maneuvers, rendezvous, ballistic missile trajectories, lunar and interplanetary trajectories, orbital perturbations, launch trajectories, reentry, spacecraft dynamics and attitude control.

290. Independent Study
(1-3; max total 6)
Prerequisite: graduate status in engineering or permission of instructor. Approved for *SP* grading.

291T. Topics in Mechanical Engineering
(1-3; max total 6)
Prerequisite: graduate status in engineering or permission of instructor. Selected mechanical engineering subjects not in current courses.