Core and Minor Course Tables

TABLE I

CORE COURSES

BIOENGINEERING & SYSTEMS BIOLOGY
APPROVED COURSES: BIOE 220A Molecular Bioengineering BIOE 220B Cellular Bioengineering

Note 1: There is a strong and growing research focus at UCSB in Systems Biology and in Energy Efficiency. Several faculty members are active in these fields as well as part of the Center for Control, Dynamical Systems and Computation (CCDC) and the Institute for Energy Efficiency (IEE). Students interested in those fields are encouraged to discuss with their advisor which classes best fit their goals.

The ***optional*** **PhD bioengineering emphasis** for doctoral students already enrolled at UCSB in both engineering and science departments and programs. The emphasis includes structured curriculum aimed at teaching biology to physical scientists at several levels (molecular, cellular, and tissue) as well as both a student-run and invited seminar series aimed at providing a community for students engaged in bioengineering related research on campus. The courses are open to all graduate students interested in bioengineering.

COMPUTATIONAL SCIENCE AND ENGINEERING

CORE COURSES:

NUMERICAL METHODS

ME 210A	Matrix Analysis and Computation
ME 210B	Numerical Simulations
ME 210C	Numerical Solution of PDEs-Finite Difference Methods
ME 210D	Numerical Solution of PDEs-Finite Element Methods
ME 216	Level Set Methods and their Applications

PARALLEL COMPUTING

CMPSC 240A	Applied Parallel Computing

APPLIED MATHEMATICS

ME 244A,B	Advanced Theoretical Methods in Engineering
Math 214A	Ordinary Differential Equations
Math 214B	Chaotic Dynamics and Bifurcation Theory
Math 215A	Partial Differential Equations
Math 215B	Fourier Series and Numerical Methods

Credit will not be given for more than one of the above applied mathematics sequences. Advanced courses may be substituted, with approval, as follows:

Instead of Math 214:

Math 243A, B	Ordinary Differential Equations

Instead of Math 215:

Math 246A, B	Partial Differential Equations

Note 2: Optional Graduate Degree Emphasis in Computational Science and Engineering

The Departments of Chemical Engineering, Computer Science, Electrical and Computer Engineering, Math, and ME offer an interdisciplinary master's and Ph.D. degree emphasis in computational science and engineering (CSE).

CSE is a rapidly growing multidisciplinary area with connections to the sciences, engineering, mathematics, and computer science. Computer models and simulations have become an important part of the research repertoire, supplementing (and is some cases replacing) experimentation. Going from application area to computational results requires domain expertise, mathematical modeling, numerical analysis, algorithm development, software implementation, program execution, analysis, validation, and visualization of results. CSE addresses these issues.

DYNAMIC SYSTEMS, CONTROL AND ROBOTICS

CORE COURSES:

ME 201	Advanced Dynamics
ME 215A	Applied Dynamical Systems I
ME 215B	Applied Dynamical Systems II
ME 236	Nonlinear Control Systems
ME 243A	Linear Systems I
ME 243B	Linear Systems II

MICRO/NANOSCALE SYSTEMS

CORE COURSES:

ME 257	Introduction to Multiphysics Simulation
ME 291A	Physics of Transducers
ME 292	Design of Transducers
ECE 220A	Semiconductor Device Processing

Note 3: Students in micro/nanoscale systems frequently specialize in a secondary area, taking core classes from Dynamics and Control; Solids, Structures, and Materials; or Fluid Mechanics. As this research area is interdisciplinary, courses may also be found in other departments (200 level or above). These should be chosen with the approval of your faculty advisor once you have identified a research area. Final approval for these courses is given by the Graduate Advisor.

SOLID MECHANICS, STRUCTURES AND MATERIALS

CORE COURSES:

ME 219	Mechanics of Materials
ME 230	Elasticity & Plasticity
ME 264	Mechanical Behavior of Materials
ME 265	Composite Materials
ME 271	Finite Element Structural Analysis
ME 275	Fracture Mechanics

THERMOFLUID SCIENCES

CORE COURSES:

ME 220A,B	Fundamentals of Fluid Mechanics
ME 221	Advanced Viscous Flow
ME 252 A,B	Computational Fluid Dynamics

Table II

Approved Courses

The approved courses for the PhD are all ME 200-level courses (except seminars, projects and research group studies) plus those listed below. The entire list in Table I are approved courses as well. Classes are listed below by area for convenience.

BIOENGINEERING & SYSTEMS BIOLOGY

APPROVED COURSES:

ME 246	Molecular and Cellular Biomechanics
ME 211	Pattern Formation and Self-Organization
ME 210B	Numerical Simulation
ME 215A	Applied Dynamical Systems I
ME 219	Mechanics of Materials
ME 225RS	Engineering Biomaterials
ME 225EY	Biological Computing
ME 258	Methods in Mechanobiology and Biofabrication
CHE 255	Methods in Systems Biology
ECE 235	Stochastic Processes in Engineering
CHE 202	Biomaterials and Biosurfaces
CHE 238A	Rheology of Complex Fluids

COMPUTATIONAL SCIENCE AND ENGINEERING

APPROVED COURSES:

MATRL 228	Computational Materials
CHE 220A,B	Advanced Transport Processes-Laminar Flow & Convection
CHE 220C	Advanced Transport Processes-Mass Transfer
CHE 220D	Complex Fluids and Rheology
Math 243C	Ordinary Differential Equations
Math 246C	Partial Differential Equations
ECE 271A	Principles of Optimization
ECE 271C	Optimal Control of Dynamic Systems

DYNAMIC SYSTEMS, CONTROL AND ROBOTICS

APPROVED COURSES:

ME 179 D,L,P	Introduction to Robotics
ME 203	Operator Theory Methods in Dynamical Systems
ME 225EH	Soft Robotics
ME 225FB	Nonlinear Networks: Dynamics, Learning, and Application
ME 225ML	Research Topics in Machine Learning and System Identification
ME 225MM	Mathematical Methods in System and Controls
ME 225NN	Modeling and Optimization of Neural Networks
ME 254	Optimal Control of Dynamics Systems
ME 256	Introduction Robust Control with Applications
ME 269	Network Systems: Dynamics and Control
Math 118 A,B,C	Introduction to Real Analysis
Math 122 A,B	Introduction to Theory of Complex Variables
Math 147 A,B	Introduction to Differential Geometry
Math 201 A,B,C	Real Analysis
Math 202 A,B,C	Complex Analysis

MICRO/NANOSCALE SYSTEMS

APPROVED COURSES:

ME 141B	MEMS: Processing and Device Characterization
ME 225MC	MEMS Characterization
MCDB 101A	Molecular Genetics I: Prokaryotes.
Phys 141	Optics

Students in micro/nanoscale systems frequently specialize in a secondary area, taking core classes from Dynamics and Control; Solids, Structures, and Materials; or Fluid Mechanics. As this research area is interdisciplinary, courses may also be found in other departments (200 level or above). These should be chosen with the approval of your faculty advisor once you have identified a research area. Final approval for these courses is given by the Graduate Advisor.

SOLID MECHANICS, STRUCTURES AND MATERIALS

APPROVED COURSES:

ME 162	Introduction to Elasticity
ME 167	Structural Analysis
ME 185	Materials in Engineering
ME 186A	Manufacturing and Materials
ME 225FA	Failure Analysis
ME 225SD	Mechanics and Measurements
ME 267	Thin Film and Multilayers
ME 280	Defects in Engineering Materials and Analysis
Math 122 A,B	Introduction to Theory of Complex Variables
Math 202 A,B,C	Complex Analysis
MATRL 228	Computational Materials
CHE 230 A,B	Advanced Theoretical Methods in Engineering
MATRL 220	Mechanical Behavior of Materials
MATRL 251	Processing of Inorganic Materials
MATRL 261	Composite Materials
MATRL 271A	Synthesis and Properties of Macromolecules
MATRL 271B	Structure and Characterization of Complex Fluids
MATRL 271C	Properties of Macromolecules

THERMOFLUID SCIENCES

APPROVED COURSES:

ME 225AS	Introduction to Multiphase Flow
ME 225BL	Energy Transport & Conversion
ME 225CP	Individual COMSOL Project in Thermal and Fluid Science
ME 225ED	Bio-Inspired Design in Fluid Mechanics
ME 225EM	Advanced Topics in Fluid Mechanics & Heat Transfer
ME 225F	Flow Instabilities and Turbulence
ME 225FE	Modeling of Flow and Heat Transfer Using COMSOL Finite Elements Software
ME 225LF	Vortex Dynamics and Turbulence
ME 225RA	Radiation Energy Transfer
ME 225YZ	Introduction to Interfacial Phenomena
CH E 160	Introduction to Polymer Science
CH E 220A,B,C	Advanced Transport Processes
CH E 222A,B	Colloid and Interfaces I, II
CH E 230D	Statistical Methods in Chemical Engineering
CH E 238A	Rheology of Polymeric Fluids
ECE 235	Stochastic Processes in Engineering
Phys 141	Optics