SEAS ENGINEERING (EUNG)

Code	Title	Course Units
BE 1000	Introduction to Bioengineering	0.5
BE 2000	Introduction to Biomechanics	1
BE 2200	Biomaterials	1
BE 3010	Bioengineering Signals and Systems	1
BE 3060	Cellular Engineering	1
BE 3090	Bioengineering Modeling, Analysis and Design Laboratory I	1
BE 3100	Bioengineering Modeling, Analysis and Design Laboratory II	1
BE 3300	Self-Assembly of Soft Materials	1
BE 3500	Introduction to Biotransport Processes	1
BE 4000	Preceptorship in Clinical Bioengineering	1
BE 4700	Medical Devices	1
BE 4720	Medical Device Development	1
BE 4800	Introduction to Biomedical Imaging	1
BE 4830	Physics of Medical/Molecular Imaging	1
BE 4900	Independent Project in Bioengineering	1
BE 4920	Independent Project in Bioengineering	1
BE 4950	Senior Design Project	1
BE 4960	Senior Design Project	1
BE 4970	Senior Thesis in Biomedical Science	1
BE 5020	From Biomedical Science to the Marketplace	1
BE 5040	Biological Data Science II: Data Mining Principles for Epigenomics	1
BE 5100	Biomechanics and Biotransport	1
BE 5120	Bioengineering III: Biomaterials	1
BE 5130	Human Centered Design for Clinical Emergency Medicine	1
BE 5140	Rehab Engineering and Design	1
BE 5180	Optical Microscopy	1
BE 5210	Brain-Computer Interfaces	1
BE 5280	Applied Medical Innovation I	1
BE 5290	Applied Medical Innovation II	1
BE 5370	Biomedical Image Analysis	1
BE 5400	Principles of Molecular and Cellular Bioengineering	1
BE 5470	Fundamental Techniques of Imaging	1
BE 5500	Continuum Tissue Mechanics	1
BE 5510	Biomicrofluidics	1
BE 5530	Principles, Methods, and Applications of Tissue Engineering	1
BE 5550	Nanoscale Systems Biology	1
BE 5580	Principles of Biological Fabrication	1
BE 5590	Multiscale Modeling of Chemical and Biological Systems	1
BE 5610	Musculoskeletal Biology and Bioengineering	1
BE 5620	Drug Discovery and Development	1
BE 5650	Developmental Engineering of Tissues	1
BE 5660	Networked Neuroscience	1
BE 5690	Systems Biology of Cell Signaling Behavior	1
BE 5700	Biomechatronics	1
BE 5760	The Cell as a Machine	1
BE 5810	Techniques of Magnetic Resonance Imaging	1
BE 5830	Physics of Medical / Molecular Imaging	1
BE 5850	Materials for Bioelectronics	1
BIOM 5350	Introduction to Bioinformatics	1
CBE 1500	Introduction to Biotechnology	1
CBE 1600	Introduction to Chemical Engineering	1
CBE 2300	Material and Energy Balances of Chemical Processes	1
CBE 2310	Thermodynamics of Fluids	1
CBE 3200	Basic Chemical Process Safety	1
CBE 3300A	Discover, Design, Build and Test: A Hands-On Introduction to Product and Device Design	0-0.5
CBE 3300B	Discover, Design, Build and Test: A Hands-On Introduction to Product and Device Design	0-0.5
CBE 3500	Fluid Mechanics	1
CBE 3510	Heat and Mass Transport	1
CBE 3530	Molecular Thermodynamics and Chemical Kinetics	1
CBE 3600	Chemical Process Control	1
CBE 3710	Separation Processes	1
CBE 3750	Engineering and the Environment	1
CBE 4000	Introduction to Product and Process Design	1
CBE 4100	Chemical Engineering Laboratory	1
CBE 4215	Energy and Sustainability: Science, Engineering and Technology	1
CBE 4300	Introduction to Polymers	1
CBE 4470	Societally Significant Soft Matter Solutions	1
CBE 4510	Chemical Reactor Design	1
CBE 4590	Product and Process Design Projects	1
CBE 4790	Biotechnology and Biochemical Engineering	1
CBE 4800	Laboratory in Biotechnology and Biochemical Engineering	1
CBE 5000	Special Topics in Chemical and Biomolecular Engineering	1
CBE 5020	Sustainability of Materials	1
CBE 5050	Carbon Capture	1
CBE 5080	Probability and Statistics for Biotechnology	1
CBE 5100	Introduction to Polymers	1
CBE 5140	Data Science and Machine Learning in Chemical Engineering	1
CBE 5170	Principles of Genome Engineering	1
CBE 5215	Energy and Sustainability: Science, Engineering and Technology	1
CBE 5220	Polymer Rheology and Processing	1

CBE 5250	Molecular Modeling and Simulations	1
CBE 5270	Advancements and Applications in Genome Editing and Engineering	1
CBE 5300	Electrochemistry Fundamentals, Practices, and Analysis	1
CBE 5310	Nano-Transport	1
CBE 5350	Interfacial Phenomena	1
CBE 5400	Principles of Molecular and Cellular Bioengineering	1
CBE 5450	Electrochemical Energy Conversion and Storage	1
CBE 5460	Fundamentals of Industrial Catalytic Processes	1
CBE 5470	Societally Significant Soft Matter Solutions	1
CBE 5520	Protein Engineering & Practical Applications	1
CBE 5540	Engineering Biotechnology	1
CBE 5550	Nanoscale Systems Biology	1
CBE 5560	The Biochemical Engineering of Wine	1
CBE 5570	Stem Cells, Proteomics and Drug Delivery - Soft Matter Fundamentals	1
CBE 5590	Multiscale Modeling of Chemical and Biological Systems	1
CBE 5600	Water Treatment Engineering	1
CBE 5620	Drug Discovery and Development	1
CBE 5640	Drug Delivery Systems: Targeted Therapeutics and Translational Nanomedicine	1
CBE 5800	Masters Biotechnology Lab	1
CBE 5801	Laboratory in Biotechnology and Biochemical Engineering	1
CIS 0099	Undergraduate Research/Independent Study	1
CIS 1100	Introduction to Computer Programming	1
CIS 1200	Programming Languages and Techniques I	1
CIS 1210	Programming Languages and Techniques II	1
CIS 1810	The Quantum and the Computer	1
CIS 1901	C++ Programming	0-0.5
CIS 1902	Python Programming	0-0.5
CIS 1903	Go Programming	0-0.5
CIS 1904	Introduction to Haskell Programming	0-0.5
CIS 1905	Rust Programming	0-0.5
CIS 1911	Using and Understanding Unix and Linux	0-0.5
CIS 1912	DevOps	0-0.5
CIS 1921	Solving Hard Problems in Practice	0-0.5
CIS 1951	iOS Programming	0-0.5
CIS 1952	Android Programming	0-0.5
CIS 1953	3D Game Development in Unreal Engine	0-0.5
CIS 1961	Ruby on Rails Web Development	0-0.5
CIS 1962	JavaScript Programming	0-0.5
CIS 1990	Special Topics	0-0.5
CIS 2330	Introduction to Blockchain	1
CIS 2400	Introduction to Computer Systems	1
CIS 2450	Big Data Analytics	1
CIS 2620	Automata, Computability, and Complexity	1
CIS 3200	Introduction to Algorithms	1
CIS 3340	Advanced Topics in Algorithms	1
CIS 3500	Software Design/Engineering	1
CIS 3900	Robotics: Planning Perception	1
CIS 3980	Quantum Computer and Information Science	1
CIS 3990	Special Topics	0-1
CIS 4000	Senior Project	1
CIS 4010	Senior Project	1
CIS 4100	CIS Senior Thesis	1
CIS 4110	CIS Senior Thesis	1
CIS 4120	Introduction to Human Computer Interaction	1
CIS 4190	Applied Machine Learning	1
CIS 4210	Artificial Intelligence	1
CIS 4270	Trustworthy Machine Learning	1
CIS 4300	Natural Language Processing	1
CIS 4410	Embedded Software for Life-Critical Applications	1
CIS 4480	Operating Systems Design and Implementation	1
CIS 4500	Database and Information Systems	1
CIS 4510	Computer and Network Security	1
CIS 4520	Advanced Programming	1
CIS 4521	Compilers and Interpreters	1
CIS 4550	Internet and Web Systems	1
CIS 4600	Interactive Computer Graphics	1
CIS 4610	Advanced Rendering	1
CIS 4620	Computer Animation	1
CIS 4710	Computer Organization and Design	1
CIS 4810	Computer Vision & Computational Photography	1
CIS 4970	DMD Senior Project	1
CIS 4980	Senior Capstone Project	1
CIS 5000	Software Foundations	1
CIS 5010	Computer Architecture	1
CIS 5020	Analysis of Algorithms	1
CIS 5030	Algorithms for Big Data	1
CIS 5050	Software Systems	1
CIS 5110	Theory of Computation	1
CIS 5120	Introduction to Human Computer Interaction	1
CIS 5150	Fundamentals of Linear Algebra and Optimization	1
CIS 5180	Topics in Logic: Finite Model Theory and Descriptive Complexity	1
CIS 5190	Applied Machine Learning	1
CIS 5200	Machine Learning	1
CIS 5210	Artificial Intelligence	1
CIS 5220	Deep Learning for Data Science	1
CIS 5260	Machine Translation	1
CIS 5270	Trustworthy Machine Learning	1

CIS 5300	Natural Language Processing	1
CIS 5350	Introduction to Bioinformatics	1
CIS 5370	Biomedical Image Analysis	1
CIS 5400	Principles of Embedded Computation	1
CIS 5410	Embedded Software for Life-Critical Applications	1
CIS 5420	Embedded Systems Programming	1
CIS 5450	Big Data Analytics	1
CIS 5480	Operating Systems Design and Implementation	1
CIS 5490	Wireless Communications for Mobile Networks and Internet of Things	1
CIS 5500	Database and Information Systems	1
CIS 5510	Computer and Network Security	1
CIS 5520	Advanced Programming	1
CIS 5521	Compilers and Interpreters	1
CIS 5530	Networked Systems	1
CIS 5550	Internet and Web Systems	1
CIS 5560	Cryptography	1
CIS 5570	Programming for the Web	1
CIS 5590	Programming and Problem Solving	1
CIS 5600	Interactive Computer Graphics	1
CIS 5610	Advanced Computer Graphics	1
CIS 5620	Computer Animation	1
CIS 5630	Physically Based Animation	1
CIS 5640	Game Design and Development	1
CIS 5650	GPU Programming and Architecture	1
CIS 5660	Procedural Computer Graphics	1
CIS 5680	Game Design Practicum	1
CIS 5710	Computer Organization and Design	1
CIS 5730	Software Engineering	1
CIS 5800	Machine Perception	1
CIS 5810	Computer Vision & Computational Photography	1
CIS 6200	Advanced Topics in Machine Learning	1
CPLN 6500	Transportation Planning Methods	1
CPLN 7500	Advanced Transportation Seminar	1
ENGR 1050	Introduction to Scientific Computing	1
ENGR 1400	Penn Global Seminar: Robotics and Rehabilitation	1
ENGR 2120	Concepts in Micro- and Nanotechnology	1
ENGR 2500	Energy Systems, Resources and Technology	1
ENGR 3300A	Discover, Design, Build and Test: A Hands-On Introduction to Product and Device Design	0-0.5
ENGR 3300B	Discover, Design, Build and Test: A Hands-On Introduction to Product and Device Design	0-0.5
ENGR 3440	Answering Questions with Data, for Everyone	1
ENGR 4215	Energy and Sustainability: Science, Engineering and Technology	1
ENGR 4500	Modern Biotechnology for Engineers	1

ENGR 5030	Engineering in Oil, Gas and Coal, from Production to End Use	1
ENGR 5040	Fundamental Concepts in Nanotechnology	1
ENGR 5215	Energy and Sustainability: Science, Engineering and Technology	1
ENGR 5400	Engineering Economics	1
ENGR 5500	Modern Biotechnology for Engineers	1
ESE 1110	Atoms, Bits, Circuits and Systems	1
ESE 1500	Digital Audio Basics	1
ESE 1900	Silicon Garage: Introduction to Open Source Hardware and Software Platforms	0.5
ESE 2000	Artificial Intelligence Lab: Data, Systems, and Decisions	1
ESE 2040	Decision Models	1
ESE 2100	Introduction to Dynamic Systems	1
ESE 2150	Electrical Circuits and Systems	1.5
ESE 2180	Electronic, Photonic, and Electromechanical Devices	1.5
ESE 2240	Signal and Information Processing	1.5
ESE 2900	Introduction to Electrical and Systems Engineering Research Methodology	0.5
ESE 2910	Introduction to Electrical and Systems Engineering Research and Design	1
ESE 2920	Invention Studio	0.5
ESE 3030	Stochastic Systems Analysis and Simulation	1
ESE 3040	Introduction to Optimization	1
ESE 3050	Foundations of Data Science	1
ESE 3060	Deep Learning: A Hands-on Introduction	1
ESE 3190	Fundamentals of Solid-State Circuits	1.5
ESE 3200	Qubit Lab – A Hands on Introduction to Quantum Devices	1.5
ESE 3250	Fourier Analysis and Applications in Engineering, Mathematics, and the Sciences	1
ESE 3360	Nanofabrication of Electrical Devices	1.5
ESE 3400	Medical Devices Laboratory	1
ESE 3500	Embedded Systems/Microcontroller Laboratory	1.5
ESE 3600	TinyML: Tiny Machine Learning for Embedded Systems	1
ESE 3990	Special Topics	1
ESE 4000	Engineering Economics	1
ESE 4040	Engineering Markets	1
ESE 4070	Introduction to Networks and Protocols	1
ESE 4190	Analog Integrated Circuits	1
ESE 4210	Control For Autonomous Robots	1.5
ESE 4380	Machine Learning for Time-Series Data	1
ESE 5000	Linear Systems Theory	1
ESE 5010	Networking - Theory and Fundamentals	1
ESE 5030	Simulation Modeling and Analysis	1
ESE 5050	Feedback Control Design and Analysis	1
ESE 5060	Introduction to Optimization Theory	1
ESE 5070	Introduction to Networks and Protocols	1

ESE 5090	Quantum Circuits and Systems	1
ESE 5100	Electromagnetic and Optics	1
ESE 5120	Dynamical Systems for Engineering and Biological Applications	1
ESE 5140	Graph Neural Networks	1
ESE 5190	Smart Devices	1
ESE 5210	The Physics of Solid State Energy Devices	1
ESE 5230	Quantum Engineering	1
ESE 5250	Nanoscale Science and Engineering	1
ESE 5280	Estimation and Detection Theory	1
ESE 5290	Introduction to Micro- and Nano-electromechanical Technologies	1
ESE 5300	Elements of Probability Theory	1
ESE 5310	Digital Signal Processing	1
ESE 5320	System-on-a-Chip Architecture	1
ESE 5330	Stochastic Processes	1
ESE 5350	Electronic Design Automation	1
ESE 5390	Hardware/Software Co-Design for Machine Learning	1
ESE 5400	Engineering Economics	1
ESE 5430	Human Systems Engineering	1
ESE 5450	Data Mining: Learning from Massive Datasets	1
ESE 5460	Principles of Deep Learning	1
ESE 5470	Introduction to Legged Locomotion	1
ESE 5480	Transportation Planning Methods	1
ESE 5500	Advanced Transportation Seminar	1
ESE 5660	Networked Neuroscience	1
ESE 5700	Digital Integrated Circuits and VLSI-Fundamentals	1
ESE 5720	Analog Integrated Circuits	1
ESE 5730	Chips-design	1
ESE 5780	RFIC (Radio Frequency Integrated Circuit) Design	1
ESE 5800	Power Electronics	1
ESE 6170	Non-Linear Control Theory	1
ESE 6650	Datacenter Architecture	1
IPD 5000	Product Engineering Basics	1
IPD 5010	Integrated Computer-Aided Design, Manufacturing and Analysis	1
IPD 5030	Design Fundamentals	1
IPD 5040	Rehab Engineering and Design	1
IPD 5110	How to Make Things: Production Prototyping Studio	1
IPD 5140	Design for Manufacturability	1
IPD 5150	Product Design	1
IPD 5160	Advanced Mechatronic Reactive Spaces.	1
IPD 5190	Smart Devices	1
IPD 5250	Ergonomics/Human Factors Based Product Design	1
IPD 5290	Designing Connected Objects and Experiences	1
IPD 5510	Design Processes	1
IPD 5520	Problem Framing	1
IPD 5680	Integrative Design Studio: Biological Design	1
IPD 5900	Special Topics in Integrated Product Design	0.5-1
MEAM 1010	Introduction to Mechanical Design	1
MEAM 2010	Machine Design and Manufacturing	1
MEAM 2020	Introduction to Thermal-Fluids Engineering	1
MEAM 2030	Thermodynamics I	1
MEAM 2100	Statics and Strength of Materials	1
MEAM 2110	Engineering Mechanics: Dynamics	1
MEAM 2200	Fundamentals of Materials Science and Engineering	1
MEAM 2250	Engineering in the Environment	1
MEAM 2300	Bicycles: The Mechanical Advantage	1
MEAM 2470	Mechanical Engineering Laboratory I	.5
MEAM 2480	Mechanical Engineering Lab I	.5
MEAM 3020	Fluid Mechanics	1
MEAM 3200	Intro to Mechanical and Mechatronic Systems	1
MEAM 3210	Dynamic Systems and Control	1
MEAM 3330	Heat and Mass Transfer	1
MEAM 3470	Mechanical Engineering Design Laboratory	1
MEAM 3480	Mechanical Engineering Design Laboratory	1
MEAM 3540	Mechanics of Solids	1
MEAM 4050	Mechanical Properties of Macro/Nanoscale Materials	1
MEAM 4110	How to Make Things: Production Prototyping Studio	1
MEAM 4150	Product Design	1
MEAM 4210	Control For Autonomous Robots	1.5
MEAM 4450	Mechanical Engineering Design Projects	1
MEAM 4460	Mechanical Engineering Design Projects	1
MEAM 5020	Energy Engineering in Power Plants and Transportation Systems	1
MEAM 5030	Direct Energy Conversion: from Macro to Nano	1
MEAM 5040	Tribology	1
MEAM 5050	Mechanical Properties of Macro/Nanoscale Materials	1
MEAM 5060	Failure Analysis of Engineering Materials	1
MEAM 5080	Materials and Manufacturing for Mechanical Design	1
MEAM 5100	Design of Mechatronic Systems	1
MEAM 5130	Feedback Control Design and Analysis	1
MEAM 5140	Design for Manufacturability	1
MEAM 5160	Advanced Mechatronic Reactive Spaces.	1
MEAM 5170	Control and Optimization with Applications in Robotics	1
MEAM 5180	Biomedical Microsystems	1
MEAM 5190	Elasticity and Micromechanics of Materials	1
MEAM 5200	Introduction to Robotics	1
MEAM 5270	Finite Element Analysis	1
MEAM 5290	Introduction to Micro- and Nano-electromechanical Technologies	1
MEAM 5300	Continuum Mechanics	1

MEAM 5350	Advanced Dynamics	1
MEAM 5360	Viscous Fluid Flow and Modern Applications	1
MEAM 5370	Nanotribology	1
MEAM 5430	Performance, Stability and Control of UAVs	1
MEAM 5450	Aerodynamics	1
MEAM 5500	Design of Microelectromechanical Systems	1
MEAM 5530	Atomic Modeling in Materials Science	1
MEAM 5550	Nanoscale Systems Biology	1
MEAM 5610	Thermodynamics: Foundations, Energy, Materials	1
MEAM 5620	Water Treatment Engineering	1
MEAM 5700	Transport Processes I	1
MEAM 5710	Advanced Topics in Transport Phenomena	1
MEAM 5750	Micro and Nano Fluidics	1
MEAM 6130	Non-Linear Control Theory	1
MPHY 6090	Biomedical Image Analysis	1
MSE 1010	Introduction to Materials Science & Engineering	1
MSE 2010	Materials Lab I	.5
MSE 2020	Materials Lab II	.5
MSE 2150	Introduction to Functional Materials: From Macro to Nanoscale	1
MSE 2200	Fundamentals of Materials Science and Engineering	1
MSE 2600	Energetics of Macro and Nano-scale Materials	1
MSE 3010	Materials Lab III	.5
MSE 3300	Self-Assembly of Soft Materials	1
MSE 3600	Structure at the Nanoscale	1
MSE 3930	Materials Selection	1
MSE 4050	Mechanical Properties of Macro/Nanoscale Materials	1
MSE 4280	Solid-State Materials Chemistry	1
MSE 4300	Introduction to Polymers	1
MSE 4400	Phase Transformations	1
MSE 4550	Electrochemical Engineering of Materials	1
MSE 4600	Computational Materials Science	1
MSE 4650	Fabrication and Characterization of Micro and Nanostructured Materials	1
MSE 4950	Senior Design	1
MSE 4960	Senior Design	1
MSE 5000	Experimental Methods in Materials Science	1
MSE 5020	Sustainability of Materials	1
MSE 5050	Mechanical Properties of Macro/Nanoscale Materials	1
MSE 5060	Failure Analysis of Engineering Materials	1
MSE 5150	Mathematical Methods for Engineering Applications	1
MSE 5180	Structure and Function of Biological Materials	1
MSE 5200	Structure of Materials	1
MSE 5250	Nanoscale Science and Engineering	1
MSE 5300	Thermodynamics and Phase Equilibria	1

MSE 5360	Electronic Properties of Materials	1
MSE 5370	Nanotribology	1
MSE 5380	Phase Transformations	1
MSE 5400	Kinetics of Materials	1
MSE 5450	Materials for Energy and Environmental Sustainability	1
MSE 5500	Elasticity and Micromechanics of Materials	1
MSE 5550	Electrochemical Engineering of Materials	1
MSE 5610	Atomic Modeling in Materials Science	1
MSE 5650	Fabrication and Characterization of Micro and Nanostructured Materials	1
MSE 5700	Physics of Materials I	1
MSE 5750	Statistical Mechanics	1
MSE 5760	Machine Learning and Its Applications in Materials Science	1
MSE 5800	Introduction to Polymers	1
MSE 5850	Materials for Bioelectronics	1
MTR 5350	Introduction to Bioinformatics	1
NETS 1120	Networked Life	1
NETS 1500	Market and Social Systems on the Internet	1
NETS 2120	Scalable and Cloud Computing	1
NETS 2130	Crowdsourcing and Human Computation	1
NETS 3120	Theory of Networks	1
NETS 4120	Algorithmic Game Theory	1
NGG 5210	Brain-Computer Interfaces	1
OIDD 4110	How to Make Things: Production Prototyping Studio	1
OIDD 4150	Product Design	1
OIDD 5110	How to Make Things: Production Prototyping Studio	1
OIDD 5150	Product Design	1
PHRM 5640	Drug Delivery Systems: Targeted Therapeutics and Translational Nanomedicine	1
SCMP 5590	Multiscale Modeling of Chemical and Biological Systems	1
VIPR 0120	Vagelos Integrated Program in Energy Research (VIPER) Seminar, Part I	0.5
VIPR 1210	Vagelos Integrated Program in Energy Research (VIPER) Seminar, Part II	0.5