

SPACE ENGINEERING CERTIFICATE

Smaller in scope than majors or minors, certificates usually are offered in areas of concentration for which no major or minor exists and are comprised of at least 4 units of coursework. Certificates are conferred concurrent with the student's undergraduate degree. They do not appear on the diploma, but are noted on the transcript. The Space Engineering certificate consists of 5 units of coursework from disciplines including mechanical engineering, computer science, electrical and computer engineering, and biomedical engineering.

Course	Title
Certificate Requirements (5 units)	
<i>Required Introductory Course (1 unit)</i>	
MECH_ENG 364-0	Introduction to Aerospace Engineering
or Introduction to Space Engineering (new course)	
<i>Elective Courses (3 units)</i>	
3 units of unique course work at the 300-level, or higher, from a minimum of 2 of the 3 elective areas below ¹	
<i>Getting To Space</i>	
<i>Thriving In Space</i>	
<i>Benefiting From Space</i>	
<i>Project Course (1 unit)</i>	
300-level or higher project course with space theme as approved by faculty committee	

¹ Only select 200-level course may approved for the Space Engineering Certificate.

Students can declare the certificate and submit updates to their courses in MAS (McCormick Advising System) (<https://mas.mccormick.northwestern.edu/>) before the beginning of their final quarter as undergraduates.

Getting To Space

Course	Title
BMD_ENG 313-0	Wearable Devices: From Sensing to Biomedical Inference
BMD_ENG 317-0	Biochemical Sensors
BMD_ENG 353-0	Bioelectronics
CHEM_ENG 307-0	Kinetics and Reactor Engineering
CHEM_ENG 321-0	Fluid Mechanics
CHEM_ENG 322-0	Heat Transfer
CHEM_ENG 323-0	Mass Transfer
CHEM_ENG 341-0	Dynamics and Control of Chemical and Biological Processes
CHEM_ENG 345-0	Process Optimization for Energy and Sustainability
CHEM_ENG 351-0	Process Economics, Design, & Evaluation
CHEM_ENG 361-0	Introduction to Polymers
CHEM_ENG 365-0	Sustainability, Technology, and Society
CHEM_ENG 367-0	Quantitative Methods in Life Cycle Analysis
CHEM_ENG 408-0	Chemical Engineering Kinetics and Reactor Design
CHEM_ENG 420-0	Transport Phenomena
CIV_ENV 320-0	Structural Analysis-Dynamics
CIV_ENV 423-0	Matrix Analysis of Structures
COMP_ENG 346-0	Microcontroller System Design

COMP_ENG 366-0	Embedded Systems
or COMP_ENG 466-0	Embedded Systems
COMP_SCI 348-0	Introduction to Artificial Intelligence
COMP_SCI 349-0	Machine Learning
COMP_SCI 409-0	Swarms and Multi-Robot Systems
COMP_SCI 410-0	Autonomous Quadrotor Design and Control
COMP_SCI 449-0	Deep Learning
COMP_SCI 469-0	Machine Learning & Artificial Intelligence for Robotics
ELEC_ENG 332-0	Introduction to Computer Vision
ELEC_ENG 360-0	Introduction to Feedback Systems
ELEC_ENG 374-0	Introduction to Digital Control
ELEC_ENG 470-0	Introduction to Nonlinear Control Theory
IEMS 341-0	Social Networks Analysis
or IEMS 341-SA	Social Networks Analysis
or IEMS 441-0	Social Network Analysis
IEMS 490-0	Selected Topics in IE (Computational Social Science)
MAT_SCI 331-0	Soft Materials
MAT_SCI 358-0	Modeling and Simulation in Materials Science and Engineering
MAT_SCI 435-0	High Temperature Materials
MAT_SCI 437-0	Additive Manufacturing of Soft Materials
MAT_SCI 458-0	Atomic Scale Computational Materials Science
MECH_ENG 341-0	Computational Methods for Engineering Design
MECH_ENG 362-0	Stress Analysis
MECH_ENG 363-0	Mechanical Vibrations
MECH_ENG 373-0	Engineering Fluid Mechanics
MECH_ENG 377-0	Heat Transfer
MECH_ENG 378-0	Applied Computational Fluid Dynamics and Heat Transfer
MECH_ENG 380-0	Thermal Energy Systems Design
MECH_ENG 395-0	Special Topics in Mechanical Engineering (Finite Element Methods in Mechanics, Machine Learning for Mechanical Sciences, or Propulsion)
MECH_ENG 425-0	Fundamentals of Fluid Dynamics
MECH_ENG 427-0	Viscous Fluid Dynamics
MECH_ENG 430-0	Turbulence & Combustion
MECH_ENG 441-0	Engineering Optimization for Product Design and Manufacturing
MECH_ENG 495-0	Selected Topics in Mechanical Engg (Aerodynamics or Metal and Ceramic Additive Manufacturing)

Thriving In Space

Course	Title
BMD_ENG 313-0	Wearable Devices: From Sensing to Biomedical Inference
BMD_ENG 317-0	Biochemical Sensors
BMD_ENG 353-0	Bioelectronics
CHEM_ENG 307-0	Kinetics and Reactor Engineering
CHEM_ENG 321-0	Fluid Mechanics
CHEM_ENG 322-0	Heat Transfer
CHEM_ENG 323-0	Mass Transfer
CHEM_ENG 341-0	Dynamics and Control of Chemical and Biological Processes
CHEM_ENG 345-0	Process Optimization for Energy and Sustainability
CHEM_ENG 351-0	Process Economics, Design, & Evaluation
CHEM_ENG 361-0	Introduction to Polymers
CHEM_ENG 365-0	Sustainability, Technology, and Society
CHEM_ENG 367-0	Quantitative Methods in Life Cycle Analysis

CHEM_ENG 395-0	Special Topics in Chemical Engineering (Electrochemical Energy Storage)
CHEM_ENG 408-0	Chemical Engineering Kinetics and Reactor Design
CHEM_ENG 420-0	Transport Phenomena
CHEM_ENG 441-0	Electrocatalysis for Sustainable Fuels and Chemicals
CIV_ENV 250-0	Earth Surface Engineering ²
CIV_ENV 320-0	Structural Analysis–Dynamics
CIV_ENV 395-0	Special Topics in Civil and Environmental Engrg (Adaptive Architecture, Instabilities for Functionality, Mechanics of Earthquake Ruptures, or Multiphysical Underground Processes)
CIV_ENV 423-0	Matrix Analysis of Structures
COMP_ENG 364-0 or COMP_ENG 464-0	CyberPhysical Systems Design and Application Cyber-Physical Systems Design and Application
COMP_ENG 365-0 or COMP_ENG 465-0	Internet-of-things Sensors, Systems, And Applications Internet-of-things Sensors, Systems, And Applications
COMP_ENG 395-0	Special Topics in Computer Engineering (Computing and Sustainability or Data-driven Plant Science)
COMP_SCI 301-0	Introduction to Robotics Laboratory
COMP_SCI 302-0	Artificial Life
COMP_SCI 348-0	Introduction to Artificial Intelligence
COMP_SCI 349-0	Machine Learning
COMP_SCI 409-0	Swarms and Multi-Robot Systems
COMP_SCI 449-0	Deep Learning
COMP_SCI 469-0	Machine Learning & Artificial Intelligence for Robotics
ELEC_ENG 307-0	Communications Systems
ELEC_ENG 333-0	Introduction to Communication Networks
ELEC_ENG 379-0	Lasers and Coherent Optics
ELEC_ENG 380-0	Wireless Communications
ES_APPM 495-0	Selected Topics in Applied Mathematics (Biological Fluid Dynamics)
IEMS 341-0 or IEMS 341-SA or IEMS 441-0	Social Networks Analysis Social Networks Analysis Social Network Analysis
IEMS 490-0	Selected Topics in IE (Computational Social Science)
MAT_SCI 331-0	Soft Materials
MAT_SCI 358-0	Modeling and Simulation in Materials Science and Engineering
MAT_SCI 381-0	Materials for Energy-Efficient Technology
MAT_SCI 437-0	Additive Manufacturing of Soft Materials
MAT_SCI 458-0	Atomic Scale Computational Materials Science
MAT_SCI 495-0	Advanced Special Topics in Material Science (Solid State Electrochemistry for Energy Storage and Conversion)
MECH_ENG 341-0	Computational Methods for Engineering Design
MECH_ENG 362-0	Stress Analysis
MECH_ENG 363-0	Mechanical Vibrations
MECH_ENG 377-0	Heat Transfer
MECH_ENG 378-0	Applied Computational Fluid Dynamics and Heat Transfer
MECH_ENG 380-0	Thermal Energy Systems Design
MECH_ENG 395-0	Special Topics in Mechanical Engineering (Finite Element Methods in Mechanics, Machine Learning for Mechanical Sciences, Orbital Mechanics, or Propulsion)
MECH_ENG 441-0	Engineering Optimization for Product Design and Manufacturing
MECH_ENG 472-1	Robot Design Studio
MECH_ENG 472-2	Robot Design Studio

MECH_ENG 495-0 Selected Topics in Mechanical Engg (Mechanophysiology or Metal and Ceramic Additive Manufacturing)

² CIV_ENV 250-0 Earth & Planetary Surface Engineering is approved for the Space Engineering Certificate.

Benefiting From Space

Course	Title
ASTRON 321-0	Observational Astrophysics
ASTRON 405-0	Basics of Radio Astronomy
ASTRON 414-0	Planetary Astrophysics
COMP_SCI 348-0	Introduction to Artificial Intelligence
COMP_SCI 349-0	Machine Learning
COMP_SCI 409-0	Swarms and Multi-Robot Systems
COMP_SCI 449-0	Deep Learning
COMP_SCI 469-0	Machine Learning & Artificial Intelligence for Robotics
ELEC_ENG 335-0 or ELEC_ENG 435-0	Deep Learning Foundations from Scratch Deep Learning: Foundations, Applications, and Algorithms
ELEC_ENG 375-0 or ELEC_ENG 375-0	Machine Learning: Foundations, Applications, and Algorithms Machine Learning: Foundations, Applications, and Algorithms
ELEC_ENG 389-0	Superconductivity and Its Applications
ELEC_ENG 454-0	Advanced Communication Networks
ES_APPM 495-0	Selected Topics in Applied Mathematics (Soft Matter)
MECH_ENG 382-0	Experiments in Micro- and Nano Science and Engineering