ROBOTICS ENGINEERING, B.S.

Overview
Degree Program

The Bachelor of Science in Robotics Engineering degree program, formerly Robotics, is envisioned as an interdisciplinary major that prepares the students for work and advanced study in Robotics Engineering.

Program distinctives will include:

1. Interdisciplinary program (Computer Science and Engineering) focusing on an AI approach to Robotics.
2. Equips the students with the breadth and depth of training required by the growing professional Robotics Engineering field.
3. Christ-centered approach to the profession.

The backbone of the program is existing courses from Math, Computer Science, Chemistry and Physics plus Engineering that provide students with real world applications of computation, sensing, and actuation, as well as a solid foundation of understanding, programming, design, and implementation of robotic systems. In addition, the Bachelor of Science in Robotics Engineering provides students with foundational knowledge of Computer Science, Mathematics and Physics/Engineering. The program is intended to operate in partnership with the B.S. Engineering program.

Learning Outcomes
Program Learning Outcomes

Upon completion of the Bachelor of Science in Robotics Engineering, students will be able to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, computing, science, mathematics, robotics and automation (ULO 1).
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (ULO 1).
3. Communicate effectively with a range of audiences (ULO 2).
4. Recognize ethical and professional responsibilities in engineering, computing, robotics and automation practice and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts (ULO 3).
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives (ULO 2).
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions (ULO 1).
7. Acquire and apply new knowledge as needed, using appropriate learning strategies (ULO 1).
8. Summarize the key issues in science and faith and recognize the harmony possible while studying God's creation (ULO 2, 3).

Each Program Learning Outcome (PLO) listed above references at least one of the University Learning Outcomes (ULO 1, 2, 3), which may be found in the General Information section (https://catalog.biola.edu/general-information/#UniversityLearningOutcomes) of this catalog.

In addition, PLOs 1-7 reference ABET student outcomes, which may be found in the Accreditation Criteria & Supporting Documents (https://www.abet.org/accreditation/accreditation-criteria/) section of ABET's website.

Program Educational Objectives

The Bachelor of Science in Robotics Engineering program provides students with a general robotics, computing and engineering background to tackle design problems and demands. In keeping with Biola University's mission, this program provides students with an experience that equips them with the following:

1. Diverse Knowledge: Graduates will be able to apply interdisciplinary skills to solve problems that impact society.
2. Continuous Growth: Graduates will be equipped with skills associated with lifelong learning.
3. Professional Development: Graduates will be prepared to navigate a diverse and changing job market.

Admission Recommendations
Admission Recommendations

Recommended high school courses: Pre-calculus or above and Physics.

Program Requirements
GPA Requirement

To continue in the program, a student is required to have a cumulative GPA of 2.5 or higher in their first year of computer science, physics, math, and engineering courses taken at Biola. These courses may include: MATH 150, MATH 151, CSCI 105, CSCI 106, ENGR 122, PHSC 132, PHSC 134, PHSC 233, and PHSC 237.

A minimum grade of a C is required in all B.S. Robotics Engineering major courses taken at Biola. Anyone receiving a lower grade must repeat the course with a higher grade to receive credit for the course.

Curriculum Requirements

Code	Title	Credits
Robotics Engineering majors meet the Core Curriculum requirement of 9 credits in science, mathematics, and ENGL 313 within the major. The foreign language requirement is met by two years of high school study in the same language or four credits of college foreign language. The following courses are strongly recommended: ARTS 111, PHIL 215, and ENGL 2301.		
The Bible requirement is 18 credits: BBST 103, BBST 165, BBST 209, BBST 210, BBST 260, and BBST 365.		
Program Courses		
Math and Science Required Courses		
MATH 150	Calculus I	4
MATH 151	Calculus II	4
MATH 203	Discrete Structures	3
MATH 250	Calculus III	4

MATH 320	Probability and Statistics for Engineers and Scientists	3
MATH 334	Linear Algebra and Differential Equations	4
PHSC 132	General Physics I: Mechanics and Heat	3
PHSC 134	General Physics I Laboratory	1
PHSC 233	General Physics II: Electricity and Magnetism	3
PHSC 237	General Physics II Laboratory	1

Computer Science, Engineering, and Robotics Required Courses

CSCI 105	Introduction to Computer Science	3
CSCI 106	Data Structures	3
CSCI 300	Theory of Algorithms	3
ENGR 122	Introduction to Engineering Lab	1
ENGR 212	Engineering Economics	3
ENGR 360	Mechatronics	3
ENGR 370	Computer Aided Engineering Design	3
ENGR 470	Senior Design Capstone	3
ROBO 320	Robot Modeling and Dynamics	3
ROBO 322	Embedded Systems	3
ROBO 410	Artificial Intelligence	3
ROBO 420	Programming of Autonomous Mobile Robots	3
ROBO 430	Control Systems	3
ROBO 471	Robotics Capstone	3

Computer Science/Engineering/Robotics Electives - Select 9 credits from the courses listed below.		9
CSCI 220	Computer Organization and Assembly Language Programming	
CSCI 230	Programming Languages	
CSCI 305	Programming for Data Science I	
CSCI 306	Programming for Data Science II [1]	
CSCI 311	Operating Systems [1]	
CSCI 335	User Interface Design and Programming	
CSCI 430	Computer Communications [1]	
CSCI 440	Topics in Computer Science [1]	
ENGR 313	Statics	
ENGR 321	Circuits and Instrumentation I	
ENGR 465	Special Topics in Engineering	
ENGR 471	Engineering Capstone	
ENGR 490	Directed Research in Engineering	
ROBO 465	Special Topics in Robotics	
ROBO 480	Internship in Robotics [2]	
ROBO 490	Directed Research	

General Elective - Select 3 credits from the list of CSCI/ENGR/ROBO electives or the list below.		3
MATH 321	Numerical Analysis	
MATH 333	Operations Research	
MATH 336	Mathematical Methods in Physics	
MATH 440	Complex Variables	

PHSC 318	Classical Mechanics	
ENGL 3133	Writing in the Disciplines for Science & Engineering [3]	3
Program Course Requirements: 85 credits		
Core Curriculum Requirements [4]		**46**
Total Credits		**131**

[1] Prerequisite course(s), which may be counted as an elective for Robotics Engineering, must be taken prior to taking this course.
[2] A maximum of 6 credits is allowed for ROBO 480.
[3] Fulfills the ENGL 313 Core Curriculum Requirement.
[4] See Core Curriculum Program section (https://catalog.biola.edu/academic-policies/undergraduate-core-curriculum-program/) for details.

Course Sequence

NOTE: The course sequence table is designed by the major department and is one way that the classes will work out properly in sequence for your major. However, there are alternative or flexible ways to rotate some of the classes within the same year/level and sometimes between year levels. Please contact your major department advisor to discuss flexible alternatives in scheduling the sequence of your classes.

Taking coursework during the summer session may also be an option to accelerate your degree path.

See Core Curriculum Program section (https://catalog.biola.edu/academic-policies/undergraduate-core-curriculum-program/) for a list of approved Core Curriculum courses.

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First Year

Fall	Credits	Spring	Credits
ARTS 111 (strongly recommended; fulfills Core Curriculum Fine Arts)	3	CSCI 106	3
BBST 103 or 165	3	ENGL 100 or 112	3
CSCI 105	3	ENGR 122	1
GNST 102	1	MATH 151	4
KNES 107	1	PHSC 132	3
MATH 150	4	PHSC 134	1
		KNES Activity (see Core Curriculum)	1
	15		**16**

Second Year

Fall	Credits	Spring	Credits
BBST 103 or 165	3	BBST 209 or 210	3
MATH 250	4	ENGR 212	3
MATH 334	4	MATH 203	3
PHSC 233	3	PHIL 215 (strongly recommended; fulfills Core Curriculum Philosophy)	3
PHSC 237	1	ROBO 322	3
Communication (see Core Curriculum)	3		
	18		**15**

Third Year

Fall	Credits	Spring	Credits
BBST 209 or 210	3	BBST 260	3
CSCI 300	3	MATH 320	3
ENGL 3133	3	ROBO 420	3

	Credits		Credits
ENGR 360	3	Major Elective	3
ENGR 370	3	Behavioral Science (see Core Curriculum)	3
ROBO 320	3	Foreign Language (see Core Curriculum)	4
	18		**19**

Fourth Year

Fall	Credits	Spring	Credits
BBST 365	3	ENGL 2301 (strongly recommended; fulfills Core Curriculum Literature)	3
ENGR 470	3	ROBO 430	3
HIST 200, 201, or POSC 225	3	ROBO 471	3
ROBO 410	3	Major Elective	3
Major Elective	3	Major Elective	3
	15		**15**

Total Credits 131

	Credits		Credits
HNRS 326	2	HNRS 339	2
CSCI 300	3	ENGR 212	3
ENGR 360	3	MATH 320	3
ENGR 370	3	ROBO 420	3
ROBO 320	3	Major Elective	3
	18		**18**

Fourth Year

Fall	Credits	Spring	Credits
HNRS 443	4	HNRS 458	4
ENGL 3133	3	ROBO 430	3
ENGR 470	3	ROBO 471	3
ROBO 410	3	Major Elective	3
Foreign Language (see Core Curriculum)	4	Major Elective	3
		Major Elective	3
	17		**19**

Total Credits 144

Note: If two years of the same foreign language were not taken in high school, four credits at the college level will be required for graduation.

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For students who enroll in more than 18 semester credits, please note the additional cost per credit in the catalog's Financial Information section (https://catalog.biola.edu/financial-information/tuition-information/).

First Year

Fall	Credits	Spring	Credits
HNRS 101	4	HNRS 105	4
HNRS 102	4	HNRS 106	4
CSCI 105	3	ENGR 122	1
GNST 102	1	MATH 151	4
KNES 107	1	PHSC 132	3
MATH 150	4	PHSC 134	1
		KNES Activity (see Core Curriculum)	1
	17		**18**

Second Year

Fall	Credits	Spring	Credits
HNRS 210	4	HNRS 230	4
HNRS 215	4	HNRS 231	4
MATH 250	4	CSCI 106	3
MATH 334	4	MATH 203	3
PHSC 233	3	ROBO 322	3
PHSC 237	1		
	20		**17**

Third Year

Fall	Credits	Spring	Credits
HNRS 324	4	HNRS 337	4