FIRST EDUCATION

Robotics Capstone | Course Overview

Year-Long Course Outline with CTE Competencies

Equipment Requirements – XRP robot, *FIRST* Tech Challenge Starter Bot, *FIRST* Robotics Competition Kit Bot

Course Description

FIRST CTE Capstone is a culminating, project-based engineering experience in which students apply advanced technical, leadership, and project management skills to design, build, program, manufacture, and compete with an industrial-scale robotic system.

Students operate as a professional engineering team using authentic industry workflows including systems engineering, CAD/CAM manufacturing, embedded programming, electrical integration, quality control, data-driven optimization, documentation management, and stakeholder presentation.

The course mirrors real-world product development cycles, requiring students to manage budgets, timelines, risk mitigation, testing protocols, and iterative refinement. Through participation in a *FIRST team*, students demonstrate workforce readiness across Engineering, Manufacturing, Information Technology, and Mechatronics career pathways.

Course Outcomes

COMPETENCY	STUDENT OUTCOMES
Lead the design and integration of a complex robotic system using systems engineering methodologies.	Students will lead the design and integration of a complex robotic system by defining technical requirements, developing multi-disciplinary architectures, and conducting rigorous trade-off analyses to manage the interface between hardware and software.
Design, prototype, and manufacture of precision mechanical systems using professional engineering tools and processes.	Students will design and manufacture precision mechanical systems by developing advanced CAD assemblies, producing industry-standard manufacturing drawings with tolerances, and utilizing digital fabrication workflows to validate performance through empirical testing.
Develop scalable, modular control software incorporating autonomous navigation, sensor fusion, and closed-loop control systems.	Students will develop scalable, modular control software by implementing command-based architectures, tuning PID and motion profiling systems, and integrating vision or AI-based logic to optimize robot performance through data-driven telemetry analysis.
Design and troubleshoot integrated electrical and control systems following industry safety and reliability standards.	Students will design and troubleshoot integrated electrical and control systems by creating formal schematics, implementing safe power distribution and circuit protection, and integrating sensors, actuators, and CAN-based devices to diagnose and resolve complex system-level failures.
Manage engineering projects using structured planning, documentation, and leadership strategies.	Students will manage engineering projects using structured planning and leadership strategies by developing project timelines and Gantt charts, assigning team roles to ensure task accountability, and conducting formal design reviews to manage risk and implement mitigation strategies
Apply data-driven decision-making and continuous improvement methodologies to refine engineering systems.	Students will refine engineering systems through data-driven decision-making by collecting and analyzing performance metrics, applying iterative testing cycles to identify inefficiencies, and implementing corrective actions to document measurable performance gains.
Produce and deliver professional engineering documentation and presentations aligned to industry standards.	Students will produce and deliver professional engineering documentation and presentations by maintaining detailed engineering notebooks and revision logs, creating technical drawings and software documentation, and defending design decisions and trade-offs to stakeholders using data-driven evidence.
Demonstrate workplace professionalism, ethical leadership, and career pathway preparation.	Students will demonstrate workplace readiness and professional leadership by consistently applying safety and quality standards, collaborating effectively in cross-functional teams, and engaging with industry mentors to prepare portfolio artifacts for postsecondary or employment opportunities.

Industry Certifications

Certiport: Entrepreneurship & Small Business
Certiport:Communication Skills for Business
Certiport:PMI Project Management Ready
AMTEC Emerging Technicians Certification
Salesforce: Certified Tableau Desktop Foundations

FIRST Training learning content that can be used to implement this course.

Engineering Explorations Course	*FIRST* Robotics Competition Trainings		*FIRST* Tech Challenge Skill Builders
Unit 1: Welcome to *FIRST*	Module 1: Intro to *FIRST* Robotics Competition	Module 7: Kickoff	Chassis and Drive Systems Lesson and Challenges
Unit 2: Build a Bot	Module 2: How does *FIRST* Robotics Competitions Work?	Module 8: Design and Mechanical	Intakes Lesson and Challenges
Unit 3: Make it Move	Module 3: Intro to CAD and 3D Printing	Module 9: Programming and Electrical	Programming Lesson and Challenges
Unit 4: Programming Autonomous Robots	Module 4: Fabrication Tools and Safety	Module 10: Business and Media	
Unit 5: Build and Program Manipulators	Module 5: Rapid Prototyping	Module 11: Preparing for Competition	
Unit 6: The Ball Game	Module 6: Preparing for Build Season	Module 12: Season Wrap-up	
	Java Programming I	Java Programming II	

Standards Alignments

Organization	Aligned Standards
NGSS	HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4, HS-PS3-3
ISTE	1.1.c, 1.4.a, 1.4.b, 1.4.c, 1.5.a, 1.5.b, 1.7.c
ITEEA (STEL)	1.Q, 2.T, 3.J, 4.N, 5.I, 7.X, 8.K
NIMS	Measurement, Materials & Safety (MMS), CNC Milling (Operations), CNC Turning (Operations), Job Planning, Benchwork & Layout, Quality & Continuous Improvement, Maintenance Awareness, Workforce Readiness
NBEA	Information Technology I.A, Communication III.A, Management III.A, Career Development I.B
ACTE-CRP	CRP1, CRP2, CRP4, CRP5, CRP6, CRP7, CRP8, CRP9, CRP10, CRP11, CRP12