Engineering and Science Technologies Career Field Pathways and Course Structure

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Criteria for Course/Model Development

1. Courses are designed to attract student enrollment.
2. The Courses are designed to fit in a comprehensive middle and high school model typically offering 40-50 minutes per day (120-150 hours/year) as well as a career center model typically offering 120-150 minutes per day (360-450 hours/year).
3. There are no prerequisite course requirements.
4. The course structure must facilitate testing using CTE Technical tests.
5. Recommended first course in career field is indicated by a (1)
6. Each Pathway has a recommended "first course in the pathway" that is designated with a (2).
7. Courses that carry Career Technical Assurance Guide (CTAG) credit are marked by a (3).
8. Program of Study should align with in-demand occupations which requires the skillsets modeled in the course outlines.
9. The pathway course structure should align with postsecondary programs for enhancing successful articulation.
10. Programs must be comprised of a minimum of four courses from the pathway courses. Additional courses can come from the pathway. The Capstone course must be taught in addition to the four-course minimum. There is no maximum on the number of courses.

Assessment Considerations

1. Assessments will be developed for every course except the Capstone course.
2. It is recommended that students sit for course assessments after the completion of the course.

Program of Study Requirements

1. CTE-26 Application, Program of Study, and Assurances must be approved.
2. Coursework includes articulated credit that is directly related to the secondary/postsecondary Career Field. Postsecondary credit will be transcripted no later than the conclusion of the term in which the student has met the postsecondary residency requirements.
3. Program of Study provides educational experiences to prepare the student for state or industry recognized assessment and the appropriate state technical competency assessment.
4. College-ready assessments (Compass, Asset, ACT) must be accessible to all students.

Engineering and Science Technologies Career Field Pathways and Course Descriptions

F6 **Engineering Design & Development**	F7 **Robotics**	F8 **Mechatronics**
• Engineering Logic[1] • Engineering Principles • Engineering Design[2] • Computer Aided Drafting & Modeling[3] • AC Electronic Circuits • DC Electronic Circuits[3] • Battery Technology • Analog Based Electronic Devices • Digital Electronics[3] • Introduction to Semiconductors[3] • Energy Systems Management • Mechanical Engineering • Aerospace Engineering • Unmanned Aircraft Systems[3] • Aviation • Programming[3] • Applications of Artificial Intelligence • Architecture Design – Structural and Mechanical/Electrical/Plumbing • Architecture Design – Site and Foundation Plans • Plan Reading and Estimating[3] • Engineering Capstone	• Engineering Logic[1] • Engineering Principles[2] • Robotics • Industrial Robotics[3] • Fluid Mechanics[3] • Mechanical Engineering • AC Electronic Circuits • DC Electronic Circuits[3] • Digital Electronics[3] • Automation Technologies[3] • Industrial Maintenance • Unmanned Aircraft Systems • Programming[3] • Applications of Artificial Intelligence • Engineering Capstone	• Engineering Logic[1] • Engineering Principles • Engineering Design • Manufacturing Operations[2,3] • Principles of Advanced Manufacturing[3] • Mechanical Engineering • Fluid Mechanics[3] • Machine Operations • Industrial Robotics[3] • Automation Technologies[3] • Digital Electronics[3] • Welding Technologies • Industrial Maintenance • Operations Management • Applications of Artificial Intelligence • Engineering Capstone

Engineering and Science Technologies Career Field Pathways and Course Descriptions

Courses in Engineering Design & Development (F6)

Pathway Course Name	Subject Code
Engineering Logic	175017
Engineering Principles	175002
Engineering Design	175001
Computer Aided Drafting & Modeling	175006
AC Electronic Circuits	175100
DC Electronic Circuits	175105
Battery Technology	TBD
Analog Based Electronic Devices	175012
Digital Electronics	175007
Introduction to Semiconductors	176030
Energy Systems Management	010715
Mechanical Engineering	175008
Aerospace Engineering	TBD
Unmanned Aircraft Systems	177024
Aviation	177013
Programming	145160
Applications of Artificial Intelligence	145130
Architecture Design – Structural and Mechanical/Electrical/Plumbing	178020
Architecture Design – Site and Foundation Plans	178021
Plan Reading and Estimating	178019
Engineering Capstone	175009

Engineering Logic
Subject Code: 175017
This course develops foundational knowledge across electrical, mechanical, design, and manufacturing systems. It cultivates critical thinking, problem-solving, and analytical skills essential to engineering practice. Through hands-on activities and theoretical concepts, learners build the mental aptitude needed to tackle engineering challenges, emphasizing safety, quality, and technical precision throughout all processes.

Engineering Principles
Subject Code: 175002
Learners explore foundational concepts and practices across engineering fields, emphasizing mechanics, materials science, electrical principles, and fluid dynamics. The course focuses on applying these principles to analyze, design, and optimize engineering systems. Students develop critical thinking and problem-solving skills essential for understanding both mechanical and electrical components in engineering applications.

Engineering Design
Subject Code: 175001
Learners develop fundamental skills in the engineering design process, focusing on problem-solving, conceptualization, and effective communication of ideas. The course covers techniques in sketching, technical drawing interpretation, and basic modeling to visualize and plan engineering solutions without reliance on computer-aided tools. Emphasis is placed on critical thinking, creativity, and practical application of design principles.

Computer Aided Drafting & Modeling
Subject Code: 175006
Learners develop skills in creating precise technical drawings and 3D models using Computer-Aided Drafting and Modeling (CAD/M) software. The course emphasizes understanding drafting standards, interpreting engineering drawings, and applying modeling techniques for design visualization and product development. Students gain hands-on experience in producing detailed plans and digital prototypes that support engineering and manufacturing processes.

AC Electronic Circuits
Subject Code: 175100
Students will learn the fundamental principles of electricity with emphasis on AC (alternating current) circuits. They will use concepts of Ohm's Law, the Power Formula and Kirchhoff's Law with series, parallel and series-parallel circuit applications. The relationship between electricity and magnetism and motor theory will also be introduced. The student will master electrical safety, breadboard wiring, basic circuit troubleshooting, operation of function generator, digital multimeter (DMM) and oscilloscope.

DC Electronic Circuits
Subject Code: 175105
Students will learn the fundamental principles of electricity with emphasis on DC (direct current) circuits. They will use concepts of Ohm's Law, the Power Formula and Kirchhoff's Law with series, parallel and series-parallel circuit applications. The student will master electrical safety, breadboard wiring, basic circuit troubleshooting, operation of DC power supply and digital multimeter (DMM).

Battery Technology
Subject Code: TBD
Students examine battery technology with a focus on design, function, and manufacturing. They explore battery chemistries, energy storage principles, and performance factors such as capacity, efficiency, and lifespan. Students study battery production processes, materials, and environmental impacts, while learning to test, select, and safely handle batteries for various applications. Emphasis is placed on emerging technologies, industry standards, and the critical role of batteries in modern electrical and electronic systems.

Analog Based Electronic Devices
Subject Code: 175012
This course focuses on the theory, design, and application of analog-based electronic devices. Learners study AC/DC principles, transistors, amplifiers, filters, and power supplies, gaining skills to analyze, construct, and troubleshoot analog circuits. Through practical exercises, students develop the ability to interpret schematics, understand component functions, and apply safe wiring and assembly techniques. Emphasis is placed on signal processing and power management within analog systems to build a strong foundation in electronics.

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Digital Electronics
Subject Code: 175007
Learners explore the fundamental principles and practical applications of digital electronics. The course covers numbering systems, Boolean algebra, logic gates, combinational and sequential circuits, and memory devices. Students develop skills in designing, constructing, and troubleshooting digital circuits and systems. Emphasis is placed on interpreting schematics, using diagnostic tools, and understanding digital communication and power supply components essential for digital electronics applications.

Introduction to Semiconductors
Subject Code: 176030
This course is a broad introduction to semiconductor and integrated circuit manufacturing from a technician and maintenance perspective. In lecture, students will learn about what a cleanroom is, why it's important to gown up, and have a broad non-quantitative introduction to semiconductor processing. In the lab students will use hand-tools to perform inspection, maintenance and repair of mechanical fasteners and fixtures associated with semiconductor equipment and gown up to simulate working in a bunny suit.

Energy Systems Management
Subject Code: 010715
Students will apply basic principles of energy accounting, thermodynamics and heat transfer, energy conversion and efficiency to heating, power generation and transportation. Students will apply the principles and practices needed for managing renewable and non-renewable energy resources. Throughout this course, future energy systems and energy use scenarios are investigated, with a focus on promoting the use of renewable energy resources and technologies.

Mechanical Engineering
Subject Code: 175008
Learners develop the ability to interpret mechanical schematics and blueprints to accurately assemble and maintain mechanical systems. They apply technical math and scientific principles to analyze system performance and solve practical problems. Emphasis is placed on effective troubleshooting techniques, preventive maintenance, and adherence to safety standards to ensure reliable operation and workplace safety.

Aerospace Engineering
Subject Code: TBD
Students build foundational skills in space systems engineering through the study of rocketry, orbital mechanics, and the evolution of spaceflight. They design, test, and analyze rockets using simulation tools, technical drawings, and physical models. Emphasis is placed on interpreting flight data, applying physics and math principles, and understanding mission planning. Learners explore satellite behavior, launch dynamics, and energy transfer to develop the knowledge and precision required for safe, efficient aerospace systems.

Unmanned Aircraft Systems
Subject Code: 177024
Students will learn and simulate fundamentals of air traffic control. Subjects taught include principles of aircraft tracking using radar and transponders, controlling aircraft departures, takeoffs, ground operation and in air flight control. Students will learn and simulate techniques of sequencing aircraft approaches and departures using approach control radar. Students will study concepts of meteorology, the flight environment, identification of emergency codes, fundamental aspects of flight and air navigation.

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Aviation
Subject Code: 177013
In this course, students apply knowledge of aviation theory and navigation to flight performance and planning. Students will apply principles of simple machines and fluid mechanics to aircraft operations. Identification of aircraft engines and airframe related systems will be emphasized. Weather theories and concepts are used to interpret weather-briefing documents. Additionally, students will distinguish among airport environments, and understand rules, regulations and orders relevant to the airport industry.

Programming
Subject Code: 145060
In this course, students will learn the basics of building simple interactive applications. Students will learn the basic units of logic: sequence, selection, and loop. Students will apply algorithmic solutions to problem-domain scenarios. Students will gain experience in using commercial and open-source languages, programs, and applications.

Applications of Artificial Intelligence
Subject Code: 145130
This course will prepare students to apply artificial intelligence, machine learning, and neural networks to common workflows, processes, and problems in programming and design. Students will analyze the broader societal, technological, and ethical impacts and implications of its usage and development. Students will learn how to construct prompts and queries and how to critically analyze generated responses.

Architecture Design – Structural and Mechanical/Electrical/Plumbing
Subject Code: 178020
Students will use architecture design principles to organize and arrange structures to create a perspective of a building. Students will use orthographic/pictorial projection, freehand technical sketching and computer-aided drafting (CAD) skills to generate floor and wall plans, elevations, sections, details and schedules. Students will develop sets of structural framing and mechanical working drawings that include plumbing, HVAC and electrical power and lighting plans.

Architecture Design – Site and Foundation Plans
Subject Code: 178021
Students use advanced architectural design concepts to construct design models including perspective drawings for final presentations. Students use orthographic/pictorial projection, freehand technical sketching and computer- aided drafting (CAD) tools to create site foundation and section plans that include topographical details and schedules. Additionally, students perform zoning analysis, develop preliminary plot plans, and construct grading and utilities plans that include legal descriptions and cut and fill volumes.

Plan Reading and Estimating
Subject Code: 178019
Students learn blueprint reading as it relates to architecture and construction. Students will use scaling, orthographic projections, dimensioning practices, symbols, notations, and abbreviations to perform area calculations and to interpret floor plan, section, and elevations and develop an estimate of material, time, personnel, and equipment needs, availability, and cost. Using construction plans, students will identify problems or shortcomings related to the layout and installation of materials for the project.

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Engineering Capstone
Subject Code: 175009
The capstone course provides opportunities for students to apply knowledge, attitudes and skills that were learned in an Engineering program in a more comprehensive and authentic way. Capstones often include project/problem-based learning opportunities that occur both in and away from school. Under supervision of the school and through community partnerships, students may combine classroom learning with work experience. This course can be delivered through a variety of delivery methods including cooperative education or apprenticeship.

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Courses in Robotics (F7)

Pathway Course Name	Subject Code
Engineering Logic	175017
Engineering Principles	175002
Robotics	175004
Industrial Robotics	176025
Fluid Mechanics	TBD
Mechanical Engineering	175008
AC Electronic Circuits	175100
DC Electronic Circuits	175105
Digital Electronics	175007
Automation Technologies	TBD
Industrial Maintenance	176020
Unmanned Aircraft Systems	177024
Programming	145060
Applications of Artificial Intelligence	145130
Engineering Capstone	175009

Engineering Logic
Subject Code: 175017
This course develops foundational knowledge across electrical, mechanical, design, and manufacturing systems. It cultivates critical thinking, problem-solving, and analytical skills essential to engineering practice. Through hands-on activities and theoretical concepts, learners build the mental aptitude needed to tackle engineering challenges, emphasizing safety, quality, and technical precision throughout all processes.

Engineering Principles
Subject Code: 175002
Learners explore foundational concepts and practices across engineering fields, emphasizing mechanics, materials science, electrical principles, and fluid dynamics. The course focuses on applying these principles to analyze, design, and optimize engineering systems. Students develop critical thinking and problem-solving skills essential for understanding both mechanical and electrical components in engineering applications.

Robotics
Subject Code: 175004
Learners explore the fundamentals of robotics including mechanical design, electronics, and programming of robotic systems. The course covers the integration of sensors, actuators, control systems, and software to build and operate robots for industrial and practical applications. Students develop skills in troubleshooting, programming, and automating robotic processes to solve real-world problems.

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Industrial Robotics
Subject Code: 176025
Learners explore the fundamentals of industrial robots, including their design, operation, and applications in manufacturing and automation. The course covers robot types, kinematics, sensors, actuators, programming, and safety protocols. Emphasis is placed on integrating robots into production systems for tasks such as assembly, welding, material handling, and inspection, alongside troubleshooting and maintenance practices.

Fluid Mechanics
Subject Code: TBD
Students will explore the operation, installation, and maintenance of mechanical, hydraulic, pneumatic, and pumping systems used in manufacturing. Emphasis is placed on motors, drives, schematics, and fluid power systems. Learners will analyze schematics, calculate performance metrics, and troubleshoot real-world issues. Safety practices, personal protective equipment, and regulatory compliance are integrated throughout to prepare students for safe, effective work in modern engineering and industrial environments.

Mechanical Engineering
Subject Code: 175008
Learners develop the ability to interpret mechanical schematics and blueprints to accurately assemble and maintain mechanical systems. They apply technical math and scientific principles to analyze system performance and solve practical problems. Emphasis is placed on effective troubleshooting techniques, preventive maintenance, and adherence to safety standards to ensure reliable operation and workplace safety.

AC Electronic Circuits
Subject Code: 175100
Students will learn the fundamental principles of electricity with emphasis on AC (alternating current) circuits. They will use concepts of Ohm's Law, the Power Formula and Kirchhoff's Law with series, parallel and series-parallel circuit applications. The relationship between electricity and magnetism and motor theory will also be introduced. The student will master electrical safety, breadboard wiring, basic circuit troubleshooting, operation of function generator, digital multimeter (DMM) and oscilloscope.

DC Electronic Circuits
Subject Code: 175105
Students will learn the fundamental principles of electricity with emphasis on DC (direct current) circuits. They will use concepts of Ohm's Law, the Power Formula and Kirchhoff's Law with series, parallel and series-parallel circuit applications. The student will master electrical safety, breadboard wiring, basic circuit troubleshooting, operation of DC power supply and digital multimeter (DMM).

Digital Electronics
Subject Code: 175007
Learners explore the fundamental principles and practical applications of digital electronics. The course covers numbering systems, Boolean algebra, logic gates, combinational and sequential circuits, and memory devices. Students develop skills in designing, constructing, and troubleshooting digital circuits and systems. Emphasis is placed on interpreting schematics, using diagnostic tools, and understanding digital communication and power supply components essential for digital electronics applications.

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Automation Technologies
Subject Code: TBD
Students develop skills in automating manufacturing processes through the integration of robotics, programmable logic controllers (PLCs), and control systems. They design, program, and troubleshoot automated work cells using schematics, blueprints, and simulation software. Emphasis is placed on optimizing robotic operations, configuring sensors and actuators, and improving system efficiency. Learners apply automation tools to streamline production, monitor data for continuous improvement, and ensure safe, high-performance manufacturing environments.

Industrial Maintenance
Subject Code: 176020
Prepares students to diagnose, maintain, and support the interconnected systems that drive modern manufacturing operations. Through hands-on, technical problem-solving, students develop the ability to interpret technical documentation, safely service equipment, and restore functionality to complex industrial systems to ensure reliability, efficiency, and continuous production in advanced manufacturing environments.

Unmanned Aircraft Systems
Subject Code: 177024
Students will learn and simulate fundamentals of air traffic control. Subjects taught include principles of aircraft tracking using radar and transponders, controlling aircraft departures, takeoffs, ground operation and in air flight control. Students will learn and simulate techniques of sequencing aircraft approaches and departures using approach control radar. Students will study concepts of meteorology, the flight environment, identification of emergency codes, fundamental aspects of flight and air navigation.

Programming
Subject Code: 145060
In this course, students will learn the basics of building simple interactive applications. Students will learn the basic units of logic: sequence, selection, and loop. Students will apply algorithmic solutions to problem-domain scenarios. Students will gain experience in using commercial and open-source languages, programs, and applications.

Applications of Artificial Intelligence
Subject Code: 145130
This course will prepare students to apply artificial intelligence, machine learning, and neural networks to common workflows, processes, and problems in programming and design. Students will analyze the broader societal, technological, and ethical impacts and implications of its usage and development. Students will learn how to construct prompts and queries and how to critically analyze generated responses.

Engineering Capstone
Subject Code: 175009
The capstone course provides opportunities for students to apply knowledge, attitudes and skills that were learned in an Engineering program in a more comprehensive and authentic way. Capstones often include project/problem-based learning opportunities that occur both in and away from school. Under supervision of the school and through community partnerships, students may combine classroom learning with work experience. This course can be delivered through a variety of delivery methods including cooperative education or apprenticeship.

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Courses in Mechatronics (F8)

Pathway Course Name	Subject Code
Engineering Logic	175017
Engineering Principles	175002
Engineering Design	175001
Manufacturing Operations	175003
Principles of Advanced Manufacturing	176035
Mechanical Engineering	175008
Fluid Mechanics	XXXXX
Machine Operations	176004
Industrial Robotics	176025
Automation Technologies	XXXXX
Digital Electronics	175007
Welding Technologies	176009
Industrial Maintenance	176020
Operations Management	142020
Applications of Artificial Intelligence	145130
Engineering Capstone	175009

Engineering Logic
Subject Code: 175017
This course develops foundational knowledge across electrical, mechanical, design, and manufacturing systems. It cultivates critical thinking, problem-solving, and analytical skills essential to engineering practice. Through hands-on activities and theoretical concepts, learners build the mental aptitude needed to tackle engineering challenges, emphasizing safety, quality, and technical precision throughout all processes.

Engineering Principles
Subject Code: 175002
Learners explore foundational concepts and practices across engineering fields, emphasizing mechanics, materials science, electrical principles, and fluid dynamics. The course focuses on applying these principles to analyze, design, and optimize engineering systems. Students develop critical thinking and problem-solving skills essential for understanding both mechanical and electrical components in engineering applications.

Engineering Design
Subject Code: 175001
Learners develop fundamental skills in the engineering design process, focusing on problem-solving, conceptualization, and effective communication of ideas. The course covers techniques in sketching, technical drawing interpretation, and basic modeling to visualize and plan engineering solutions without reliance on computer-aided tools. Emphasis is placed on critical thinking, creativity, and practical application of design principles.

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Manufacturing Operations
Subject Code: 175003
Learners develop practical knowledge and skills related to manufacturing operations in terms of production planning, quality control, and workplace safety. The course emphasizes understanding various manufacturing methods, equipment operation, and the coordination of resources to efficiently produce goods. Students gain hands-on experience in monitoring production lines, maintaining equipment, and implementing continuous improvement practices.

Principles of Advanced Manufacturing
Subject Code: 176035
This course introduces students to modern manufacturing organizations, technology, business systems, and problem solving. Provides the fundamentals of Lean Manufacturing, Quality Systems and Statistical Process Control, documentation and standard operating procedures, concepts in measurement, geometric dimensioning and tolerancing, visualization and graphics.

Mechanical Engineering
Subject Code: 175008
Learners develop the ability to interpret mechanical schematics and blueprints to accurately assemble and maintain mechanical systems. They apply technical math and scientific principles to analyze system performance and solve practical problems. Emphasis is placed on effective troubleshooting techniques, preventive maintenance, and adherence to safety standards to ensure reliable operation and workplace safety.

Fluid Mechanics
Subject Code: TBD
Students will explore the operation, installation, and maintenance of mechanical, hydraulic, pneumatic, and pumping systems used in manufacturing. Emphasis is placed on motors, drives, schematics, and fluid power systems. Learners will analyze schematics, calculate performance metrics, and troubleshoot real-world issues. Safety practices, personal protective equipment, and regulatory compliance are integrated throughout to prepare students for safe, effective work in modern engineering and industrial environments.

Machine Operations
Subject Code: 176004
This course covers precision machining using both manual and CNC equipment. Learners develop skills in operating lathes, mills, grinders, and other machines, performing subtractive and additive manufacturing processes. Emphasis is placed on interpreting technical drawings, selecting appropriate tooling, programming CNC machines, and conducting accurate measurements and inspections to ensure quality. Students gain hands-on experience with machining techniques, tooling setup, and quality control for a comprehensive foundation in modern manufacturing operations.

Industrial Robotics
Subject Code: 176025
Learners explore the fundamentals of industrial robots, including their design, operation, and applications in manufacturing and automation. The course covers robot types, kinematics, sensors, actuators, programming, and safety protocols. Emphasis is placed on integrating robots into production systems for tasks such as assembly, welding, material handling, and inspection, alongside troubleshooting and maintenance practices.

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Automation Technologies
Subject Code: TBD
Students develop skills in automating manufacturing processes through the integration of robotics, programmable logic controllers (PLCs), and control systems. They design, program, and troubleshoot automated work cells using schematics, blueprints, and simulation software. Emphasis is placed on optimizing robotic operations, configuring sensors and actuators, and improving system efficiency. Learners apply automation tools to streamline production, monitor data for continuous improvement, and ensure safe, high-performance manufacturing environments.

Digital Electronics
Subject Code: 175007
Learners explore the fundamental principles and practical applications of digital electronics. The course covers numbering systems, Boolean algebra, logic gates, combinational and sequential circuits, and memory devices. Students develop skills in designing, constructing, and troubleshooting digital circuits and systems. Emphasis is placed on interpreting schematics, using diagnostic tools, and understanding digital communication and power supply components essential for digital electronics applications.

Welding Technologies
Subject Code: 176009
Learners develop skills in welding processes, metallurgy, joint design, and weld testing. They apply principles of arc and non-arc welding, select appropriate materials and parameters, and evaluate weld quality using industry standards.

Industrial Maintenance
Subject Code: 176020
Prepares students to diagnose, maintain, and support the interconnected systems that drive modern manufacturing operations. Through hands-on, technical problem-solving, students develop the ability to interpret technical documentation, safely service equipment, and restore functionality to complex industrial systems to ensure reliability, efficiency, and continuous production in advanced manufacturing environments.

Operations Management
Subject Code: 14020
Operations Management explores how to plan, organize and monitor day-to-day business activities. Learners will develop knowledge and skills to plan production activities, promote workplace safety and manage inventory, quality control and operational risk. This course also includes learning outcomes in facilities management and managerial accounting.

Applications of Artificial Intelligence
Subject Code: 145130
This course will prepare students to apply artificial intelligence, machine learning, and neural networks to common workflows, processes, and problems in programming and design. Students will analyze the broader societal, technological, and ethical impacts and implications of its usage and development. Students will learn how to construct prompts and queries and how to critically analyze generated responses.

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Engineering Capstone
Subject Code: 175009
The capstone course provides opportunities for students to apply knowledge, attitudes and skills that were learned in an Engineering program in a more comprehensive and authentic way. Capstones often include project/problem-based learning opportunities that occur both in and away from school. Under supervision of the school and through community partnerships, students may combine classroom learning with work experience. This course can be delivered through a variety of delivery methods including cooperative education or apprenticeship.

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