ENGINEERING AND TECHNOLOGY EDUCATION DEPARTMENT

Advanced Manufacturing I *5608*
TEH600, TEH601
- Grades 10-12
- 2 semesters, 2 credits
- Dual credit through Ivy Tech
- Recommended Prerequisite: Introduction to Advanced Manufacturing and Logistics
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Advanced Manufacturing I is a course that includes classroom and laboratory experiences in two broad areas: Industrial Technology/Software Controls and Manufacturing Trends. Industrial Technology and Software Controls covers wiring and schematic diagrams used to design, install, and repair electrical/electronic equipment such as wireless communication devices and programmable controllers. Course content will include basic theories of electricity, electronics, digital technology, and basic circuit analysis. Activities include experiences in soldering, use of an oscilloscope, meters, signal generators and tracers, bread boarding, circuit simulation software, and troubleshooting. Understanding and using the underlying scientific principles related to electricity, electronics, circuits, sine waves, and Ohm's Law are integral to this course. Manufacturing Trends covers basic concepts in manufacturing operations and plant floor layout in the production environment. Applications of Computer Numerical Control (CNC) and lathe and turning operations are developed as a foundation for machining operations. Coordinate system concepts are introduced as relevant to machining processes, as well as fluid and mechanical power, welding, and lean manufacturing. Fluid power concepts will include hydraulic components and circuits, laws and principles, fluid power controllers, and the construction of systems. In the mechanical power portion of the course, students will learn about machine specifications, basic forces, friction, simple machines, motors, and motor controls. Students will also be introduced to lean manufacturing where they will study concepts including: lean goals, product quality, eliminating waste, cost effectiveness, lean concepts, resource planning, continuous improvement, and the various advantages of lean manufacturing. This course includes MSSC concepts required to earn MSSC certification.

Advanced Manufacturing II *5606*
TEH602, TEH603
- Grades 11-12
- 2 semesters, 2 credits
- Dual credit through Ivy Tech
- Recommended Prerequisite: Advanced Manufacturing I
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas
- Qualifies as a quantitative reasoning course

Advanced Manufacturing II introduces basic blueprint reading, Computer Numerical Control (CNC) operation, and the skills commonly used in the manufacturing industry. Areas of study will include interpretation of drawing dimensions and notes to ANSI standards for machining including Geometric Dimensioning and Tolerancing (GDT), welding, fabrication applications, and inspection techniques. Students will be able to use Computer Aided Design software (CAD) to create 3D models and working drawings. Skills in the setup and operation of a CNC mill and lathe will also be acquired using multiple machine tool controllers. Other more general topics will include coordinate systems, dimensioning, line precedence, multi-view drawings, safe dress, tool paths, speed and feed calculations, and tool selection. The course also introduces robotics, automation, and Computer Integrated Manufacturing Technology (CIMT). Common types of factory automation will be identified. The course will focus on three main types of manufacturing automation including Programmable Logic Controllers (PLC), Computer Numerically Controlled Machines (CNC), and Robotics. Topics cover robotic principles including basic theory, robot safety, robotic classifications, applications, socioeconomic impact, work cell design, robot programming (Pendant and Software Language), and sensor and actuator interfacing. Students will be required to design, program, and troubleshoot computer controlled machine logic and production processes in a project oriented learning environment.

Computers in Design and Production (CADD) *4800*
TEH430, TEH431
- Grades 9-10
- 2 semesters, 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Computers in Design and Production is a course that specializes in using modern technological processes, computers, design, and production systems in the production of products and structures through the use of automated production systems. Emphasis is placed on using modern technologies and on developing career related skills for electronics, manufacturing, precision machining, welding, and architecture career pathways. Students apply ingenuity using tools, materials, processes, and resources to create solutions as it applies in the electronics, manufacturing, precision machining, welding, and architecture. The content and activities should be developed locally in accordance with available advanced technologies in the school. Course content should address major technological content related to topics such as: architectural drawing and print design; design documentation using CAD systems; assignments involving the interface of CAD, CNC, CAM, and CIM technologies; computer simulation of products and systems; publishing of various media; animation and related multimedia applications; 3-D modeling of products or structures; digital creation and editing of graphics and audio files; control technologies; and automation in the modern workplace.

Introduction to Advanced Manufacturing and Logistics *4796*
TEH604, TEH605
- Grades 9-12
- 2 semesters, 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Introduction to Advanced Manufacturing and Logistics is a course that specializes in how people use modern manufacturing systems with an introduction to advanced manufacturing and logistics and their relationship to society, individuals, and the environment. Students apply the skills and knowledge of using modern manufacturing processes to obtain resources and change them into industrial materials, industrial products, and consumer products. Students investigate the properties of engineered materials such as metallics, polymers, ceramics, and composites. Students study six major types of material processes: casting and molding, forming, separating, conditioning, finishing, and assembling. After gaining a working knowledge of these materials, students are introduced to advanced manufacturing, logistics, and business principles that are utilized in today's advanced manufacturing industry. Students gain a basic understanding of tooling, electrical skills, operation skills, inventory principles, MSDS's, chart and graph reading, and MSSC concepts. There is also an emphasis placed on the flow process principles, material movement, safety, and related business operations. Students have the opportunity to develop the characteristics employers seek as well as skills that will help them in future endeavors.

Introduction to Communications *4790*
TEH111, TEH112
- Grades 9-12
- 2 semesters, 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Introduction to Communications is a course that specializes in identifying and using modern communication to exchange messages and information. This course explores the application of the tools, materials, and techniques used to design, produce, use, and assess systems of communication. Students will produce graphic and electronic media as they apply communication technologies. This course will also explore the various technical processes used to link ideas and people through the use of electronic and graphic media. Major goals of this course include an overview of communication technology, the way it has evolved, how messages are designed and produced, and how people may profit from creating information services and products. Students will explore mass media communication processes including radio and television broadcasting, publishing and printing activities, telecommunication networks, recording services, computer and data processing networks, and other related systems. Using the base knowledge students will use the design process to solve design projects in each communication area.

Introduction to Construction *4792*
TEH131, TEH132
- Grades 9-12
- 2 semesters, 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Introduction to Construction is a course that will offer hands-on activities and real world experiences related to the skills essential in residential, commercial, and civil building construction. During the course students will be introduced to the history and traditions of construction trades. The student will also learn and apply knowledge of the care and safe use of hand and power tools as related to

each trade. In addition, students are introduced to blueprint reading, applied math, basic tools and equipment, and safety. Students will demonstrate building construction techniques, including concrete and masonry, framing, electrical, plumbing, dry walling, HVAC, and painting as developed locally in accordance with available space and technologies. Students learn how architectural ideas are converted into projects and how projects are managed during a construction project in this course. Students study construction technology topics such as preparing a site, doing earthwork, setting footings and foundations, building the superstructure, enclosing the structure, installing systems, finishing the structure, and completing the site. Students also investigate topics related to the purchasing and maintenance of structures, special purpose facilities, green construction, and construction careers.

Introduction to Design Processes *4794*
TEH332, TEH333
- Grades 9-12
- 2 semesters, 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Introduction to Design Processes is a course that specializes in modern design and engineering processes with a focus on creative problem solving in developing, testing, communicating, and presenting post-evaluation of products. Students use the design process to analyze research, develop ideas, and produce product solutions. This process gives a framework through which they design and manufacture tests, and present their ideas. Students will demonstrate and utilize design principles and elements for visual presentation. Designing aspects will also cover aesthetics, ergonomics, the environment, safety, and production. The design process is a core-learning tool for many courses enabling the student to solve problems in a systematic, logical, and creative manner. Students develop a good understanding of the way the process helps them think creatively and develop aesthetic ideas. The design process encourages the students to engage in higher level thinking to create solutions for many types of problems.

Introduction to Transportation *4798*
TEH121, TEH122
- Grades 9-12
- 2 semesters, 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Introduction to Transportation is an introductory course designed to help students become familiar with fundamental principles in modes of land, sea, air, and space transportation, including basic mechanical skills and processes involved in transportation of people, cargo, and goods. Students will gain and apply knowledge and skills in the safe application, design, production, and assessment of products, services, and systems as it relates to the transportation industries. Content of this course includes the study of how transportation impacts individuals, society, and the environment. This course allows students to reinforce, apply, and transfer their academic knowledge and skills to a variety of interesting and relevant transportation related activities, problems, and settings.

PROJECT LEAD THE WAY – ENGINEERING ACADEMY

Greenfield-Central High School has joined with a national pre-engineering program to offer college credit courses that are designed to better prepare students for college engineering coursework. Project Lead The Way, or PLTW, is a collaborative effort of the math, science, and technology departments.

Project Lead The Way has developed a four year sequence of courses which, when combined with college preparatory mathematics and science courses in high school, introduces students to the scope, rigor, and discipline of engineering and engineering technology prior to entering college. It is recommended that students successfully complete Algebra in the 8th grade. Courses are counted as Core 40 directed electives. These can be applied to the Academic Honors Diploma or Technical Honors Diploma. Competencies are defined by Project Lead The Way, Inc. Upon successful completion of each PLTW course and the exit exam, students may receive credits at no cost from the following universities: Purdue University, Indiana State University, IUPUI, University of Southern Indiana, Ivy Tech (dual credit), and Rochester Institute of Technology.

Students must earn a C+ or better in all PLTW - Engineering courses to continue in the program.

Required courses:

9th Grade: IED – Introduction to Engineering Design
10th Grade: POE – Principles of Engineering
11th Grade: DE – Digital Electronics ***and*** <u>one</u> of the following:
AE – Aerospace Engineering
CEA – Civil Engineering and Architecture
ES – Environmental Sustainability
12th Grade: EDD – Engineering Design and Development

Introduction to Engineering Design PLTW *4812*
TEH160, TEH161
- Grades 9-10
- 2 semesters, 2 credits
- **Dual credit and weighted grade**
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Introduction to Engineering Design PLTW is an introductory course which develops student problem solving skills using the design process. Students document their progress of solutions as they move through the design process. Students develop solutions using elements of design and manufacturability concepts. They develop hand sketches using 2D and 3D drawing techniques using Computer Aided Design (CAD). **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead The Way network and follow all training and data collection requirements.**

Principles of Engineering PLTW *4814*
TEH260, TEH261
- Grades 10-11
- 2 semesters, 2 credits
- **Dual credit and weighted grade**
- Recommended Prerequisites: Introduction to Engineering Design or permission of the instructor
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas
- Qualifies as a quantitative reasoning course

Principles of Engineering PLTW is a course that focuses on the process of applying engineering, technological, scientific, and mathematical principles in the design, production, and operation of products, structures, and systems. This is a hands-on course designed to provide students interested in engineering careers to explore experiences related to specialized fields such as civil, mechanical, and materials engineering. Students will engage in research, development, planning, design, production, and project management to simulate a career in engineering. The topics of ethics and the impacts of engineering decisions are also addressed. Classroom activities are organized to allow students to work in teams and use modern technological processes, computers, CAD software, and production systems in developing and presenting solutions to engineering problems. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead The Way network and follow all training and data collection requirements.**

Digital Electronics PLTW *4826*
TEH350, TEH351
- Grades 11-12
- 2 semesters, 2 credits
- **Dual credit and weighted grade**
- Recommended Prerequisites: Introduction to Engineering Design and Principles of Engineering, or permission of the instructor
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas
- Qualifies as a quantitative reasoning course

Digital Electronics PLTW is a course of study in applied digital logic that encompasses the design and application of electronic circuits and devices found in video games, watches, calculators, digital cameras, and thousands of other devices. Instruction includes the application of engineering and scientific principles as well as the use of Boolean algebra to solve design problems. Using computer software that reflects current industry standards, activities should provide opportunities for students to design, construct, test, and analyze simple and complex digital circuitry software that will be used to develop and evaluate the product design. This course engages students in critical thinking and problem-solving skills, time management and teamwork skills. **NOTE: Use of the PLTW**

Course number is limited to schools that have agreed to be part of the Project Lead The Way network and follow all training and data collection requirements.

Aerospace Engineering PLTW *4816*
TEH460, TEH461
- Grades 11-12
- 2 semesters, 2 credits
- **Dual credit and weighted grade**
- Recommended Prerequisites: Introduction to Engineering Design and Principles of Engineering, or permission of the instructor
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas
- Qualifies as a quantitative reasoning course

Aerospace Engineering PLTW should provide students with the fundamental knowledge and experience to apply mathematical, scientific, and engineering principles to the design, development, and evolution of aircraft, space vehicles, and their operating systems. Emphasis should include investigation and research on flight characteristics, analysis of aerodynamic design, and impact of this technology on the environment. Classroom instruction should provide creative thinking and problem-solving activities using software that allows students to design, test, and evaluate a variety of air and space vehicles, their systems, and launching, guidance, and control procedures. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead The Way network and follow all training and data collection requirements.**

Civil Engineering and Architecture PLTW *4820*
TEH500, TEH501
- Grades 11-12
- 2 semesters, 2 credits
- **Dual credit and weighted grade**
- Recommended Prerequisites: Introduction to Engineering Design and Principles of Engineering, or permission of the instructor
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas
- Qualifies as a quantitative reasoning course

Civil Engineering and Architecture PLTW introduces students to the fundamental design and development aspects of civil engineering and architectural planning activities. Application and design principles will be used in conjunction with mathematical and scientific knowledge. Computer software programs should allow students opportunities to design, simulate, and evaluate the construction of buildings and communities. During the planning and design phases, instructional emphasis should be placed on related transportation, water resource, and environmental issues. Activities should include the preparation of cost estimates as well as a review of regulatory procedures that would affect the project design. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead The Way network and follow all training and data collection requirements.**

Environmental Sustainability PLTW *4818*
SCH364, SCH365
CIP Code 14.0501
- Grades 11-12
- 2 semesters, 2 credits
- **Dual credit and weighted grade**
- Recommended Prerequisites: Introduction to Engineering Design and Principles of Engineering
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas

Environmental Sustainability PLTW is an activity, project, and problem-based course in which students investigate and design solutions to solve real-world challenges related to world food security, renewable energy, and clean drinking water. Students completing Environmental Sustainability will develop an understanding of the scientific and technological foundations for each of the problems. Students apply their knowledge and skills as they use an engineering design process to design and test solutions that help solve these global challenges. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead The Way network and follow all training and data collection requirements.**

Engineering Design & Development PLTW *4828*
TEH660, TEH661

- Grade 12
- 2 semesters, 2 credits
- **Dual credit and weighted grade**
- Recommended Prerequisites: Introduction to Engineering Design, Principles of Engineering Design, and one specialty course, or permission of the instructor
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors, and Core 40 with Technical Honors diplomas
- Qualifies as a quantitative reasoning course

Engineering Design and Development PLTW is an engineering research course in which students work in teams to research, design, test, and construct a solution to an open-ended engineering problem. The product development life cycle and a design process are used to guide the team to reach a solution to the problem. The team presents and defends their solution to a panel of outside reviewers at the conclusion of the course. The EDD course allows students to apply all the skills and knowledge learned in previous pre-engineering courses. The use of 3D design software helps students design solutions to the problem their team has chosen. This course also engages students in critical thinking, problem-solving, time management, and teamwork skills, which are valuable for students' future careers. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead The Way network and follow all training and data collection requirements.**