

Advanced Manufacturing Systems - CPS (AVM)

AVM 1100. Fundamental Measurement Analysis. (3 Hours)

Covers Measurement System Analysis (MSA), which is of critical importance to manufacturing. Its proper utilization allows companies to identify quality and production issues and to prioritize and to address them accordingly. Introduces fundamentals of measurement systems, statistical concepts, sources of variation, measurement strategies, and planning. Reviews and explores measurement system variability and techniques. Discusses linearity, repeatability, reproducibility, and production capability using Gage repeatability & reproducibility (R&R), process capability (Cp), and process capability index (Cpk).

AVM 1150. Fundamentals of Manufacturing Systems. (3 Hours)

Introduces the basic elements of manufacturing process including planning, operations, materials supply, quality control, process integration, and environmental compliance. Discusses advanced and micro-manufacturing methods including 3-D printing and other additive manufacturing methods. Evaluates design for manufacturing methods, computer integration, automation and robotics, as well as Industrial IoT, in technical and business aspects.

AVM 1200. Fundamentals of Safety, Health, and Environmental Issues. (3 Hours)

Presents a comprehensive overview of health and safety issues as they relate to the environment and the workplace. Introduces students to the scientific and technical foundations of the subject including environmental pollutants and biological, chemical, and physical agents. Policy decisions and safety regulations provide a solid basis for students to recognize hazards at the workplace and in the environment. Offers students an opportunity to become familiar with standard workplace policies, procedures, and guidelines. Covers personal protection, recording, and accident investigation procedures. Subjects are presented and discussed based on historical examples such as the Bhopal gas leak, the Chernobyl explosion, and others.

AVM 1990. Elective. (1-4 Hours)

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

AVM 2200. Composite Materials and Applications. (3 Hours)

Provides a comprehensive training covering fundamental principles, technologies, and applications of composite materials. Offers students an opportunity to gain an understanding of strengthening mechanisms in fiber, particle, metal-matrix, ceramic-matrix, carbon-carbon, and hybrid composites and to learn how to calculate elastic modulus, critical fiber length, and other parameters. Discusses design considerations of aramid-reinforced composites, such as Kevlar, and other composite materials in terms of their applications. Reviews applications of composite materials in aviation, defense, sports, and advanced manufacturing.

AVM 2250. Materials Performance and Applications. (3 Hours)

Offers students an opportunity to obtain a fundamental understanding of relationships of materials composition, structure, treatment, and performance. Relates these topics to manufacturing processes used to achieve targeted performance characteristics. Emphasizes materials characterization, data collection, processing, and analysis. Incorporates failure analysis into the discussion and reviews in terms of product performance, durability, and cost. Evaluates advanced surface engineering and design methods for improving product performance. Reviews materials performance in aerospace, robotics, and semiconductor industries.

AVM 2990. Elective. (1-4 Hours)

Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

AVM 3000. Materials Processing. (3 Hours)

Offers students an opportunity to learn the fundamental principles of materials processing. Discusses a variety of ferrous and nonferrous metals, alloys, ceramics, and plastics in terms of processing methods, technologies, and manufacturability. Considers microstructural changes related to product performance and specifications. Uses phase diagrams and isothermal transformational diagrams to explain materials transformations and properties. Evaluates thermal, mechanical, composite, joining, surface engineering, and other processing methods from the point of view of applications, scalability, and cost.

AVM 3100. Nondestructive Testing. (3 Hours)

Reviews and discusses fundamental principles of nondestructive testing (NDT) in-depth. NDT methods are an essential part of today's advanced inspection processes due to their efficiency, speed, and cost-effectiveness. Introduces radiation, optical, electromagnetic, acoustic, and other methods of NDT. Reviews manufacturing, materials, and medical applications. Presents recent advances in portable NDT equipment in terms of their use in manufacturing, quality control, and systems.

Prerequisite(s): MET 3300 with a minimum grade of D

AVM 3500. Business Operations and Supply Chain. (3 Hours)

Offers a look at real-world challenges faced in supply chain management. Explores gathering market data on an industry and creating a should cost model. Offers students an opportunity to gain exposure to pricing indices and realize risks that can impact businesses on a day-to-day basis. Uses tools such as SWOT analyses and Porter's Five Forces to promote strategic thinking. Expands into business continuity planning and scenario planning. Witnesses the importance of planning ahead on communication, backup plans, and safety stocks. Students are introduced to supply chain KPIs, prepared for negotiations, and participate in negotiations. Finally, offers students an opportunity to learn the business impacts of choosing to select a new vendor to add to an organization.

Prerequisite(s): MGT 2220 with a minimum grade of D-

AVM 4100. Mechatronics. (3 Hours)

Introduces students to design and other requirements of essence to advanced manufacturing engineers. Provides essential multidisciplinary information in mechanical, electrical, and computer engineering, as well as in electronics and in materials. Discusses sensors, actuators, and computer control systems and integration in view of application in different industries. Reviews robotics, automation, intelligent devices, and cloud integration as essential components of the next industrial revolution.

Prerequisite(s): MET 2000 with a minimum grade of D- ; (EET 3100 with a minimum grade of D- or EET 3300 with a minimum grade of D-)

AVM 4150. Automation 1. (3 Hours)

Offers an overview of the important concepts of industrial automation: analog/digital; input/output; continuous, synchronous, and asynchronous processes; components and hardware; process and machine systems; and automated machinery. Offers students an opportunity to gain thorough knowledge of the internals of a Programmable Logic Circuit (PLC), as well as an opportunity to create simple programs for a set of control requirements. Requires students to undertake a project to design a control scheme, program the same on PLC simulation software, and test the operation of that program.

Prerequisite(s): EET 3300 with a minimum grade of D-

AVM 4160. Automation 2. (3 Hours)

Continues AVM 4150. Presents an overview of the important concepts of industrial automation: analog/digital; input/output; continuous, synchronous, and asynchronous processes; components and hardware; process and machine systems; and automated machinery. Examines the internals of a programmable logic circuit and how to create simple programs for a set of control requirements. Requires students to undertake a project to design a control scheme, program the same on PLC simulation software, and test the operation of that program.

Prerequisite(s): AVM 4150 with a minimum grade of D-

AVM 4250. Hydraulics and Pneumatics. (3 Hours)

Examines energy transmission based on hydraulics and pneumatics. Introduces basic fluid dynamics and offers students an opportunity to gain basic knowledge of functionality and design of pumps, motors, cylinders, and valves. Studies calculation methods for hydraulic/pneumatic components and systems, as well as basic system principles for control of position, velocity and speed, force and torque, and power. Emphasizes measurement methods in hydraulic and pneumatic systems.

Prerequisite(s): MTH 2105 with a minimum grade of D- ; PHY 1200 with a minimum grade of D-

AVM 4300. Advanced Manufacturing and Additive Processes. (3 Hours)

Provides a comprehensive overview of manufacturing approaches and technologies used in today's industry, including one of the fastest-growing areas—additive manufacturing (AM). Offers students an opportunity to understand the fundamentals of AM and 3-D printing, the key AM processes, including technologies based on material extrusion, vat photopolymerization, powder bed fusion, and binder and material jetting. Focuses on benefits of rapid prototyping and its application to aerospace, automotive, consumer good business, and healthcare. Includes important design and fabrication considerations.

Prerequisite(s): AVM 1150 with a minimum grade of D