

## MANUFACTURING ENGINEERING TECHNOLOGY

### Manufacturing Engineering Technology

College of Science, Engineering & Technology  
Department of Automotive & Manufacturing Engineering Technology  
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The mission of the Manufacturing Engineering Technology (MET) degree program at Minnesota State Mankato, is to provide a broad-based education to enable graduates to enter a variety of globally competitive manufacturing careers to serve the needs of the citizens of Minnesota, and the world by:

- providing the highest quality education to prepare application-oriented graduates for career opportunities in both traditional and computer-automated manufacturing environments;
- encouraging and supporting faculty, and students to engage in scholarly activities and research that support effective and ethical transfer of technology;
- providing access to state of the art equipment, facilities, and methodologies, along with faculty expertise to benefit MET students; and
- engaging in partnerships with area industry and other constituencies to broaden access to the program for traditional and diverse populations, while supporting K-12 pipeline development.

**Program Description.** Manufacturing Engineering Technology (MET) degree program awards a Bachelor of Science degree (BS) to successful students through a four-year curriculum.

“Engineering Technology” is the profession in which knowledge of the applied mathematical and natural sciences gained by higher education, practical experience, and competence developed in a specific field, is devoted to application of engineering principles and the implementation of technological advances for the benefit of humanity through its focus on product improvement, manufacturing, and automation of technological processes and operational functions. - Engineering Technology Council of the American Society of Engineering Education (ASEE).

“Modern manufacturing activities have become exceedingly complex because of rapidly increasing technology and expanded environmental involvement. This, coupled with increasing social, political, and economic pressures, has increased the demand for highly skilled manufacturing technologists, engineers, and managers.” – Society of Manufacturing Engineers Fundamentals of Manufacturing 2005. Students use major study areas of applied mathematics, engineering sciences and materials, product design, manufacturing processes, automated systems and controls, quality, manufacturing management and personal and professional effectiveness to perform in careers requiring the application of scientific and engineering knowledge and methods. Combined with technical skills in support of engineering activities; student careers often fit in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer. Engineering technology is oriented less toward theory and more toward practical applications. - American Society of Engineering Education (ASEE).

Manufacturing involves plans, materials, personnel, and equipment which are transformed in some way that adds value. Students require leadership and managerial skills necessary to enter careers in process and systems design, manufacturing operations, maintenance, technical sales or service functions. The curriculum concentrates on the study of individual subsystems and their overall optimization of cost, quality, speed, and flexibility goals for the success of a manufacturing enterprise. Students from the program are currently employed in a wide variety of industries including medical, electronics, power systems, defense, and automotive. A list of companies and industry sectors employing MET graduates may be obtained from the Department Chair.

The Society of Manufacturing Engineers ([sme.org](http://sme.org)) is the lead professional society used in developing program criteria guiding program relevance and improve-

ment directions. Students are encouraged to take the Certified Manufacturing Technologist (CMfgT) exam in the senior year and pursue other certifications as their experience broadens.

The primary goal of the MET program is to provide all graduates with the solid technical foundation necessary to insure their success in a wide variety of employment opportunities. To accomplish this goal, program outcomes and objectives are defined and assessed for continuous improvement. These are consistent with the mission of the university and college and reviewed by the Industrial Advisory Board on an annual basis. They are as follows:

**Program Outcomes.** Students at the time of graduation are prepared to:

1. apply knowledge, problem solving techniques, and hands-on skills in the assessment, design, application, and continuous improvement of manufacturing systems, including automated manufacturing, processes, process controls, manufacturing operations, management, and systems integration.
2. specify and implement hard and soft technologies to solve manufacturing system problems using creativity in design.
3. demonstrate the application of their knowledge of mathematics, statistics, science, engineering and technology.
4. conduct, analyze and interpret experiments and apply results to improve processes and systems.
5. recognize the need and develop the skills for life-long learning.
6. communicate effectively across all design and management interface levels of an organization.
7. function effectively in a team and or leadership environment.
8. implement accepted professional standards of integrity and ethical conduct.
9. understand and engage in behavior which respects diversity and global cultures.
10. practice timeliness and quality with regard to work requirements

**Program Objectives.** Graduates two to three years into their careers should have the foundation to:

1. deliver products, services, and support to both internal and external organizations by applying technical knowledge, problem solving techniques and hands-on skills in traditional and emerging areas of manufacturing.
2. actively participate in on-going professional development, professional growth and increasing professional responsibility.
3. effectively communicate ideas to technical and non-technical people.
4. perform, lead, and manage in cross-functional teams
5. work within the accepted standards of professional integrity and conduct.
6. design, analyze, build, and test virtual or real models in product development and continuous improvement environments.
7. implement, and continuously improve cost, quality, time, and flexibility goals using world class management methodologies.

**Accreditation.** The MET degree program is accredited by the Technology Accreditation Commission (TAC) of the Accreditation Board for Engineering and Technology (ABET), 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, Phone: 410-347-7700, Fax: 410-625-2238, e-mail: [tac@abet.org](mailto:tac@abet.org), Website: <http://www.abet.org>

**Admission to the MET Major** is granted by the AMET Department. Admission to the major is required to register for 300-level courses. Minimum requirements for acceptance into the MET major include a cumulative GPA of 2.0 or higher and the completion of the following courses with a grade of “C” (2.0) or higher: CHEM 104, CMST 100 or CMST 102, EET 133, ENG 101, MET 104, MET 142, MET 144, MET 177, MATH 121, MATH 127, STAT 154, PHYS 211, PHYS 212.

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## POLICIES/INFORMATION

**GPA Policy.** A minimum GPA of 2.0 is required.

Refer to the College regarding required advising for students on academic probation.

**Department Grade Policy.** All courses in the MET Major, and the required Communications, Basic Science, and Mathematics courses must be completed with a grade of "C" or better.

**P/N Grading Policy.** No more than 1/4 of all undergraduate credits may be P/N, except those courses offered P/N only.

**Residency.** A minimum of 50 percent of the credits for a major or minor in Manufacturing Engineering Technology must be taken at Minnesota State Mankato.

Prerequisites and co-requisites must be observed unless written permission is obtained from the instructor and the Department of AMET. A flow chart of prerequisites is available in the Department Office.

The scheduling of all department courses is done annually, based on enrollment and staffing. To obtain a current class schedule, contact the Department.

## MANUFACTURING ENGINEERING TECHNOLOGY BS

### Required General Education

CHEM 104	Introduction to Chemistry (3)
CMST 100	Fundamentals of Communication (3) <b>OR</b>
CMST 102	Public Speaking (3)
ENG 101	Composition (4)
MATH 115	Precalculus Mathematics (4)
MATH 121	Calculus I (4)
PHYS 211	Principles of Physics I (4)
STAT 154	Elementary Statistics (3)

Please see advisor for additional General Education requirements.

### Prerequisites to the Major

ENG 271	Technical Communication (4)
EET 113	DC Circuits (3)
MATH 127	Calculus II for Engineering Technology: Integration (2)
PHYS 212	Principles of Physics II (4)

### Major Common Core

AET 334	Fluid Power (3)
AET 378	Composite Materials (3)
MET 104	Introduction to Manufacturing Engineering Technology (1)
MET 142	Computer Aided Design (3)
MET 144	Product Development and Design (3)
MET 177	Materials Processing I and Metallurgy (4)
MET 277	Materials Processing II (4)
MET 323	Statics (3)
MET 324	Strength of Materials and Dynamics (4)
MET 325	Project Management (2)
MET 341	Advanced Computer Aided Design (4)
MET 347	Manufacturing Automation (3)
MET 386	Metrology for Engineering Technologist (3)
MET 407	Manufacturing Resource Planning and Control (3)
MET 421	Project Valuation and Justification (2)
MET 423	Ergonomics and Work Measurement (4)
MET 424	Industrial Safety (2)
MET 426	Logistics and Transportation (3)
MET 427	Quality Management Systems (3)
MET 448	Computer Integrated Manufacturing (3)
MET 488	Senior Design Project I (2)
MET 489	Senior Design Project II (2)

**Minor Required: None.**

## MANUFACTURING ENGINEERING TECHNOLOGY MINOR

### Required for Minor

MET 104	Introduction to Manufacturing Engineering Technology (1)
MET 142	Computer Aided Design (3)
MET 177	Materials Processing I and Metallurgy (4)

### Additional electives required for minor (8 credits)

### Required for Minor (Electives, 8 credits)

Choose 8 credits of MET/AET courses from major core courses.

## COURSE DESCRIPTIONS

### **MET 104 (1) Introduction to Manufacturing Engineering Technology**

An overview of careers, technology and requirements for individuals interested in Manufacturing Engineering Technology. Hands-on experience is gained in a variety of new technologies. Careers in engineering and technology are examined along with professional organizations and ethics. The course is intended as a first step toward a career in manufacturing.

### **MET 142 (3) Computer Aided Design**

Computer Aided Designing covers a process of developing and analyzing solid parametric models for mechanical applications. Course includes solving technical designing problems based on real-world applications as well as creation of technical documentation: working and assembly drawings. Introduction to the Finite Element Analysis is included in the course.

### **MET 144 (3) Product Development and Design**

Analysis and application of key steps in the product realization process. External and internal factors affecting strategic product life-cycle management are emphasized along with the relationship of design to marketing and manufacturing activities and product development cost implications. Students work individually and in teams on a competitive semester-long design project assessing customer needs, product specifications, generation and selection of concepts, prototype development, test and product production planning. Concentrates on development of verbal, written and e-communication skills. Provides knowledge and practice in conducting effective project management.

### **MET 177 (4) Materials Processing I and Metallurgy**

Fundamentals of machine technology and metallurgy. Theory and step-by-step procedures are used to provide instruction on how to turn materials into products. Students learn to perform machining on a lathe, mill, and drill press, and also inspect the products. Basics of metal processing, plastic molding, and other processes are discussed. Extra lab time is required.

### **MET 222 (3) Introduction to Statics and Mechanics of Materials**

Course introduces the design theory and applied principles of force equilibrium, stress and strain, shear, bending moments, force diagrams, deformations of beams, and stress/strain analysis.

Pre: PHYS 101, MATH 115

Fall, Spring

### **MET 277 (4) Materials Processing II**

A study of the principles of manufacturing technologies, measurements and equipment used in processing of an end product. Advanced manufacturing processes including casting, forging, sheet metal forming, material removal, joining, and powder metals are discussed. Topics also include materials treatment, preparation, and design for manufacture. Extra lab time is required.

Pre: MET 177

### **MET 323 (3) Statics**

This course covers principles of statics, force equilibrium, analysis of structures, friction, centroid, centers of gravity, and moment of inertia.

Pre: PHYS 211 and MATH 121

Fall, Spring, Summer

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### **MET 324 (4) Strength of Materials and Dynamics**

This course covers stress and strain, torsion, bending of beams, shearing stresses in beams, compound stresses, principal stresses, deflections of beams, columns, connections, and pressure vessels. Topics also include kinematics and kinetics of rigid bodies, work, energy and power.

Pre: MET 323

Fall, Spring, Summer

### **MET 325 (2) Project Management**

Planning, organizing, directing, and reporting for industrial, team-based project management are studied in relationship to organizational factors of structure and culture.

Pre: ENG 271, MET 277, STAT 154

Spring

### **MET 341 (4) Advanced Computer Aided Design**

This course emphasizes the use of CAD in design, analysis, and manufacturing. Topics include component design, mechanics, animation, finite element analysis, CNC machining and rapid prototyping using CAD.

Pre: MET 142

### **MET 347 (3) Manufacturing Automation**

CNC programming, computer-aided manufacturing (CAM), flexible automations, machining centers, robotics, programmable logic controllers, tooling systems. Extra lab time is required.

Pre: AET 334, EET 113, MET 277, MET 341, MET 323

### **MET 386 (3) Metrology for Engineering Technologist**

Quality and its continuous improvement is supported by metrology, statistical process control, and geometric dimensioning and tolerancing. This course presents these topics and their integration into operations.

Pre: MATH 121, STAT 154. Admission to AET/MET major.

Fall

### **MET 398 (0) Co-Operative Experience**

Enrolling for this option allows to work full-time for up to one semester in a field related to one's major. No credit is awarded for this work experience but enrolled students maintain full-time student status. For more information, please contact the department internship coordinator or the department chair.

### **MET 407 (3) Manufacturing Resource Planning and Control**

Strategic plant resource management for global manufacturing. Approaches examine and practice continuous improvements to the value stream related to design integration, production scheduling, staffing, facilities planning, and material flow.

Pre: MET 325

### **MET 421 (2) Project Valuation and Justification**

Principles of engineering economy are enhanced through spreadsheet modeling and proposal development of the justification of capital projects.

Pre: MET 325

Fall

### **MET 423 (4) Ergonomics & Work Measurement**

Investigates work design and automated and manual operations. Measurement, and development of design-based solutions for reduction of environmental stresses to the human body through worker-machine systems analysis are applied. Regulatory, legal, and ethical issues are reviewed in the context of global manufacturing applications.

Pre: STAT 154

### **MET 424 (2) Industrial Safety**

Techniques of developing safety practices in an industrial environment. Topics include OSHA, current legislation, cost analysis, personal protection, employee selection, psychological aspects, product safety, hazard materials and catastrophe control.

### **MET 426 (3) Logistics and Transportation**

Fundamentals of logistics: control of materials, WIP, finished goods, costs of logistics. Theory and step-by-step procedures are used to analyze logistic systems, material handling, packaging, and transportation, including global logistics.

Pre: MET 407

Spring

### **MET 427 (3) Quality Management Systems**

This course is focused on quality assurance systems, management philosophies, methodology, function and impact of quality systems in manufacturing operations. Development and application of statistical process control tools.

Pre: STAT 154

### **MET 448 (3) Computer Integrated Manufacturing**

This course covers the following topics: manufacturing systems integration techniques, Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM), Computer-Aided Process Planning (CAPP), Direct Numerical Control (DNC), Flexible Machining Systems (FMS), Automated Storage and Retrieval Systems (ASRS), Automated Guided Vehicles (AGV) and Robotics.

Pre: MET 347, PHYS 212

Fall

### **MET 488 (2) Senior Design Project I**

An examination of manufacturing design and research. Students refine their design proposal and begin their senior design projects. This course also prepares the student for MET 489, Senior Design Project II, where the design proposal, design project, and final report are completed. This course should be taken in the fall semester of the senior year.

Pre: ENG 271, MET 144, MET 277, MET 325

### **MET 489 (2) Senior Design Project II**

Completion of the capstone design project; a continuation of MET 488.

Pre: MET 347, MET 421

### **MET 492 (1-4) Seminar: Manufacturing**

Selected manufacturing topics.

### **MET 497 (1-10) Internship: Manufacturing**

Manufacturing work experience in an area pertinent to the student's objective. Consent of internship coordinator required prior to the beginning of employment and registration. Typically done between the junior and senior year.

Pre: 50% of major

### **MET 499 (1-4) Individual Study**