

## Manufacturing Engineering Technology

*College of Science, Engineering & Technology*

*Department of Automotive & Manufacturing Engineering Technology*

205 Trafton Science Center E

Phone: 507-389-6383

Fax: 507-389-5002

Web site: [www.cset.mnsu.edu/met](http://www.cset.mnsu.edu/met)

Chair: Dr. Ann Goebel, M.S.

Craig Evers, Ph.D., P.E., Bruce Jones, Ph.D., Andrzej Markowski, Ph.D., Gary Mead, M.S., Harry Petersen, Ph.D., P.E., Paul Sullivan, Ph.D., P.E.

The mission of the Manufacturing Engineering Technology (MET) degree program at Minnesota State University, 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;
- equipping or developing 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 improvement 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.** MET 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.
3. demonstrate the application of their knowledge of mathematics, statistics, science, engineering and technology.
4. conduct, analyze and interpret experiments and apply experimental results to improve processes and systems.
5. recognize the need and develop the skills for life long learning.
6. communicate effectively with others.
7. function effectively in a team and or leadership environment.
8. implement accepted professional standards of integrity and ethical conduct.

**Program Objectives.** MET 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 ongoing 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), web: <http://www.abet.org>

**Admission to Major** is granted by the department. Minimum university admission requirements are:

- a minimum of 32 earned semester credit hours.
- a minimum cumulative GPA of 2.00 ("C").

Contact the department for application procedures.

### MANUFACTURING ENGINEERING TECHNOLOGY BS

#### Required General Education (25 credits):

ENG 101	Composition (4)
SPEE 100	Fundamentals of Speech Communication (3) <b>OR</b>
SPEE 102	Public Speaking (3)
MATH 115	Precalculus Mathematics (4)
MATH 121	Calculus I (4)

## MANUFACTURING ENGINEERING TECHNOLOGY

PHYS 211 Principles of Physics I (4)  
CHEM 104 Introduction to Chemistry (3)  
STAT 154 Elementary Statistics (3)  
plus additional B.S. General Education as required by university

### Required Support Courses (12 credits):

ENG 271 Technical Communication (4)  
MATH 127 Calculus II for Engineering Technology: Integration (2)  
PHYS 212 Principles of Physics II (4)  
CS 171 Introduction to C++ Programming (2)

### Required for Major (60 credits):

MET 104 Introduction to Manufacturing Engineering Technology (1)  
MET 142 Computer Aided Drafting (3)  
MET 144 Product Development and Design (3)  
MET 177 Materials Processing I and Metallurgy (4)  
MET 277 Materials Processing II (4)  
MET 322 Statics, Dynamics, and Mechanics of Materials (5)  
MET 341 Advanced Computer Aided Design (4)  
MET 347 Manufacturing Automation (4)  
MET 387 Junior Design Project (1)  
MET 407 Manufacturing Resource Planning and Control (4)  
MET 423 Ergonomics and Work Measurement (4)  
MET 424 Industrial Safety (2)  
MET 425 Project and Value Management (4)  
MET 426 Logistics and Transportation (2)  
MET 427 Quality Management Systems (3)  
MET 488 Senior Design Project I (1)  
MET 489 Senior Design Project II (2)  
AET 334 Fluid Power (3)  
AET 378 Composite Materials (3)  
EET 113 DC Circuits (3)

**Minor Required: None.**

### MANUFACTURING ENGINEERING TECHNOLOGY MINOR

**Total Credits (16 credits)**

#### Required for Minor (8 credits):

MET 104 Introduction to Manufacturing Engineering Technology (1)  
MET 142 Computer Aided Drafting (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.

### 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 bi-annually, based on enrollment

and staffing. To obtain a current class schedule, contact the Department.

### 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 Drafting

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.

Coreq: MET 141

#### MET 145 (2) Computer Graphics

A course intended for engineering students. Principles of CAD along with engineering applications are covered.

#### 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.

Coreq: MET 141

#### 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.

Pre: MET 177, Coreq: MET 245

#### MET 322 (5) Statics, Dynamics, & Mechanics of Materials

Course covers principles of force equilibrium, stress and strain, shear and torsion, bending moments, force diagrams, deformations of beams, stress/strain analysis, kinematics and kinetics of rigid bodies, work, energy, and power.

Pre: PHYS 211 and MATH 121

#### 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, on-line collaboration, CNC machining and rapid prototyping using CAD.

#### MET 345 (1-2) CAD Projects

Advanced applications of computer aided design. Solid and parametric systems.

Pre: MET 245

#### MET 347 (4) Manufacturing Automation

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

Pre: MET 277; Coreq: CS 171, MATH 121

**MET 387 (1) Junior Design Project**

An examination of manufacturing design and research, along with a review of topics such as ethics, professionalism, measurement, statistics, and career development/placement. This course prepares the student for MET 488, Senior Design Project I, where the design proposal, design project and final report are completed.

Pre: MET 104; Coreq: STAT 154

**MET 407 (4) Manufacturing Resource Planning and Control**

Planning and control of plant resources in globally competitive manufacturing environments. Studies hard and soft technology assets applied to systematic resource management in the manufacturing supply chain. Approaches to manufacturing problems related to design integration, production scheduling, staffing, plant layout, material flow, and inventory issues are examined. Evaluation of demand patterns and product mix are discussed in selection and application of traditional, contemporary or mixed production and inventory control methods. Examines arrangement and layout of physical facilities and modern techniques for efficient utilization of production space. Decision making tools and techniques to engage employees in product production improvement are studied and applied through a variety of simulation methods.

Pre: MET 245 and MET 277

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

Investigates work design and environmental stresses from heat, noise, vibration, repetitive motion, illumination, force, and posture in worker-machine systems. Principles and practical applications of time and motion studies in manual and automated work settings are studied. Regulatory and legal implications are reviewed in the context of human factors. Presents ethical behavior and dilemmas in organizations. The impact of work design on quality, throughput, safety, ergonomics and scheduling are linked with methods of improvement. Concepts of work simplification, standardization, job rating and time study are simulated through software manipulation.

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 425 (4) Project and Value Management**

Studies planning, organizing, directing, and reporting for industrial project management. Organizational factors of structure and culture and the impact each has on project management are evaluated. Students work through situational case studies individually and in project teams, using project management tools. Students develop their interpersonal and group dynamics skills for effectively leading project teams and create investment proposals for analysis using time value of money, and cash flows. Principles of engineering economy are enhanced through spreadsheet modeling for industry applications.

Coreq: MET 407

**MET 426 (2) Logistics and Transportation**

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

**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: Basic manufacturing and design knowledge for industry sector discipline and elementary statistics.

**MET 488 (1) 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.

Coreq: STAT 154

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

A continuation of MET 488.

Pre: MET 488, ENG 271

**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**