

**B.S. in Mechanical Engineering Degree Program
Handbook
(Fall 2008)**

**The University of New Mexico
School of Engineering
Department of Mechanical Engineering**

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The School of Engineering at the University of New Mexico is ranked among the top engineering schools in the country. Our Mechanical Engineering faculty have degrees from some of the best institutions in the world. We are ABET accredited, and we take great pride in the quality and breadth of our programs. This is apparent through the successes of our many outstanding alumni. We recognize that education is a lifelong process; let us help you with your educational journey.

College is an exciting and challenging part of your life; it takes dedication and marshaling of your energies to achieve your degree. As a student, your goal should be to become a professional, not just to take courses. We look forward to working with you while you are here and after you graduate, helping you gain the knowledge and build the skills necessary to achieve all your life's goals.

1 Introduction

This handbook provides information about the *Bachelor of Science in Mechanical Engineering (BSME)* degree program, offered by the Department of Mechanical Engineering (ME).

Students are expected to study this document carefully, and consult with their ME advisors if there are any questions.

The BSME program is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). The acronym "ABET", as used in this handbook, is meant to refer to the EAC of ABET in all cases.

Successful completion of the ME program (or other ABET accredited engineering programs) with a B.Sc. degree is the first step to becoming a licensed professional engineer. Various states require engineering licenses for those individuals who publicly represent themselves as engineers. This requirement is for the purpose of protecting the public interest. Therefore, all ABET accredited programs must meet various minimum standards. The purpose of this document is to provide students with the information which supersedes and supplements the University of New Mexico (UNM) Catalog.

2 Career Opportunities

Mechanical Engineering is a very diversified profession that is concerned with the research and development of new technologies, adoption of technologies, design, analysis, and operation of machines, hardware, software, and systems. It has been and continues to be a field that provides challenging, exciting, and rewarding career opportunities. Mechanical engineers apply mathematics, physics, chemistry, and other sciences, together with computers, instrumentation, and other tools to create a wide range of hardware, software, and systems.

The continuing need to improve and design products and systems makes the mechanical engineering profession essential and very much in demand. The B.Sc. degree program in ME provides graduates with the necessary skills to compete in this rapidly changing discipline. In addition, the BSME provides a solid, scientific foundation for other degrees such as the MBA, MD, DDS, etc.

The present demand for MEs is excellent, and the employment rate for UNM graduates continues to be high. The demand is expected to remain strong, with continued economic expansion.

Mechanical Engineers are employed by large corporations as well as by small companies, in various governmental agencies and laboratories, and as consulting engineers. Many mechanical engineers have started and developed successful companies with products that meet society's needs and desires. The career work is varied; it includes research, development,

design, manufacturing, sales, and management. It also provides professional opportunities for interaction among engineering disciplines and sciences. Industries employing mechanical engineers include public utilities, aerospace, computer, heating and air conditioning, automotive, transportation, and construction. Mechanical engineers are also employed by Government laboratories involved in activities as wide as developing alternative energy sources, oceanographic studies, space missions, aircraft testing, weapons development, and atmospheric research. Students are urged to become familiar with the types of assistance provided by the UNM Career Services (located in Student Services Center) in relation to both the Co-operative Education Program and employment.

3 Admission to Baccalaureate Program

Students must be admitted for study at the University of New Mexico, and must have completed approximately one year of the freshman year subjects, before applications are processed for admission to the Baccalaureate Program in Mechanical Engineering. Approval from the ME Department is required. Applicants must consult the appropriate departmental advisor for evaluation of academic work before admission can be completed.

At least 18 semester hours of freshman year technical subjects (Computer Science, Engineering, Math, Physics, and Chemistry) are required by the School of Engineering for admission into degree programs. A minimum grade-point average of 2.50 in those technical courses is required for admission to undergraduate study in Mechanical Engineering. A total of 26 semester hours (technical plus non-technical courses) applicable to the BSME degree is required for admission with a grade-point average of at least 2.20. All applicants must have completed English 101 or its equivalent before admission. All courses required in the BSME program must have grades of C- or better for satisfying both admission and graduation requirements, except a C (or better) in Core Curriculum courses is required.

Students transferring from other units of the School of Engineering must have a GPA of at least 2.50 on all required technical course work applied towards the BSME degree before being admitted to Mechanical Engineering.

Transfer students from other universities or from other colleges at UNM must complete at least 18 semester hours of required technical (Computer Science, Engineering, Math, Chemistry, and Physics) courses applicable towards the BSME degree at UNM with a grade-point average of at least 2.5 before being admitted to Mechanical Engineering.

For all transfer students, a grade-point average of 2.20 is required for all (technical plus non-technical) courses taken at UNM that are applicable towards the BSME degree before being admitted to Mechanical Engineering.

4 Advisement

Pre-major engineering students who have indicated ME as their intended major are advised by the ME Undergraduate Advisor. Upon admission to the ME program (until graduation), each student will be assigned to one of the faculty members for advisement. Students in the ME program are required to seek advisement from their designated advisor each semester during the pre-registration period.

The purpose of this session is to help the student with any problems he/she may have in his/her program of studies. Students will HAVE AN ADVISEMENT HOLD AND not be allowed to register until they have consulted with their advisor.

5 Probation, Suspension, and Dismissal

The School of Engineering (SOE) uses two probation procedures:

1. A student enrolled in the SOE will be placed on *Academic Probation* when the cumulative GPA of all work taken at UNM falls below 2.0.
2. A student enrolled in the SOE and admitted to the ME Department will be placed on *SOE Probation* under any of the following conditions:
 - When a cumulative GPA based on work taken at UNM and accepted towards the BSME degree falls below a 2.00 (overall) or below 1.50 in the most recent semester.
 - When the student is making unsatisfactory progress towards the BSME degree.

Students on probation are subject to suspension from UNM or dismissal from the SOE. (See the UNM Catalog.)

6 Program Goals

The principal goal of the BSME program is to provide students with the fundamentals of mechanical engineering to insure they will have a solid base for an engineering career. This includes building a sufficient knowledge, creative and analytical capability, and communication skills so that the graduates can continue to expand their learning as their fields of interest and the scope of mechanical engineering changes. Our core courses are intended to provide a broad base so that those who terminate their formal education with the BSME degree can continue to grow intellectually. Likewise, the base provides insight into fields that students may choose to study at the graduate level.

This goal is met by a curriculum in which fundamental knowledge of earlier years is applied in later engineering courses. Specifically, the goals for the BSME program at UNM are closely linked to the criteria set forth by ABET. The following statement has been adopted by the Mechanical Engineering Faculty to represent our educational goals.

Objectives

The Department of Mechanical Engineering will produce graduates who:

- A. *apply modern mathematics, science, engineering, and technology to solve a wide variety of mechanical engineering problems and work professionally in a changing environment.*
- B. *work collaboratively, communicate effectively, and think creatively in the design and analysis of mechanical and thermal systems.*
- C. *behave ethically and professionally in addressing societal needs.*
- D. *assume leadership roles in industry, research, academia, and government.*

Outcomes

The Department of Mechanical Engineering at the University will provide students with a quality mechanical engineering education. Each Mechanical Engineering student will demonstrate the following by the time of graduation:

- a. *an ability to apply their knowledge of mathematics, science, and engineering*
- b. *an ability to design and conduct experiments as well as analyze and interpret data*
- c. *an ability to design a system, component, or process that meets desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability*
- d. *an ability to function in multi-disciplinary teams*
- e. *an ability to identify, formulate, and solve engineering problems*
- f. *an understanding of professional and ethical responsibility*
- g. *an ability to communicate effectively*
- h. *the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*
- i. *a recognition of the need for and an ability to engage in life-long learning*
- j. *a knowledge of contemporary issues*
- k. *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice*

7 The BSME Curriculum

The BSME Curriculum is shown in Figure 1. It is the student's responsibility to fulfill all the degree requirements.

Students are responsible for reading and understanding the UNM Catalog. Entering students should especially read the sections which pertain to general academic regulations, School of Engineering (SOE) regulations, the requirements for the BSME program, and the course descriptions, including the prerequisites and co-requisites.

Figure 1 - Curriculum in Mechanical Engineering - Fall 2003

Total credit hours required for graduation: 130

Freshman - 1st semester 17 credit hours

Chem 121L General Chemistry (4)
Engl 101 Comp I: Exposition (3)
ME 160L Mech Engr Design I (3)
Math 162L Calculus I (4)
Core Humanities Elective (3)

Sophomore - 1st semester 16 credit hours

ME 260L Mech Engr Design II (3)
CE 202 Engineering Statics (3)
Phys 161 General Physics II (3)
Math 264L Calculus III (4)
ME 217 Energy, Env. & Society (3)

Junior - 1st Semester 16 credit hours

ME 317L Fluid Mech (4)
ME 301 Thermodynamics (3)
CE 302 Mechanics of Materials (3)
Math Elective (3)⁴
Econ 105 Intro to Macroeconomics (3)

Senior - 1st semester 16 credit hours

ME 320L Heat Transfer (4)
ME 459 Mech Engr Design IV (3)
ME 380 Mech Control Systems (3)
Mech Engr Science Elective (3)¹
Core Fine Arts Elective (3)

Freshman - 2nd semester 17 credit hours

Chem 122L General Chemistry (4)
Engl 102 Comp II: Analysis & Arg (3)
Phys 160 General Physics I (3)
Math 163L Calculus II (4)
CS 151L Computer Prog Fund (3)

Sophomore - 2nd semester 16 credit hours

ME 306 Dynamics (3)
EECE 203L Circuit Analysis (3)
Math 316 Applied Ord Diff Eqns (3)
ME 318L Mech Engr Lab (4)
Core Writing & Speaking Elective (3)

Junior - 2nd semester 16 credit hours

ME 302 Appl Thermo -or- ME 314 Dyn Mach (3)
ME 360L Mech Engr Design III (3)
ME 357 Intro to Mech Vibrations (3)
ME 370 Engr Materials Science (3)
ME 352L Engr Materials Science Lab (1)
Core Second Language Elective (3)

Senior - 2nd semester 16 credit hours

ME 460 Mech Engr Design V (4)
Technical Elective (3)³
Mech Engr Tech Elective (3)²
Mech Engr Science Elective (3)¹
Core Humanities Elective (3)

FSAE Option

FSAE is a program in which the students design, build, and test a racing car. Students wishing to pursue the Formula SAE option, substitute the following curriculum for the second semester of their Junior year and both semesters of their senior year. All three FSAE courses must be completed for this option.

Senior - 1st semester 16 credit hours

ME 320L Heat Transfer (4)
ME 459 Mech Engr Design IV (3)
ME 380 Mech Control Systems (3)
ME 407 FSAE II (3)
Core Fine Arts Elective (3)

Junior - 2nd semester 16 credit hours

ME 302 Appl Thermo -or- ME 314 Dyn Mach (3)
ME 360L Mech Engr Design III (3)
ME 357 Intro to Mech Vibrations (3)
ME 370 Engr Materials Science (3)
ME 352L Engr Materials Science Lab (1)
ME 406 FSAE I (3)

Senior - 2nd semester 16 credit hours

ME 408 FSAE III (1)
Mech Engr Science Elective (3)¹
Mech Engr Tech Elective (3)²
Mech Engr Science Elective (3)¹
Core Humanities Elective (3)
Core Second Language Elective (3)

Students admitted or re-admitted to the Mechanical Engineering Department the Fall semester of 1998 or later are required to take the Fundamentals of Engineering (FE) exam during their Senior year.

¹ **“Mechanical Engineering Science Electives”** includes all Mechanical Engineering elective courses 300 level and above except for: ME 304, ME366, ME455, ME456, ME 463, ME484, ME485, or ME488. Undergraduate Problems, ME 451/452 and Special Topics courses, 461/462 must be approved by the Mechanical Engineering Undergraduate Advisor to be used as a Mechanical Engineering Science Elective.

² **“Mechanical Engineering Technical Electives”** include all Mechanical Engineering elective courses 300 and above.

³ **“Technical Elective”** may be selected from the mechanical engineering technical or science electives or from appropriate upper division (300 level and above) courses from Math/Statistics, Chemistry, Physics, Computer Science, and Engineering. Technical Electives may not be taken on the CR/NC grading option.

⁴ **“Math Elective”** course must be selected from Math 311, 312, 313, 314, 321, or Stat 345.

Figure 2 - Prerequisites for Required BSME Courses

COURSE	PREREQUISITE
Freshman	
Chem 121L General Chemistry (4)	Math 121 or 150 C or Better
Engl 101 Comp I: Exposition (3)	Appropriate ACT/SAT Score
ME 160 ME Design I (3)	Eligibility for Math 150
Math 162L Calculus I (4)	Math 123, 150 (C or better)
Chem 122L General Chemistry (4)	Chem 121 (C or better)
Engl 102 Comp II: Analysis & Arg (3)	Engl 101 (C or better)
Phys 160 General Physics I (3)	Math 162 (Pre or Co-req)
Math 163L Calculus II (4)	Math 162 (C or better)
CS 151L Computer Prog Fund (3)	Math 150
Sophomore	
ME 260 ME Design II (3)	Math 163, ME 160
CE 202 Engineering Statics (3)	Phys 160, Math 163
Phys 161 General Physics II (3)	Phys 160, Math 163 (Pre or Co-req)
Math 264L Calculus III (4)	Math 163 (C or better)
ME 217 Energy, Env. & Society (3)	None
ME 306 Dynamics (3)	CE 202, Math 264
EECE 203L Circuit Analysis (3)	CS 151, Math 163 (C or better); Math 316 (Co-req), Phys 161
Math 316 Applied Ord Diff Eqns (3)	Math 163 (Math 264L recommended)
ME 318L Mech Engr Lab (4)	Phys 161, Math 264L, Math 316 (Co-req), EECE 203L (Co-req)
Junior	
ME 317L Fluid Mech (4)	ME 306, Math 264L, Math 316, ME 318
ME 301 Thermodynamics (3)	ME 301 (Co-Req)
CE 302 Mechanics of Materials (3)	Chem 122, Phys 161, Math 163, Math 264L
Econ 105 Intro to Macroeconomics (3)	CE 202, Math 264L
ME 302 Appl Thermodynamics (3)	None
ME 314 Dyn Mach (3)	ME 301
ME 360 ME Design III (3)	ME 306
ME 357 Intro to Mech Vibrations (3)	CE 302, ME 260, Math 316
ME 370 Engr Materials Science (3)	ME 306, Math 316
ME 352L Engr Materials Science Lab (1)	Chem 122
	Chem 122
Senior	
ME 459 ME Design IV (3)	ME 370, ME 360
ME 380 Mech Control Systems (3)	ME 357
ME 320L Heat Transfer (4)	ME 301, ME 317L, Math 316
ME 460 Engineering Design V (3)	ME 320L, ME 459, ME 380

8 Core Curriculum Electives for ME Students

The Core Curriculum electives for students who were admitted (or re-admitted) to UNM for Fall 1999 (and beyond) are shown below. **A grade of C or better (not C-) is required in all courses used to fulfill the requirements of the Core Curriculum.** This includes required courses: English 101 & 102, Math 162 (or 163), Chemistry 121L (or 122L), Physics 160 (or 161), American Studies 182, and Economics 105.

CORE Curriculum Electives

1. **Writing and Speaking.** All UNM students are required to take English 101 and 102 plus one of the additional courses listed below to satisfy the UNM Writing and Speaking CORE requirement. Students who have part or all of English 101-102 waived on the basis of ACT or SAT scores or the Writing Proficiency Portfolio (applies only to English 102) need only take any remaining freshman English courses and a third course in this category. Every student, however, should have at least one college communications experience. Students must make up the hours for waived course. The BSME degree requires 130 hours of approved coursework.
 - English 219 (Technical Writing), 220 (Expository Writing)
 - Communication and Journalism 130 (Public Speaking)
 - Philosophy 156 (Reasoning and Critical Thinking).

2. **Humanities.** Two courses chosen from among the following:
 - American Studies 186 (Introduction to Southwest Studies)
 - Classics 107 (Greek Mythology), 204 (Greek Civilization), 205 (Roman Civilization)
 - Comparative Literature and Cultural Studies 223, 224 (Literary Questions)
 - English 150 (The Study of Literature), 292, 293 (Western Literature/World Contexts)
 - Foreign Languages (M Lang) 101 (Elementary Topics in Foreign Languages)
 - History 101, 102 (Western Civilization), 161, 162 (History of the United States)
 - Honors Legacy Seminars at the 100- and 200-level
 - Philosophy 101 (Introduction to Philosophical Problems), 201 (Greek Philosophy), 202 (Modern Philosophy)
 - Religious Studies 107, 263, and 264 (Living World Religions)

3. **Foreign Language.** One course chosen from any of the lower division non-English offerings of the Departments of Linguistics (including Sign Language), Spanish and Portuguese, and Foreign Languages and Literatures and foreign languages in other departments and programs. Students with knowledge of a second language equivalent to four semesters of study are deemed to have satisfied this requirement. CLEP and AP credit can be used for placement, but unless the student has demonstrated knowledge equivalent to four semesters of study, an additional semester of a second language must be

taken.

4. Fine Arts. One course chosen from among the following:

- Architecture 101 (Introduction to Architecture)
- Art History 101 (Introduction to Art), 201, 202 (History of Art I, II)
- Dance 105 (Dance Appreciation)
- Fine Arts 284 (Experiencing the Arts)
- Media Arts 210 (Introduction to Film)
- Music 139 (Music Appreciation)
- Theater 122 (Introduction to Theater)

Students may instead elect to take one three-credit studio course offered by the Departments of Art and Art History, Music, Theater and Dance and the Media Arts to fulfill this requirement.

9 Mechanical Engineering Required Courses

The following courses are required Mechanical Engineering courses for students following either the Senior Design or FSAE tracks.

- 160L Mechanical Engineering Design I (3)** Introduction to engineering graphics, the design process, computer aided design, engineering ethics, design economics, and project management. Prerequisite: eligibility for admission to MATH 150. Two hrs lecture, 3 hrs lab.
- 260L Mechanical Engineering Design II (3)** The design process, project management, shop practice CNC and rapid prototyping, design economics and engineering ethics. Prerequisites: 160L, MATH 162. Two hrs lecture, 3 hrs lab.
- 301 Thermodynamics (3)** Thermodynamics equilibrium, thermodynamics properties and equations of state. First and second laws of thermodynamics and their applications to engineering systems. Availability and irreversibility and their application to second law analysis. Prerequisites: CHEM 122L, PHYC 161, MATH 163.
- 302 Applied Thermodynamics (3)** Thermodynamics relations, thermodynamic properties of mixtures, psychrometrics, thermodynamics of chemical reactions, phase and chemical equilibrium, thermodynamics cycles and design of energy systems. Prerequisite 301.
- 306 Dynamics (3)** Principles of dynamics. Kinematics and kinetics of particles, systems of particles and rigid bodies. Prerequisites: CD 202, MATH 264.
- 314 Design of Machinery (3)** Graphical and analytical techniques in kinematics and kinetics of linkages. Synthesis of linkages. Cam design. Prerequisite: 306.
- 317L Fluid Mechanics (4)** Fluid statics. Control volume forms of continuity, momentum and energy. Pipe flow and turbo-machinery. Introduction to boundary layers and turbulent flow. Laboratory experiments and demonstrations of basic concepts. Prerequisite: 306, 318L, and MATH 264. Co-requisite 301.
- 318L Mechanical Engineering Laboratory (4)** Measurement techniques and instrumentation for experiments in mechanical engineering, report writing, basic concepts of probability and statistics, discrete and continuous probability distributions, test statistics, classical and robust test of significance, measurement and uncertainty, design of experiments, regression analysis, applications in analysis of engineering experiments.

- 320L Heat Transfer (4)** Principles and engineering applications of heat transfer by conduction, convection, and radiation. Laboratory experiments and demonstrations of fundamental heat transfer concepts. Prerequisites: 301, 317L, and MATH 316.
- 352L Materials Laboratory (1)** The effects of microstructure, processing, composition, and thermal treatment on physical and mechanical properties of engineering materials will be investigated. A variety of materials will be processed, tested, and microscopically studied in the laboratory. Corequisite: 370.
- 357 Introduction to Mechanical Vibrations (3)** Free and forced vibrations of one and two degrees of freedom systems for both steady state and transient forcing. Also vibrations of selected continuous systems and balancing. Prerequisite: 306, MATH 316.
- 360L Mechanical Engineering Design III (3)** Finite element analysis and its use in the design process, validation of FEA results, CAD, engineering ethics, design economics, and project management. Prerequisites: 260L, CE 302, MATH 264, MATH 316. Two hours of lecture, 3 hours of lab.
- 370 Engineering Materials Science (3)** The structure of matter and its relation to mechanical properties. Mechanical behavior of structural materials: metals, ceramics, and polymers. Prerequisite: CHEM 122L. Corequisite: 352L.
- 380 Analysis and Design of Mechanical Control Systems (3)** System dynamics and modeling; transfer functions; concept of feedback and system stability; transient and steady-state response; control system analysis and design using root locus and frequency response methods. Prerequisites: 357 and MATH 316. Restrictions: ME majors and senior standing.
- 406 Formula SAE Racecar Design (3)** Design a racecar that will participate in Formula SAE international competition including acceleration, autocross, and endurance events. Vehicles are judged on performance, cost, and design. Project management, vehicle dynamics, tires, breaks, suspension, and steering are covered. Restrictions: ME majors and junior standing.
- 407 Formula SAE Racecar Fabrication Lab (3)** Manufacture the vehicle designed in 406. Make project management decisions on build or buy balancing cost, performance, and schedule. Use CAD/CAM extensively to design, machine, and fabricate complex parts. Plan integrated drivers' training and test programs. Prerequisite: 357 AND 406.
- 408 Formula SAE Racecar Test Lab. (1)** Implement a testing program to validate vehicle design fabricated in 407 using state of the art data acquisition equipment. Modify and redesign as required. Continue drivers' training program. Participate in Formula SAE international competition. Prerequisite: 407.
- 459 Mechanical Engineering Design IV (3)** Review of stresses. Statistical considerations. Methods of design for static and fatigue strength. Design of machinery elements such as bolts, welded joints, springs, bearings, belts, chains, clutches, breaks, and shafts. Prerequisites: 370 and CE 302.
- 460 Mechanical Engineering Design V (3)** Capstone design course for Mechanical Engineering students. Students work in teams to design complete engineering systems. Considerations include technical solution, function, manufacturability, cost, safety, and standards, and materials. Prerequisites: 320L, 380, 459, ENGL 102.

10 Mechanical Engineering Technical/Science Electives Guidelines

Mechanical Engineering students must follow these general guidelines in choosing their Mechanical Engineering Technical Elective and Mechanical Engineering Science Elective courses. In all cases, electives taken for degree requirements *must be approved* by the student's academic advisor.

The electives are divided into two groups, the Mechanical Engineering Technical Electives and the Mechanical Engineering Science Electives. Mechanical Engineering Technical Elective courses can be used for both the "Technical Elective" in the degree program and for the "Mechanical Engineering Technical Elective". Mechanical Engineering Science Elective courses can be used for the "Technical Elective", "Mechanical Engineering Technical Elective", and for the "Mechanical Engineering Science Elective" courses in the degree program.

Mechanical Engineering Technical Electives and Mechanical Engineering Science Electives may not be taken on the CR/NC grading option.

11 Mechanical Engineering Technical Electives

The following are Mechanical Engineering Technical Elective courses (with an ME prefix) that are offered on a regular basis by ME Department. Upon approval of instructor, students may also register in 500-level courses (see the UNM Catalog).

- 451-452¹** **Undergraduate Problems (1-3 hrs. per semester, to a maximum of 6)** A project of an original nature carried out under faculty supervision. A student may earn 451 or 452 credit for an industrial project by arranging approval of the project by a faculty advisor and the department chairperson. Prerequisites: senior standing and permission of instructor.
- 455** **Engineering Project Management (3)** Estimating, proposing, planning, scheduling, quality and cost control, and reporting of an engineering project. Case studies of typical engineering projects. Small projects carried out by student teams. Prerequisites: senior standing in Mechanical Engineering. (Offered upon demand)
- 456** **Engineering Entrepreneurship (3)** Review and application of necessary elements for successfully launching technical businesses; focuses upon technology, manufacturing, management, marketing, legal and financial aspects. Students work in groups developing elements of new businesses and producing business plans. Prerequisites: graduate or senior standing, or working professional. (Offered upon demand)
- 461-462¹** **Special Topics (1-4)** Formal course work on special topics of current interest. Prerequisites: senior standing in ME and permission of instructor. (Offered upon demand)
- 463** **Undergraduate Honors Thesis (1-3 per semester to a maximum of 6)** Independent project of an original nature carried out under faculty supervision in partial fulfillment of Departmental Honors designation. Prerequisites: junior standing; open only to undergraduate honors candidates; minimum GPA of 3.20; registration requires permission of the department chairperson and of the supervising professor.
- 484** **Computer-Aided Design (3)** Implementation of CAD/CAM in automated manufacturing systems, laboratory work on CAD solid modeling software. Prerequisite: senior standing.
- 485** **Modern Manufacturing Methods (3)** Study of business of manufacturing, emphasizing modern approaches. Topics include: US manufacturing dilemma; JIT, kanban, pull manufacturing, quality; modeling; design for production; manufacturing economics; management issues; DIM; case studies. Prerequisite: senior standing.

¹ME 451, 452, 461 and 462 may be used as Mechanical Engineering Science Electives if approved by the Undergraduate Advisor.

488 **Design & Manufacturing in Industry (3)** Weekly visits to local companies to examine design and manufacturing techniques. A product- and/or process-oriented term paper (and presentation) is required, covering economic, design, and manufacturing issues. Prerequisites: senior standing. Transportation not provided.

12 Mechanical Engineering Science Electives

These courses can be used for the “Technical Elective”, the “Mechanical Engineering Technical Elective”, or for the “Mechanical Engineering Science Electives” in the degree program.

302 **Applied Thermodynamics (3)** Thermodynamic relations, equations of state, thermodynamic properties of mixtures, psychrometrics, thermodynamics of chemical reactions, phase and chemical equilibrium, power, refrigeration and heat pump cycles. Prerequisites: 301

314 **Dynamics of Machinery (3)** Graphical and analytical techniques in kinematics and kinetics of linkages. Synthesis of linkages. Cam Design. Prerequisite: 306

350 **Engineering Economy (3)** A study of methods and techniques used in determining comparative financial desirability of engineering alternatives. Includes time value of money (interest), depreciation methods, and modern techniques for analysis of management decisions. Junior standing.

365 **Heating, Ventilating & Air Conditioning Systems (3)** Methods of analysis and design of systems for conditioning of spaces for people and equipment. Prerequisite: 320 (On demand)

400 **Numerical Methods in Mechanical Engineering (3)** Applications of solution procedures for linear and non-linear systems of equations, numerical differentiation and integration, eigenvalue problems and finite-difference methods to specific problems in Mechanical Engineering including one- and two-dimensional, steady and time-dependent heat transfer, fluids, and solid mechanics problems. Prerequisites: 317, 320, CE 302, and Math 316 or permission of instructor.

401 **Advanced Mechanics of Materials (3)** State of stress and strain at a point, stress-strain relationships; topics in beam theory such as un-symmetrical bending, curved beams, and elastic foundations; torsion of non-circular cross-sections; energy principles. Prerequisites: CE 302.

404 **Computational Mechanics (3)** Terminology and concepts associated with weak formulations and the finite element approach; time integrators; stiffness and mass matrices; internal force approach; problems include static and transient analyses of heat conduction, torsion, wave propagation, beam deflection, and applications in design. Prerequisite: Senior standing in ME or Math 312.

405 **High Performance Engines (3)** Students will capitalize on 1) applications of engineering fundamentals to engine operation and design; 2) implementation of computing and information technology for modeling, simulation, visualization, and design; and 3) case studies of “famous” racing engines. Prerequisite (ME 301 or CHNE 301)

412 **Introduction to Continuum Mechanics (3)** (Also offered as CE 412) Vector and tensor analysis, kinematics of continua, equations of motion, first and second laws of thermodynamics, constitutive equations for elastic solids and compressible viscous fluids. Prerequisites: Math 311 or senior standing in engineering, physics, or mathematics.

- 416 Intermediate Dynamics (3)** Review of Newtonian mechanics, dynamic analysis in non-Newtonian reference frame, Lagrangian equation of motion. Prerequisites: 306, 357, Math 316.
- 421 Thermal System Design and Optimization (3)** Review of thermal sciences, optimization methods, introduction to thermal design and optimization, design of different thermal systems such as heat exchanger, energy conversion, heat transfer enhancement, Cryogenics, micro-electronic cooling. Environmental issues and thermoeconomics. Prerequisites: 301, 317L, 320L.
- 428 Advanced Fluid Mechanics (3)** Introduction to potential flow, compressible flow and viscous flow including lubrication and boundary layers. Applications to be discussed will be selected from topics in piping networks, turbo machinery, computational methods, turbulence, and measurement techniques. Prerequisites: 301, 317L, 320L.
- 429 Gas Dynamics (3)** One and two-dimensional compressible flow of ideal gases including shock waves, friction and heat transfer. Development of the fundamental equations of compressible flow along with applications, including numerical and experimental methods. Prerequisites: ME 301, ME 317L, ME 320L
- 447 Principles of Precision Engineering (3)** Lectures and laboratories emphasizing precision engineering in advanced manufacturing. Sub-micron, micro-inch, and nanometer resolution and repeatability; applications for ultra-precision systems and design of instruments to achieve accurate metrology and repeatable performance. Term project to demonstrate principles. Prerequisite: senior standing.
- 461 - 462 Special Topics (1-4)** Formal course work on special topics of current interest. Prerequisites: senior standing in ME and permission of instructor. These courses may be used as ME Science electives only if they are approved by the Undergraduate Advisor. (Offered upon demand)
- 470 Microprocessors in Mechanical Systems (3)** Introduction to microprocessor organization, interfacing, machine and assembler-language programming. Several projects involving the use of a micro-controller in various mechanical systems. Prerequisites: senior standing or permission of instructor.
- 471 Advanced Materials Science (3)** Further developing of the concepts of materials science starting where ME 370 leaves off. Including: crystal structure and symmetry operators, structure and energy of defects such as dislocations and interfaces, thermodynamic basis of phase diagrams, and kinetics of phase transformations. These concepts will be applied to explain the mechanical, electronic, optical, etc. properties of solid materials. Prerequisites: ME 370.
- 474 Modeling, Simulation, and Synthesis of Electromechanical Control Systems (3)** Computer-aided simulation of dynamic systems and design of control systems. Design of actuators and sensors; linearization techniques; scaling. Performance criteria, robustness, state-space design. Synthesis through hardware implementation of an electromechanical control system. Prerequisite: 380 or EECE 445.
- 475 Random Dynamic Processes and Controls** The class concentrates on the practical application of random analyses to control systems. Frequency domain aspects of control systems will be reviewed. The course utilizes random analysis tools including Power Spectral Density and coherence. Pre-requisite: ME 380 and ME 461A or equivalent, or permission of the instructor. Student should have a basic knowledge of MATLAB.

- 480** **Dynamic System Analysis (3)** Mathematical modeling of continuous and discrete systems (mechanical, hydraulic, electric, electro-mechanical, thermal, etc.). Analysis of state equations. Controllability, observability, and stability. Prerequisites: 380.
- 481** **Digital Control of Mechanical Systems (3)** Analysis and design of systems using digital computers in the real-time control of dynamic processes. Design methods will include classical techniques based on the Z-transform and modern techniques based on the state-space approach. Prerequisite: 380.
- 482** **Robot Engineering (3)** Robot geometry, resolution, accuracy and repeatability, kinematic design of robots, Denavit-Hartenberg homogeneous transformation, direct and inverse kinematics and solutions, motion trajectories, differential tracking, force and compliant analysis, robotic control and programming, hands-on robotic problems. Prerequisites: senior standing.
- 483** **Statistical Methods for Improving Product Quality (3)** Course covers basic concepts of statistical inference and topics in reliability, acceptance sampling, statistical process control, full and fractional factorial experiments, and response surface methodology. The emphasis will be on the effective implementation of the techniques rather than their mathematical development.
- 486** **Design for Manufacturability (3)** Introduction to methods of design for manufacturability. Emphasis is on teamwork and designing customer's needs. This is achieved through statistical methods and computer based systems. Prerequisite: senior standing.
- 487** **LEGO Robotics (3)** Design and construction of an autonomous, microcomputer-controlled mobile robot using LEGO pieces and assorted electromechanical actuators and sensors. Students work in teams and robots compete at the end of the semester. Prerequisites: senior standing.
- 489** **Intelligent Controls in Manufacturing (3)** Emphasizes factory automation through software system architecture. Topics include hierarchical control systems, open architecture controllers, Computer Integrated Manufacturing (CIM), concurrent engineering, genetic algorithms, fuzzy logic, and control systems for machines, work-cells, and factories. Prerequisites: senior standing.

13 Independent Study and Research Project Experience

The following professors have indicated an interest in guiding BSME students through independent study or research projects:

- Dr. Marwan Al-Haik: Material science
- Dr. Nader Ebrahimi: Optimization of Mechanical Systems
- Dr. Juan Heinrich: Fluid mechanics and finite element analysis
- Dr. Marc Ingber: computational fluid mechanics
- Dr. Tariq Khraishi: Solid mechanics, crystal plasticity, finite-element modeling
- Dr. Zayd Leseman: Material science
- Dr. Ron Lumia: Robotics and Manufacturing (including software related issues)
- Dr. Andrea Mammoli: fluid mechanics, computer modeling, and environmental designs
- Dr. Arsalan Razani: Energy and Environment; Thermal System Design

and Optimization

- Dr. John Russell: Dynamics, aeronautics
- Dr. Yu-Lin Shen: Materials science and Solid Mechanics
- Dr. Greg Starr: Robotics, Control Systems, and Micro-controller Applications
- Dr. Bert Tanner: Robotics
- Dr. Randy Truman: Fluid Mechanics and Optical Diagnostics
- Dr. Peter Vorobieff: Fluid Mechanics (experimental)
- Dr. John Wood: Manufacturing

Through these activities, students may obtain technical/science elective credits (ME451-2 courses). To obtain approval, the student is required to prepare a written proposal that includes the following information:

1. Identification: title, author, course number, credit hours, semester, and supervising professor.
2. Introduction: a brief description of the problem, its engineering significance, and how it fits into the student's educational goals.
3. Procedure: a description of the work as well as the approach to the problem; it should include the equipment, resources, technician time, and other needs for carrying out the work.
4. Results: a discussion of the expected results or goals of the activity.
5. A statement as to whether the course will count as a Mechanical Engineering technical elective or as a Mechanical engineering science elective.
6. Bibliographical references.

The proposal need not be lengthy: one or two pages will suffice.

Upon approval of the proposal by the supervising professor and the Undergraduate Advisor, it will be filed in the student's academic folder. This should be done no later than the first week of the semester.

Students may participate in ME451-2 in conjunction with PURSUE or NASA Graduate Bridge programs. (Information on these and other school-wide programs can be obtained from the School of Engineering.)

14 Transfer Courses

Courses taken at regionally accredited colleges or universities may be transferred. These courses must be equivalent to the required courses in the BSME program at UNM.

Courses from engineering programs that are not accredited by ABET are not applicable towards the BSME degree at UNM.

A basic policy of ABET, which accredits the BSME program, is that technology courses should not be accepted in lieu of engineering courses.

15 Minimum Grades (“No Ds” Rule)

For students admitted to the ME Department for 1999-2000 academic year (and beyond), the minimum acceptable grade for all courses applicable towards the BSME degree is a C-. (A grade of C is required for Core Curriculum courses.)

16 Credit / No Credit Option

All courses applied towards the BSME degree must be taken for grade only; i.e., CR/NC option is not allowed for these courses (except in cases of AP and CLEP credits, as well as Core Humanities, Fine Arts, Writing/Speaking, and Second Language Electives).

17 Scholarships

The School of Engineering awards a number of scholarships to its students. Normally, a student applies for the scholarships in the spring semester of the academic year. These scholarships are awarded for the following year. Some scholarships are specifically designated for Mechanical Engineering. Students are encouraged to apply. The scholarships currently being offered are:

AIAA – American Institute of Aeronautics and Astronautics The requirements are:

- 2.8 or better GPA
- Upperclassmen or graduate student in Eng/CS/Math/Science
- US citizen or permanent resident
- Obtain application from www.aiaa.org
- Contact Dr. Truman 277-6296

ASHRAE – American Society of Heating, Refrigeration & Air Conditioning Engineers Scholarship The requirements are:

- Undergraduate Engineering Scholarship applicants deadline December 1
- Engineering Technology Scholarship applicants deadline May 1
- A cumulative college GPA of at least 3.0, where 4.0 is the highest
- Enrollment in an engineering or engineering technology college curriculum with at least one full year of studies remaining in the year the scholarship will be awarded
- Potential service to the HVAC and/or refrigeration profession
- Need for financial assistance
- Leadership ability
- Recommendation from instructor and others
- Character
- Obtain application from www.ashrea.org

ASME - American Society of Mechanical Engineers New Mexico Section Scholarship The requirements are:

- Deadline approximately April 1 and November 1 of each year, but may vary
- Mechanical Engineering major

- Currently enrolled for a minimum of 9 credit hours, and not be enrolled in final semester and a current member of ASME
- Selection based on scholarship, financial need, written communications skills, and ASME and other engineering student activities
- Obtain application from www.asme.org

Berger Memorial Scholarship The requirements are:

- 3.0 or better GPA
- Mechanical Engineering student in Junior or Senior standing

Miller Metal Company Endowed Fellowship The requirements are:

- Mechanical Engineering major
- Creative junior or senior with at least 3.0 GPA
- Must have strong commitment to Mechanical Engineering with an interest in business or management and clear set of career goals

Alan Evan Morrison Memorial Scholarship The requirements are:

- 3.0 GPA
- Creative Junior or senior
- Strong commitment to ME with an interest in business or management and a clear set of career goals

1st Lt. Brian L. Webber Memorial Fund The requirements are:

- Mechanical Engineering major
- Senior with a 3.0 or better GPA
- First preference given to students who have served in the armed forces

James O. Coupland Memorial The requirements are:

- Demonstrate academic achievement
- Demonstrate financial need for scholarship assistance
- Be enrolled as a full-time student in Mechanical Engineering at UNM School of Engineering
- First preference shall be given to students living in rural communities

Marilee B. Wildin & Maurice W. Wildin, Jr. Scholarship The requirements are:

- Must maintain a grade point average of 3.0
- Demonstrate need for financial assistance
- Be enrolled as full-time student s, as per university definition, in the School of Engineering's minimum for admission
- Be of freshman (second semester) or sophomore grade level, having come to the university from high school or through transfer
- Submit a 250-word essay on why they have chosen mechanical engineering as their field of study and what contribution they expect to make through their chosen profession

Steven Rose Memorial Scholarship The requirements are:

- Student must be a Junior or Senior studying Mechanical Engineering at UNM School of Engineering
- Student must have a GPA of at least 3.0 at the time of selection
- Preference will be given to students studying Biomedicine and/or Applied Computational Engineering

B.G. Taylor Graduate Award in Mechanical Engineering

- 3.2 or higher GPA during last two years of undergraduate program
- Must be recipient of a BSME degree from UNM during the previous year
- Must commence or continue full time graduate studies in Mechanical Engineering during the academic year following the selection
- The department may offer the award to a promising undergraduate student conditional on the student's acceptance and enrollment in the Mechanical Engineering Graduate Program during the following academic year

John P. Reynolds, Jr. Memorial Award The requirements are;

- Mechanical Engineering major
- NROTC student, Scholarship or Contract, in the field of engineering.
- Must be a graduating senior within the school year the award is given.
- Must be in the upper one-fourth of their NROTC class in both aptitude and academics.
- Must be recommended by the Dean of Engineering.
- In the event no NROTC student meets the criteria above, a NESEP student may be considered for the award.
- Contact: Major Brian P. Montoya, Marine Officer Instructor, Naval ROTC, UNM Naval Science NROTC Building, 720 Yale NE, 277-7023, bmontoya@unm.edu

18 Student Activities

Student organizations of the ME Department allow students to develop lasting friendships.

The ME Department has an active student section of the American Society of Mechanical Engineers (ASME). The section organizes tours of local industry and laboratories. It also invites speakers of interest to the students and faculty. ASME members frequently participate in design and/or paper presentation competitions.

The American Institute of Aeronautics and Astronautics (AIAA) student members also have the opportunity to prepare and present papers at an annual student conference.

Many of these groups' activities are held jointly with the local professional sections; this provides an excellent opportunity for students to interact with practicing engineers.

Pi Tau Sigma is the mechanical engineering honorary society that is open to qualified ME students. Eligible student are automatically contacted and invited to join.

19 Departmental Honors

Students who wish to graduate with Departmental Honors are required to meet

the following criteria:

1. A minimum degree GPA corresponding to the following designations:

3.5-3.74 *cum laude*

3.75-3.89 *magna cum laude*

3.9 (and higher) *summa cum laude*

2. ME 451/452 - Independent study

Complete one or more ME 451/452 Individual study course(s) with a professor in the Mechanical Engineering Department. The intent of this individual study course is to research a topic for an honors thesis. (3 hours minimum)

3. ME 463 - Honors Thesis

The students will enroll in ME 463 and complete an honors thesis. An honors thesis is a scholarly work based upon the research performed in the individual study course(s). (3 hours)

Please refer to sections of this document concerning independent studies and technical electives for further information.

20 Planning for Graduate Study

The ME Department offers programs of study towards the Master of Science and Doctor of Philosophy degrees. Consult the UNM Catalog and contact the departmental Graduate Advisor for detailed information.

Senior students with a GPA of 3.0 or greater who are within 10 semester hours of completing the BSME degree may obtain graduate credit (in graduate courses) for a maximum of nine (9) semester hours, provided that they meet the requirements specified in the Graduate sections of the UNM Catalog.

21 Application for Degree

During the second semester of a student's junior year or prior to enrollment of the 100th credit hour for the degree, a student is required to file the form "Application for an Undergraduate Degree." This form may be obtained from the ME Undergraduate Records Office (ME Building, Room 204). Failure to complete this form may delay graduation.

