

Chapter 6

Facilities

The department occupies approximately 35,000 square feet of office and laboratory space on campus in Roberts, Mueller and Wilcox Halls, along with space in Wilson Lab and Wilson Annex. These spaces have been upgraded in recent years, with Mueller Hall being built in 1987 and Roberts Hall being fully remodeled in 1989. Full laboratory facilities are available for materials characterization and processing, computer analysis and structural examination. All facilities noted here are shared, as needed, among the Metallurgical Engineering, Ceramic Engineering and our departmental graduate programs.

6.1 Classrooms

Classroom space is available in Mueller Hall, with two 40-student classrooms and one 99-student auditorium (in addition to our 35,000 square feet of space). The department also utilizes seminar rooms in Roberts and Wilcox Halls, and classrooms in More and other nearby buildings, as needed. Classroom space is officially operated by a University pool, but the department has priority for scheduling classes in the Mueller classrooms. Mueller Hall also houses the bulk of our undergraduate laboratories, the undergraduate computing facility, lockers for students and a student society office and a student lounge.

6.2 Laboratories and Computing Facilities

Due to our shared belief that students learn best by doing, there is a heavy emphasis on laboratory component in the curriculum. In order to support this component of our program, we maintain a number of laboratories primarily for undergraduate student use. In addition to undergraduate laboratories, students have access to needed research laboratories maintained by the department. Finally during the Senior project, the students use a variety of laboratories both within and outside the department. Tables I (1) through I (3) provides a summary of the laboratory facilities used for both the Metallurgical and Ceramic Engineering Engineering Programs. These tables include information about the courses that use that facility, area, general condition and adequacy of the lab. The following Tables J (1) to J (11) provide details about each of the facilities, including important pieces of equipment in the lab and identified needs for new equipment.

The students use computers extensively in our program. The department maintains state of the art computing facilities. These are described in Table J (11). In addition to the department's computing facilities, students can utilize any of the university computing rooms, which are well equipped with personal computers. All university students pay a technology fee of \$40 per quarter to pay for upgraded computing facilities. Portions of the resultant funds are allocated by a university committee to support departmental and to university-wide computing needs.

The laboratories in the Department of Materials Science and Engineering need continual upgrades in equipment and facilities to provide for a first class education for both our undergraduate and graduate students. These laboratories have been upgraded since 1989 as a result of private contributions of \$1.5M and funding from the state and federal governments. Expenditures for equipment used exclusively for teaching totaled over \$850,000 over the past 10 years. These funds have allowed upgrades in the areas of materials processing, computer analysis and control, sample preparation, spectroscopy and analysis, and x-ray diffraction.

However, the task of equipment replacement and upgrading is never complete due to the explosive growth of analytical capabilities in the materials analysis area. With the advent of computer-controlled analysis and measurement systems, another challenging area is the need to upgrade computing systems and software. Overall, it is estimated that over \$150,000 annually will be required over the next decade to ensure that the Department has fully updated laboratories in the year 2010. Funding for these laboratory facilities upgrades will come from a combination of private donations, state appropriations and grants from the federal agencies. These activities are ongoing, with different emphases depending on the availability of funds and the likelihood of success. Funding sources include private donations, state appropriations and federal grants. Upgrade and maintenance of equipment is a high priority in our development campaign for private donations.

**TABLE I (1) LABORATORY FACILITIES - Summary
Metallurgical and Ceramic Engineering**

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 165, 167	General Instruction in Ceramic Engineering Material Processing MSE 330 Inorganic Materials Processing MSE 423 Fiber Composite Materials MSE 499 Senior Project CER E 421 Ceramic Processing MET E 435 Corrosion Lab CER E 415 Electronic Properties of Ceramics CER E 411 Vitreous State CER E 470 Refractories	Excellent	Good	12	1370
Mueller 166	Microscopy Preparation Lab MSE 170 Fundamentals of Materials Science MSE 317, 318 Physical Materials Labs MSE 487 Electronic Packaging Lab MSE 498 Special Projects MSE 499 Senior Project MET E 463 Reliability and Design in Metallurgical Systems	Good	Good	6	652
Mueller 168	MSE 170 Fundamentals of Materials Science Lab	Excellent	Excellent	8	553
Mueller 170	Microscopy Teaching Lab MSE 170 Fundamentals of Materials Science MSE 317, 318 Physical Materials Labs MSE 330 Inorganic Materials Processing MSE 423 Fiber Composite Materials MSE 487 Electronic Packaging Lab MSE 498 Special Projects MSE 499 Senior Project CER E 421 Ceramic Processing	Excellent	Excellent	24	624
TOTAL AREA THIS PAGE					3199

**TABLE I (2) LABORATORY FACILITIES - Summary
Metallurgical and Ceramic Engineering**

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 176	Heat Treating and Furnace Lab MSE 330 Processing of Inorganic Materials MSE 499 Senior Project MET E 421 Metallurgical Processing CER E 411 Vitreous State	Good	Good	Service Lab	520
Mueller 178	Undergraduate Computing Lab	Excellent	Excellent	16	524
Mueller 185	Electrical Properties/Computer Lab MSE 317,318,319 Physical Materials Lab MSE 499 Senior Project CER E 401 Equipment and Plant Design CER E 411 Vitreous State CER E 415 Electrical Properties Lab	Excellent	Excellent	6	522
Roberts 109	Image Analysis and Microscopy MSE 317-318 Physical Materials Labs MSE 330 Processing Inorganic Materials MSE 423 Fiber Composite Materials MSE 499 Senior Project MET E 421 Metallurgical Processing	Excellent	Excellent	1-2	163
Roberts 129	X-Ray Diffraction MSE 314 X-Ray Diffraction and Crystallography MSE 330 Processing of Inorganic Materials MSE 499 Senior Project CER E 421 Ceramic Processing	Very Good	Fair	1	410
Roberts 131	Graduate Computing Lab	Excellent	Excellent	12	347
Roberts 221	Materials Processing Lab MSE 423 Fiber Composite Materials Lab MSE 499 Senior Project CER E 411 Vitreous State Lab	Excellent with required safety supplies & maintenance	Good	N/A	514
TOTAL AREA THIS PAGE					3000

**TABLE I (3) LABORATORY FACILITIES - Summary
Metallurgical and Ceramic Engineering**

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Wilcox 35	Rolling Mill Induction Melter MSE 317, 318, 319 Physical Materials Labs MSE 499 Senior Projects MET E 462 Mechanical Behavior of Materials	Fair	Fair	1	520
Wilcox 133	Mechanical Testing Lab – Tensile compression and bend testing of metals, ceramics and polymers. MSE 170 Fundamentals of Materials Science MSE 319 Physical Materials Lab MSE 423 Fiber Composite Materials MSE 433 Polymeric Materials MSE 499 Senior Project MET E 421 Metallurgical Processing Lab MET E 462 Mechanical Behavior of Materials MET E 463 Reliability and Design in Metallurgical systems MET 465 Mechanical Behavior Lab CER E 416 Mechanical Properties of Ceramics Lab	Good	Fair	1	422
TOTAL AREA THIS PAGE					942

TOTAL AREA

7141

Note: MSE 498 (IC Tech Lab) uses the semiconductor processing central facilities in Fluke Hall

TABLE J (1)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 165, 167	General Instruction in Ceramic Engineering Material Processing MSE 330 Inorganic Materials Processing MSE 423 Fiber Composite Materials MSE 499 Senior Project CER E 421 Ceramic Processing MET E 435 Corrosion Lab CER E 415 Electronic Properties of Ceramics CER E 411 Vitreous State CER E 470 Refractories	Excellent	Good	12	1370

NEW EQUIPMENT: Hot Platen Press

SIGNIFICANT EQUIPMENT: Composite Prepreger
 Composite Lamination Press and DSC

FUTURE PLANS: Particle size, surface area and base characterization equipment

TABLE J (2)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering g

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 166	Microscopy Preparation Lab MSE 170 Fundamentals of Materials Science MSE 317, 318 Physical Materials Labs MSE 487 Electronic Packaging Lab MSE 498 Special Projects MSE 499 Senior Project MET E 463 Reliability and Design in Metallurgical Systems	Good	Good	6	652

NEW EQUIPMENT: Buehler Low Speed Saw

SIGNIFICANT EQUIPMENT: 2nd Mounting Press
 Diamond Grinding Discs
 Cut-Off Saw
 Binocular Microscopes
 Automatic Polishing System

FUTURE PLANS: High speed diamond cut-off saw, small dish washer for glassware

TABLE J (3)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 170	Microscopy Teaching Lab MSE 170 Fundamentals of Materials Science MSE 317, 318 Physical Materials Labs MSE 330 Inorganic Materials Processing MSE 423 Fiber Composite Materials MSE 487 Electronic Packaging Lab MSE 498 Special Projects MSE 499 Senior Project CER E 421 Ceramic Processing	Excellent	Excellent	24	624

NEW EQUIPMENT: Digital camera
Dell XPS R400 W/Imaging software and Deskjet 1000C Printer

SIGNIFICANT EQUIPMENT: Wild Camera System
TV Imaging System
Dell Dimension XPS R400, 300 MHz CUP, 10 GB HD, 100 Zip, 128 MB RAM, 10/100 NIC, 32 x CD-ROM.

FUTURE PLANS: Upgrade microscopes

TABLE J (4)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 176	Heat Treating and Furnace Lab MSE 330 Processing of Inorganic Materials MSE 499 Senior Project MET E 421 Metallurgical Processing CER E 411 Vitreous State	Good	Good	Service Lab	520

SIGNIFICANT EQUIPMENT: Glass Furnace Programmer/ Controller/ Power Supply
 Keith High Temperature 1700° C Furnace w/controller & power supply
 Glo-Bar 1400° C Furnace w/controller & power supply

TABLE J (5)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 185	Electrical Properties/Computer Lab MSE 317,318,319 Physical Materials Lab MSE 499 Senior Project CER E 401 Equipment and Plant Design CER E 411 Vitreous State CER E 415 Electrical Properties Lab	Excellent	Excellent	6	522

SIGNIFICANT EQUIPMENT: 6 Work Stations consisting of HP Vectra Pentium computers with 1.2 GB hard disks, 64 MB RAM, CD-ROM, 10T NIC.
 HP Laser Printer
 Tektronix Oscilloscope
 Tektronix Function Generator
 Lab Furnace and SCR Power Supply
 Digital Multimeters
 ANSYS Software
 Ethernet Connections
 Potentiostat/Galvanostat-PAR 273 Test Cell

TABLE J (6)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Roberts 109	Image Analysis and Microscopy MSE 317-318 Physical Materials Labs MSE 330 Processing Inorganic Materials MSE 423 Fiber Composite Materials MSE 499 Senior Project MET E 421 Metallurgical Processing	Excellent	Excellent	1-2	163

SIGNIFICANT EQUIPMENT: Optical Microscope
 Stereo Microscopy
 TV Image System
 Copy Stand
 Polaroid Camera
 Dell Dimension 4100 computer with 933 Mhz Pentium CPU, 512 MB RAM, 40 GB HD, nVidia 32 MB, 10/100 NIC, 48x CD-ROM, ADI Soundmax, 250 ZIP, Firewire, 8x4x32 CD-RW and Trinitron 21" Dell monitor
 Digital Camera: CoolPix 990 digital camera 2048 x 1536 3.34 Megapixels, MC-EY1 Shutter, 128 MB flash card, USB Compact Flash Reader

FUTURE PLANS: New user friendly and more powerful image analysis package [*in process*]

TABLE J (7)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Roberts 129	X-Ray Diffraction MSE 314 X-Ray Diffraction and Crystallography MSE 330 Processing of Inorganic Materials MSE 499 Senior Project CER E 421 Ceramic Processing	Very Good	Fair	1	410

SIGNIFICANT EQUIPMENT: Data acquisition for old diffractometer converted to computer data
Data processing software

FUTURE PLANS: More space to give students adequate space
Diffractometer system being upgraded to handle high demand/use during Fall Quarter.
New Diffractometer to separate research and teaching demands – proposal for a research grad diffractometer is being prepared.

Upgrade the Phillips XRD

TABLE J (8)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Roberts 221	Materials Processing Lab MSE 423 Fiber Composite Materials Lab MSE 499 Senior Project CER E 411 Vitreous State Lab	Excellent with required safety supplies & maintenance	Good	N/A	514

SIGNIFICANT EQUIPMENT: Green State Processing Equipment
Polymer Characterization Equipment
High Temperature Furnace

NEW EQUIPMENT: Hot Press to process ceramic matrix composites (1995)
Various processing supplies (hot plates, glassware, powder, polishing equipment)
Complete thermal analysis facilities (DSC, DTA, TGA, TMA, DMAB, Dilatometer)

FUTURE PLANS: Upgrades computers.

TABLE J (9)
LABORATORY FACILITIES

PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Wilcox 35	Rolling Mill Induction Melter MSE 317, 318, 319 Physical Materials Labs MSE 499 Senior Projects MET E 462 Mechanical Behavior of Materials	Fair	Fair	1	520

NEW EQUIPMENT: Impact Testing Machine

FUTURE PLANS: New induction furnace; Hot-Isostatic Press

TABLE J (10)
LABORATORY FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Wilcox 133	Mechanical Testing Lab – Tensile compression and bend testing of metals, ceramics and polymers. MSE 170 Fundamentals of Materials Science MSE 319 Physical Materials Lab MSE 423 Fiber Composite Materials MSE 433 Polymeric Materials MSE 499 Senior Project MET E 421 Metallurgical Processing Lab MET E 462 Mechanical Behavior of Materials MET E 463 Reliability and Design in Metallurgical systems MET 465 Mechanical Behavior Lab CER E 416 Mechanical Properties of Ceramics Lab	Good	Poor – inadequate furniture, small Instron is down	1	422

SIGNIFICANT EQUIPMENT: Instron 4505 Testing Machine
 10 KN Load Cell
 10% Self-Identifying Extensometer
 Grindosonic Sonic Modulus Tester

FUTURE PLANS: One more bench top universal testing machine. Upgrade of software, hardware and furniture.

TABLE J (11)
COMPUTER FACILITIES
PROGRAM: Metallurgical and Ceramic Engineering

Physical Facility Building & Room (1)	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory (2)	Adequacy for Instruction	No. Student Stations	Area (sq ft)
Mueller 168	MSE 170 Lab	Excellent	Excellent	8	553
Mueller 178	Computer Lab	Excellent	Excellent	16	524
Roberts 131	Graduate Computing Lab	Excellent	Excellent	12	347

NEW EQUIPMENT:

Mueller 168: 9 Dell Dimension XPS R400, 300 MHz CUP, 10 GB HD, 100 Zip, 128 MB RAM, 10/100 NIC, 32 x CD-ROM. One of the 10 computers is on a cart attached to a computer projector.

Mueller 178: 16 x Dell 420 Workstations with 933-1000 MHz Pentium CPU, 256 MB RAM, 18 GBHD, nVidia 32 MB, 250 ZIP, 10/100 3Com NIC, 48x CD-ROM, 12x8x32 CD-RW, FireWire 3p, SoundBlaster Pro, and 17" monitors.

Roberts 131: 12 x Dell Dimension 4100 computers with 933 Mhz Pentium CPU, 512 MB RAM, 40 GB HD, nVidia 32 MB, 10/100 NIC, 48x CD-ROM, ADI Soundmax, 250 ZIP, FireWire, 8x4x32 CD-RW, and Trinitron 21" Dell monitors.