

**BIOMEDICAL ENGINEERING**

**491D\***. **Low Temperature Biotechnology**  
 3(3-0)  
 P: BME 311.

Special topics in biomedical engineering or bioengineering of current interest and importance.  
 QP: APPROVAL QA: BME 499

**BOTANY AND PLANT PATHOLOGY/NATURAL SCIENCE BOT**

**105. Plant Biology**  
 Fall, Spring. 3(3-0)

Plant structure, function, development, genetics, diversity and ecology.  
 QA: BOT 205

**106. Plant Biology Laboratory**  
 Fall, Spring. 1(0-3)  
 P: BOT 105 or concurrently.

Cell structure, anatomy, physiology, growth and development, and diseases of plants.  
 QA: BOT 206

**202. The Form and Evolution of Plants**  
 Spring. 4(2-4)  
 P: BS 110 or BOT 105.

Divergent and convergent evolution throughout the plant kingdom. Basic principles underlying the structure, function, and reproduction of plants.  
 QP: BS 212 ORBOT 205 QA: BOT 302

**218. Plants of Michigan**  
 Fall. 3(2-3)  
 P: BS 110 or BOT 105.

Plant taxa of Michigan and the Great Lakes region and the major habitats in which they occur. Principles and rationale of classification. Relationships between life histories, morphology and environment.  
 QP: BOT 205 ORBS 212

**301. Introductory Plant Physiology**  
 Fall, Spring. 3(2-3)  
 P: CEM 141 or CEM 151; CEM 161; BOT 105 or BS 111 or LBS 141; organic chemistry

General principles of plant physiology relating plant structure to function. Cell physiology, water relations, effects of light and temperature, respiration, photosynthesis, mineral nutrition, and hormone action.  
 QP: CEM 141 ORCEM 151CEM 161BOT 205 QA: 301

**335. Plants Through Time**  
 Spring of odd-numbered years. 3(3-0)  
 Interdepartmental with the Department(s) of Geological Sciences.  
 P: BS 110 or BOT 105 or GLG 201. R: Juniors and above.

Evolutionary history of plants, the development of ecosystems, and the use of plant fossils in the reconstruction of ancient environments and climate.  
 QP: BOT 205 ORBS 212ORLBS 140 QA: GLG 335 BOT 335

**336. Useful Plants**  
 Spring. 3(3-0)  
 P: CEM 142 or CEM 143 or CEM 152; BOT 105 or BS 110 and BS 111.

Ways in which plants are used for myriad purposes from food and construction materials to medicines and perfumes. The potential for expanding the uses of plants through biotechnology will be explored.  
 QP: BOT 205 ORBS 212 QA: BOT 336

**402. Biology of Fungi**  
 Fall. 3(2-3)  
 P: BS 110, BS 111 or BOT 105 or LBS 140 or MPH 302.

Major groups of fungi: characteristics, habitats and diversity. Significance of fungi in nature and their economic importance.  
 QP: BOT 205 ORLBS 140ORBS 212 QA: BOT 402 BOT 320

**405. Introductory Plant Pathology**  
 Fall. 4(2-4)  
 P: BS 110, BS 111 or BOT 105 or LBS 140. R: Not open to students with credit in BOT 407.

Important plant diseases and the organisms that cause them. Principles of disease management including application of chemicals, plant breeding, biological control, and genetic engineering.  
 QP: BOT 302 ORBS 212ORLBS 140 QA: 405

**406\*. Medical Mycology**  
 Spring. 3(2-3) Interdepartmental with the Department(s) of Medical Technology, Microbiology and Public Health.  
 P: BOT 402; MPH 302

Characteristics and laboratory identification of fungal diseases in humans and other animals, emphasizing laboratory techniques and morphological characteristics of the causative fungi.  
 QP: BOT 320 MPH 302 QA: BOT 406

**407\*. Diseases and Insects of Forest and Shade Trees**  
 Spring. 4(3-3) Interdisciplinary with the Department(s) of Entomology.  
 P: BOT 301 and BOT 318 or FOR 204 or HRT 210 and 211 R: Students not receive credits in both BOT 407 & BOT 407

Diseases, insects, and environmental problems which affect trees in forests, parks, suburbs, and nurseries, and methods of control.  
 QP: BOT 301 BOT 302BOT 318FOR 204 QA: BOT 407 ENT 337 FOR 330

**414. Plant Physiology: Metabolism**  
 Fall. 3(3-0)  
 P: CEM 251, BOT 105 or BS 110, BS 111 or LBS 140.

General principles underlying metabolic processes of plants. Photosynthesis, translocation and water relations, nitrogen metabolism, cell wall biosynthesis, and structures associated with those processes.  
 QP: BOT 205 ORBS 210ANDBS 211 QA: BOT 414

**415. Plant Physiology: Growth, Development and the Environment**  
 Spring. 3(3-0)  
 P: CEM 251; BOT 105 or BS 110, BS 111 or LBS 140.

Principles of plant growth and development with emphasis on environmental and hormonal factors that control progression of the plant through its life cycle. Tissue culture and genetic engineering in plants.  
 QP: CEM 241 BOT 205ORBS 210AND QA: BOT 415

**416. Experiments in Plant Physiology and Molecular Biology**  
 Fall. 4(2-5)  
 P: BOT 414 or BOT 415.

Experiments illustrating principles of plant physiology and molecular biology. Advanced techniques such as agrobacterium mediated gene transfer, DNA cloning, enzyme linked immunosassays (ELISA), protein and DNA electrophoresis.  
 QP: BOT 414 BOT 415 QA: BOT 416

**418. Plant Systematics**  
 Spring, Summer. 3(2-3)  
 P: BOT 105 or BS 110, BS 111 or LBS 140.

Classification and evolution of higher plants, with emphasis on identification, characteristics of plant families, and systematic theory and practice.  
 QP: BOT 205 ORLBS 140ORBS 212 QA: BOT 318

**423\*. Aquatic Plant Biology**  
 Fall, Summer of even-numbered years. 4(2-4)  
 P: BS 110, BS 111 or BOT 105, BOT 106.

Identification, ecology and community relations of algae and aquatic vascular plants common to the Great Lakes area. Algae and Aquatic Plants as indicators of environmental change.  
 QP: BOT 205 ANDBOT 206ORBS 210 AND LBS 141 QA: 423 447

**434. Plant Structure and Function**  
 Fall of odd-numbered years. 4(2-4)  
 P: BS 110, BS 111 or BOT 105, BOT 106 or BOT 202 or LBS 140.

Plant anatomy from a structure and function perspective. The physiological, developmental, and ecological significance of cell types, tissue types, and meristems of vegetative and reproductive plant parts.  
 QP: BS 210 BS 211ANDBS 212OR AND LBS 242 QA: BOT 434

**441\*. Plant Ecology**  
 Fall. 3(3-0)  
 P: BS 110 or BOT 105.

Ecology of plants and their communities. Effects of biotic and climatological factors influencing global distribution of plant communities. Community structure and function, microclimatology, ecophysiology, and adaptation.  
 QP: BS 212 ORBOT 205ORLBS 140 QA: BOT 441

**490\*. Directed Studies**  
 Fall, Spring, Summer. 1 to 4 credits.  
 May reenroll for a maximum of 6 credits.  
 R: Approval of department.

Directed study of published literature in an area of botany and plant pathology.  
 QA: BOT 401

**490H\*. Honors Directed Studies**  
 Fall, Spring, Summer. 1 to 4 credits.  
 May reenroll for a maximum of 6 credits.  
 R: Approval of department.

Directed study of published literature in an area of botany and plant pathology.  
 QA: BOT 400H

**496\*. Undergraduate Research**  
 Fall, Spring, Summer. 1 to 4 credits.  
 May reenroll for a maximum of 12 credits.  
 R: Approval of department.

Laboratory and/or field research in an area of botany and plant pathology.

**499\*. Senior Seminar**  
 Spring. 2(2-0) May reenroll for a maximum of 4 credits.  
 P: 3 credits of BOT 498

A capstone experience that focuses on current developments and issues in plant biology. Scientific writing and oral presentation.  
 QA: 499

**800\*. Seminar in Plant Biology**  
 Fall, Spring. 1(1-0) May reenroll for a maximum of 4 credits.  
 R: Open only to graduate students.  
 Current research and approaches in plant biology.

**801\*. Seminar in Plant Pathology**  
 Fall, Spring. 1(1-0) May reenroll for a maximum of 4 credits.  
 R: Open only to graduate students.  
 Current research and approaches in plant pathology.  
 QA: BOT 846

**BOTANY AND PLANT PATHOLOGY/NATURAL SCIENCE**

- 803\*.** **Selected Topics(MTC)**  
Fall, Spring, Summer. 1 to 4 credits.  
May reenroll for a maximum of 12 credits.
- Topics in specific areas of botany and plant pathology  
QA: BOT 890 BOT 891
- 803A\*.** **Selected Topics - Anatomy and Morphology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Recent developments in anatomy and morphology  
QA: BOT 891
- 803B\*.** **Selected Topics - Taxonomy and Systematics**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Recent developments in taxonomy and systematics  
QA: BOT 891
- 803C\*.** **Selected Topics - Ecology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Recent developments in ecology  
QA: BOT 891
- 803D\*.** **Selected Topics - Physiology and Biochemistry**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Recent developments in physiology and biochemistry  
QA: BOT 891
- 803E\*.** **Selected Topics - Genetics and Molecular Biology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Recent developments in genetics and molecular biology  
QA: BOT 891
- 803F\*.** **Selected Topics - Mycology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Recent developments in mycology  
QA: BOT 890
- 803G\*.** **Selected Topics - Plant Pathology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Recent developments in plant pathology  
QA: BOT 891
- 804\*.** **Special Problems(MTC)**  
Fall, Spring, Summer. 1 to 4 credits.  
May reenroll for a maximum of 12 credits.
- Topics may be selected from any area of botany and plant pathology.  
QA: BOT 890 BOT 891
- 804A\*.** **Special Problems in Taxonomy and Systematics**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Individual, faculty-directed study in taxonomy  
QA: BOT 801
- 804B\*.** **Special Problems in Anatomy & Morphology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Individual, faculty-directed study in anatomy & morphology  
QA: BOT 801
- 804C\*.** **Special Problems in Plant Pathology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Individual, faculty-directed study in plant pathology  
QA: BOT 801
- 804D\*.** **Special Problems in Physiology & Biochemistry**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Individual, faculty-directed study in physiology & biochemistry  
QA: BOT 801
- 804E\*.** **Special Problems in Genetics & Molecular Biology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Individual, faculty-directed study in genetics & molecular biology  
QA: BOT 801
- 804F\*.** **Special Problems in Mycology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Individual, faculty-directed study in mycology  
QA: BOT 801
- 804G\*.** **Special Problems in Ecology**  
. 1 to 4 credits. May reenroll for a maximum of 12 credits.
- Individual, faculty-directed study in ecology  
QA: BOT 801
- 810\*.** **Current Concepts in Plant Pathology**  
Spring. 3(3-0)  
P: BOT 405 or BOT 414 or BOT 415.
- Recent findings in mycology, plant virology, bacteriology, nematology, disease physiology and epidemiology.  
QP: BOT 405 ORBOT 414ORBOT 415
- 812\*.** **Epidemiology of Plant Diseases**  
Spring of even-numbered years. 3(3-0)  
P: BOT 810.
- Populations of plant pathogens within populations of plant hosts as affected by the environment and human involvement.  
QP: BOT 405 QA: BOT 812
- 823\*.** **Flowering Plant Diversity**  
Fall of odd-numbered years. 4(2-4)  
P: BOT 418.
- Evolutionary diversity of flowering plants. Family characteristics, patterns of distribution, systems of classification, evolutionary trends, economic importance.  
QP: BOT 318 QA: BOT 823 BOT 824
- 824\*.** **Principles and Methods of Plant Systematics**  
Spring of even-numbered years. 4(2-4)  
P: BOT 823.
- Classification methods, quantification of evolutionary relationships, phenetic, phyletic molecular, and cladistic approaches.  
QP: BOT 823 BOT 824
- 826\*.** **Tropical Biology: An Ecological Approach**  
Spring, Summer. 8(4-8)  
Interdepartmental with the Department(s) of Zoology.,  
P: Approval of department R: Graduate students only
- Principles of tropical ecology at the population, community and ecosystem levels. Given at various sites in Costa Rica by the Organization for Tropical Studies.  
QA: BOT 826 ZOL 826
- 827\*.** **Tropical Managed Ecosystems**  
Spring, Summer. 8(4-8)  
Interdepartmental with the Department(s) of Zoology.,  
R: Open only to graduate students.
- Approval of department.  
The scientific and social dimensions of sustainable development in the tropics. Given at various sites in Costa Rica by the Organization for Tropical Studies.
- 830\*.** **Paleobotany**  
Fall of even-numbered years. 3(2-3)  
Interdepartmental with the Department(s) of Geological Sciences.,  
R: Open only to graduate students.
- Approval of department.  
Survey of fossil plants: preservation, occurrence, geological relations, taphonomy, whole plant reconstruction, evolutionary history, and paleoecology.  
QA: BOT 830 GLG 830
- 840\*.** **Ecology and Evolution in Terrestrial Systems**  
Summer. 4(-) Interdepartmental with the Department(s) of Zoology, Crop and Soil Sciences.,  
P: STT 422
- Field experimental and quantitative approaches to ecological and evolutionary mechanisms.  
QP: STT 423 QA: BOT 839
- 844\*.** **Organelle Genetics**  
Spring of odd-numbered years. 3(3-0)  
Interdepartmental with the Department(s) of Zoology.,  
P: BOT 856 or BCH 811; ZOL 341
- Organization, structure, function, heredity, molecular biology and manipulation of chloroplasts and mitochondria. Biological interaction between nucleus and organelles  
QP: BOT 856 ZOL 441 QA: BOT 844
- 847\*.** **Advanced Mycology**  
Spring of even-numbered years. 5(2-6)  
P: BOT 302.
- Classification, morphology and relationships of fungi; physiology, genetics, and molecular biology of fungi; identification techniques within selected orders.  
QP: BOT 320 QA: BOT 847 BOT 848
- 849\*.** **Evolutionary Biology**  
Spring. 3(3-0) Interdepartmental with the Department(s) of Zoology.,  
P: ZOL 341; STT 422 or concurrently.
- Major conceptual, theoretical and empirical questions in evolutionary biology. Readings and lectures are synthesized in student discussions.  
QP: ZOL 441 STT 423
- 856\*.** **Plant Molecular Biology**  
Spring. 3(3-0) Interdepartmental with the Department(s) of Biochemistry.,  
P: ZOL 341.
- Advances in genetics and molecular biology of higher plants.  
QP: ZOL 441 QA: BOT 856 BCH 856 GEN 856
- 863\*.** **Environmental Plant Physiology**  
Spring of odd-numbered years. 3(3-0)  
Interdepartmental with the Department(s) of Horticulture.,  
P: BOT 301 or BOT 414 or BOT 415
- Interaction of the plant and its environment; photobiology, thermophysiology and plant-water relations.  
QP: BOT 301 ORBOT 413ORBOT 414 QA: BOT 863
- 865\*.** **Plant Growth and Development**  
Fall. 3(3-0)  
P: BOT 415.
- Physiology and biochemistry of growth and development as regulated by internal and external factors. Biosynthesis and action of plant hormones. Environmental factors: light and temperature.  
QP: BOT 415 QA: BOT 865

**BOTANY AND PLANT PATHOLOGY/NATURAL SCIENCE**

**880\*. Plant Virology**  
 Fall of even-numbered years. 4(2-4)  
 P: BCH 462, BOT 810. R: Open only to graduate students.  
 Biology and molecular aspects of viruses causing plant disease.  
 QP: BOT 405 BCH 453 QA: BOT 880

**881\*. Molecular and Biochemical Plant Pathology**  
 Spring of odd-numbered years. 3(2-2)  
 P: BCH 462; BOT 414 or BOT 415; BOT 810; ZOL 341. R: Open only to graduate students.  
 Biochemical and molecular bases of host-pathogen interactions. Mechanisms of pathogenicity and the nature of disease resistance.  
 QP: BCH 453 ZOL 441BOT 415ORBOT 405  
 QA: BOT 881

**884\*. Prokaryotic Diseases of Plants**  
 Fall of odd-numbered years. 4(2-4)  
 P: BOT 810.  
 Description of prokaryotic genera associated with plant diseases, identification, physiology, and genetics. Laboratory techniques.  
 QP: BOT 405 QA: BOT 884

**885\*. Plant Diseases in the Field**  
 Summer. 2(1-3)  
 P: BOT 810. R: Open only to graduate students.  
 Diagnosis of plant diseases and disorders in a field setting. Field trips and independent study are required.  
 QP: BOT 405 QA: BOT 885

**899\*. Master's Thesis Research**  
 Fall, Spring, Summer. 1 to 12 credits.  
 May reenroll for a maximum of 24 credits.  
 R: Open only to graduate students.  
 Research in anatomy, bryology, cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.  
 QA: BOT 899

**999\*. Doctoral Dissertation Research**  
 Fall, Spring, Summer. 1 to 24 credits.  
 May reenroll for a maximum of 99 credits.  
 R: Open only to doctoral students.  
 Research in anatomy, bryology, cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.  
 QA: BOT 999

**BUILDING CONSTRUCTION MANAGEMENT BCM**

**126\*. Residential Construction Materials, Methods and Drafting**  
 Fall, Spring, Summer. 5(3-4)  
 R: Open only to Building Construction Management students. Not open to students with credit in HED 150.  
 Materials, methods, codes and drafting in residential construction.  
 QA: BCM 214 BCM 215 BCM 415

**227\*. Commercial Building Construction Methods**  
 Fall, Spring. 3(3-0)  
 P: BCM 126. R: Open only to Building Construction Management students.  
 Methods, codes, and plans for constructing commercial buildings. Construction system details: site preparation, foundations, floors, framing systems, and roof systems.  
 QP: BCM 215 BCM 214 QA: BCM 217

**230\*. Utilities**  
 Fall, Spring. 3(3-0)  
 P: BCM 227. R: Not open to freshmen.  
 Open only to Building Construction Management students.  
 Heating, cooling, plumbing and electrical utilities in residential and light commercial construction utilizing applicable codes.  
 QP: BCM 216 BCM 217 QA: BCM 412

**250\*. Construction Mechanics and Equipment Management**  
 Fall. 3(2-3)  
 R: Open only to Building Construction Management and Agricultural Technology and Systems Management students.  
 Principles, applications, techniques, tools, materials and resources in building construction mechanics and light construction equipment management.  
 QA: BCM 201 BCM 327

**252\*. Current Issues in the Building and Housing Industries**  
 Fall. 3(3-0)  
 Impacts of government policies and regulations on the building and housing industries. Land use, construction technology, energy. Economics, demographics, and lifestyle choices.  
 QA: BCM 200

**311. Quantitative Methods in Technology Management**  
 Fall, Spring. 3(3-0)  
 P: MTH 116 or MTH 120; CPS 100 or CPS 130 or CPS 131. R: Not open to freshmen and sophomores.  
 Technology management methods including linear programming, scheduling, decision theory, queuing and simulation. Applications in building construction management, agriculture and associated industries.  
 QP: MTH 108 MTH 111CPS 115CPS 100 QA: ATM 311

**322\*. Structural Design**  
 Fall, Spring. 4(5-0)  
 P: BCM 227; PHY 231 or PHY 231B. R: Open only to Building Construction Management majors.  
 Mechanics, material strengths and section properties developed and applied to structural design using wood, steel and concrete. Beams, columns, footings, and foundation walls.  
 QP: BCM 215 PHY 237 QA: BCM 312 BCM 313

**324\*. Construction Estimation**  
 Fall, Spring. 4(3-2)  
 P: BCM 230, BCM 322. R: Open only to Building Construction Management majors.  
 Estimating construction projects: labor, material, overhead, and profit in unit and detailed formats. Job cost accounting and control. Estimation software.  
 QP: BCM 217 BCM 412 QA: BCM 416

**325\*. Construction and Real Estate Finance**  
 Fall, Spring. 4(4-0)  
 P: EC 201 or EC 202; MTH 116 or MTH 120. R: Not open to freshmen and sophomores. Open only to Building Construction Management majors.  
 Financial methods and instruments utilized in construction, rehabilitation, development, and purchase of real estate. Terms, contracts, valuation, brokerage, taxation, risk, and interest rate analysis.  
 QP: MTH 109 ORMTH 110ORMTH 111 QA: BCM 417 FI 395

**340\*. Residential Design Evaluation**  
 Fall. 3(3-0)  
 P: BCM 126 or HED 160. R: Not open to freshmen and sophomores. Open only to Building Construction Management and Human Environment and Design majors.  
 Qualitative methods for evaluating residential building designs. Design impacts on building occupants: children, families, singles, handicappers, elderly.  
 QP: BCM 215

**349\*. Construction Renovation**  
 Spring. 3(3-0)  
 P: BCM 227. R: Open only to Building Construction Management and Human Environment and Design majors.  
 Preservation, rehabilitation, remodeling and restoration of existing buildings. Analysis of building adaptability and design. Economic feasibility and codes. Historical and social considerations.  
 QP: BCM 217 QA: BCM 239 BCM 339

**351\*. Concepts of Fire Safe Construction**  
 Fall. 3(3-0)  
 P: BCM 126. R: Open only to Building Construction Management majors.  
 Safety and fire integrity of structures: principles, terminology, and techniques of construction affecting life. Applicable codes. Materials and assemblies. Suppression and detection systems.  
 QP: BCM 215 ORBCM 217ORBCM 412 QA: BCM 318 BCM 490

**352\*. Land Development**  
 Spring. 3(3-0)  
 P: BCM 126; BCM 325 or concurrently.  
 R: Open only to Building Construction Management, Civil Engineering, History of Art, Landscape Architecture, and Urban Planning majors.  
 Methods and practices of land development for residential and commercial uses. Market research. Land use regulations. Legal documentation. Site analysis and design. Case Studies.  
 QP: BCM 215 BCM 417 QA: BCM 418 BCM 490

**422\*. Construction Contracts**  
 Fall, Spring. 3(3-0)  
 P: BCM 227, BCM 311, BCM 324 R: Seniors and above BCM, CE  
 Construction contracts for commercial and residential projects. Contract procedures, bidding, changes, substitutions, insurance, bonding, claims, disputes, and payments. Specifications. Responsibilities of owner and contractors.  
 QP: ATM 311 BCM 217BCM 416

**423\*. Construction Project Management**  
 Fall, Spring. 3(3-0)  
 P: BCM 311, BCM 324. R: Open only to seniors and graduate students in Building Construction Management and Civil Engineering.  
 Construction management principles and practices. Site and project management.  
 QP: BCM 416 ATM 311 QA: BCM 420

**452\*. Commercial Utility Systems**  
 Spring. 3(3-0)  
 P: BCM 230. R: Open only to Building Construction Management, Mechanical Engineering, Civil Engineering, and Human Environment and Design majors.  
 Primary electrical, heating, ventilating, air conditioning, plumbing, elevator, and fire detection and suppression systems for commercial buildings.  
 QP: BCM 412

**490\*. Independent Study**  
 Fall, Spring, Summer. 1 to 4 credits.  
 May reenroll for a maximum of 8 credits.  
 R: Open only to Building Construction Management majors. Approval of department; application required.  
 Special problems in acquisition and development of residential land, design, construction technology, building materials, finance, marketing, construction management, or land use codes and regulations.  
 QA: BCM 418