

**859 Nonlinear Control**  
 Spring. 3(3-0) Interdepartmental with Electrical and Computer Engineering. Administered by Department of Electrical and Computer Engineering. RB: (ECE 826 and ME 857) SA: ECE 827

Second-order systems. Fundamental properties of solutions. Lyapunov stability. Input-output stability. Passivity. Absolute stability. Linearization. Integral control. Feedback linearization. Sliding mode control. Lyapunov redesign. Passivity-based control. Recursive methods. Applications to electrical and mechanical systems.

**860 Theory of Vibrations**  
 Fall. 3(3-0)

Discrete systems and continua. Analytical mechanics. Variational principles. Modal analysis. Function spaces. Eigenfunction expansions. Integral transforms. Stability. Approximations. Perturbations.

**861 Advanced Dynamics**  
 Fall. 3(3-0) SA: MSM 801

Dynamics of systems of particles and rigid bodies. Energy and momentum principles. Lagrangian and Hamiltonian methods. Euler angles. Applications in system dynamics and vibrations.

**863 Nonlinear Vibrations**  
 Spring of even years. 3(3-0) RB: (ME 461)

Perturbation methods. Weakly nonlinear partial and ordinary differential equations. Modal interactions, internal tuning, saturation, sub/super/composition resonances, jump phenomenon. Nonlinear normal modes.

**872 Finite Element Method**  
 Fall, Spring. 3(3-0) Interdepartmental with Civil Engineering. SA: AE 809, MSM 809

Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics, and stress analysis.

**874 Analysis of Metal Forming and Manufacturing Processes**  
 Fall of odd years. 3(3-0) RB: (ME 471 and MSM 809 and MSM 817 and MSM 810)

Review of fundamental knowledge in mechanics, materials and numerical analysis. Modeling, simulation and analysis of metal forming and manufacturing processes.

**875 Optimal Design of Mechanical Systems**  
 Spring of odd years. 3(3-0) RB: (ME 461)

Optimal design for static and dynamic response of mechanical and structural systems. Necessary and sufficient conditions for optimality. Discrete and continuous parameter problems. Sensitivity of response to design variations. Algorithms.

**891 Selected Topics in Mechanical Engineering**

Fall, Spring. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Special topics in mechanical engineering of current importance.

**898 Master's Project Research**

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 7 credits in all enrollments for this course. R: Open only to master's students in the Mechanical Engineering major. Approval of department.

Master's degree Plan B individual student project: original research, research replication, or survey and reporting on a topic such as system design and development, or system conversion of installation.

**899 Master's Thesis Research**  
 Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 24 credits in all enrollments for this course.  
 Master's thesis research.

**921 Nonlinear Elasticity**  
 Fall of odd years. 3(3-0) RB: (ME 821) SA: MSM 915

Kinematics and kinetics of large deformations. Incompressible and compressible finite elasticity. Solution of basic problems. Nonuniqueness, stability, and buckling. Singular fields near cracks and flaws.

**922 Thermoelasticity and Viscoelasticity**  
 Spring of even years. 3(3-0) RB: (ME 820 and MTH 443) SA: MSM 918

Thermomechanics of solids. Theory of thermoelasticity. Boundary value problems in thermoelasticity. Linear and nonlinear viscoelasticity. Model representation. Boltzmann superposition. Correspondence principle.

**925 Optical Methods of Measurement**  
 Fall of even years. 3(2-3) R: Approval of department. SA: MSM 905

Measurement of dimension, position, motion, strain, using optical methods including holography, speckle interferometry, Moire, photoelasticity, laser Doppler, electronic imaging, model analysis. Relevant optics theory.

**940 Selected Topics in Thermal Science**  
 Spring. 1 to 3 credits. A student may earn a maximum of 12 credits in all enrollments for this course. RB: (ME 812 and ME 814 and ME 816) R: Open only to Mechanical Engineering majors.

Conduction, convection, radiation, phase change and interactive combined modes of heat transfer. Mass transfer. Irreversible thermodynamics.

**941 Advanced Computational Fluid Dynamics and Heat Transfer**  
 Fall of even years. 3(3-0) P:M: (ME 840)

High-resolution methods such as total variation diminishing and essentially non-oscillatory, for hyperbolic conservation laws. Unstructured grid generation methods and finite element methods on these grids. Convergence acceleration methods for steady problems and basic concepts in parallel computing.

**960 Selected Topics in Vibrations**  
 Fall. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: (ME 860)

Current topics of interest to the student and faculty.

**961 Nonlinear Dynamics and Chaos**  
 Fall of even years. 3(3-0) RB: (ME 857 or ME 860 or EDE 826 or MTH 441)

Qualitative theory of dynamical systems applied to physical system models. Bifurcation theory for continuous and discrete-time systems, chaos, the Smale horseshoe, Melnikov's method, and nonlinear data analysis.

**990 Independent Study in Mechanical Engineering**

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.  
 Individualized study of a current problem in mechanical engineering.

**999 Doctoral Dissertation Research**  
 Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 72 credits in all enrollments for this course.  
 Doctoral dissertation research.

## MEDICAL TECHNOLOGY MT

### Medical Technology Program College of Natural Science

**120 Learning in the Biomedical Sciences**  
 Fall. 1 credit. Not open to students with credit in NSC 201 or NSC 202.

Learning strategies appropriate for science. Development of critical thinking and problem solving. Group processes. Adapting study to personal learning styles and college instruction.

**150 Preview of Biomedical Research**  
 Spring. 1(1-0) Interdepartmental with Natural Science.

Exploration of biomedical research careers. Biomedical research in the United States: funding, safety, regulatory agencies, ethics, experimental design, trouble-shooting, and data interpretation.

**204 Mechanisms of Disease**  
 Spring. 3(3-0) P:M: (BS 111 or LBS 145)  
 Pathophysiological mechanisms of diseases. Selected applications to organ system pathology.

**213 Application of Clinical Laboratory Principles**  
 Fall, Summer. 2(1-3) RB: (BS 111L) R:  
 Open only to students in the Clinical Laboratory Sciences or Medical Technology or Human Biology major or LBS Medical Technology coordinate major.

Lab safety and standards of good laboratory practice including specimen handling and processing. Application of technologies and techniques to the performance of clinical diagnostic testing.

**220 Preparing for a Health Professions Career**  
 Spring. 1(1-0) R: Open only to freshmen, sophomores, or juniors. SA: MT 212

Development of skills needed for success in health professions careers. Historical, economic, sociological and ethical perspectives on the U.S. health professions with focus on medical laboratory careers.

**324 Fundamentals of Hematology, Hemostasis, and Urinalysis**  
 Fall. 3(3-0) P:M: (BS 111 or concurrently or LBS 145 or concurrently)

Physiology and biochemistry of normal hematologic, hemostatic, and urinary systems. Principles of diagnostic assays to detect diseases affecting those systems.

## Medical Technology—MT

- 324L Introductory Laboratory in Hematology, Hemostasis and Urinalysis**  
Fall. 1(0-3) P:M: (MT 324) R: Open only to students in Clinical Laboratory Sciences. SA: MT 423  
Routine laboratory assays used to assess the health of the hematological, hemostatic, and urinary systems.
- 416 Clinical Chemistry**  
Fall. 4(4-0) P:M: (MT 213) and (BMB 401 or BMB 461) and (PSL 250 or PSL 432) RB: (MT 417) and (CEM 332 or CEM 333)  
Correlation of laboratory test results with normal physiology and biochemistry and with disease states. Metabolic and endocrine systems. Acquired and inherited diseases. Therapeutic drug monitoring, and toxicology.
- 417 Quality Processes in Diagnostic Laboratory Testing**  
Fall. 2(2-0) P:M: (STT 200 or concurrently or STT 201 or concurrently or STT 421 or concurrently or STT 351 or concurrently or STT 231 or concurrently) RB: (MT 213) SA: MT 414  
Statistical methods for validating diagnostic laboratory tests including quality control processes, proficiency testing, method evaluation, related regulatory requirements, laboratory information systems, and laboratory mathematics.
- 424 Advanced Hematology, Hemostasis and Urinalysis**  
Spring. 2(2-0) P:M: (MT 324) SA: MT 422  
Etiology and pathogenesis of diseases of the hematologic, hemostatic and urinary systems including anemias, leukemias, and hemophilias. Diagnostic testing for such diseases.
- 424L Advanced Laboratory in Hematology, Hemostasis, and Urinalysis**  
Spring. 1(0-3) P:M: (MT 424 or concurrently) SA: MT 423  
Specialized and advanced assays used in the diagnosis of diseases of the hematological, hemostatic, and urinary systems.
- 430 Molecular Laboratory Diagnostics**  
Spring. 2(2-0) P:M: (BMB 401) or (BMB 461 and BMB 462) and (BS 111 or LBS 145)  
Concepts and principles of molecular analysis applied to medical diagnostics and related applications.
- 433 Clinical Immunology and Immunochemistry Laboratory**  
Spring. 1(0-3) P:M: (MT 213 and MT 435 or concurrently) R: Open only to students in the Clinical Laboratory Sciences major.  
Immunologic methods for disease detection. Methods of blood typing and pre-transfusion testing.
- 434 Clinical Immunology**  
Fall. 3(3-0) P:M: (BS 111 or concurrently or LBS 145 or LBS 149H or LBS 159H) SA: MT 432 Not open to students with credit in MMG 451.  
Concepts of innate, cellular, and humoral immunity. Immunodeficiency and autoimmunity. Principles and applications of immunoassays in medical laboratories.
- 435 Transfusion and Transplantation Medicine**  
Spring. 3(3-0) P:M: (MT 434 or MMG 451) SA: MT 432  
Principles and practice of transfusion medicine including blood typing. Principles and practices of transplantation medicine. Transplantation immunology, organ procurement, and rejection detection.
- 436 Principles of Diagnostic Molecular Science**  
Spring. 2(2-0) P:M: (BMB 461 and BS 111 and ZOL 341) Not open to students with credit in MT 830. C: BMB 462 concurrently.  
Principles and techniques of molecular diagnostic assays including applicable regulations.
- 437 Clinical Applications of Diagnostic Molecular Science**  
Spring. 2(2-0) P:M: (MT 436) Not open to students with credit in MT 831.  
Application of molecular diagnostic methods in clinical and other types of laboratory disciplines.
- 438 Molecular Diagnostic Laboratory**  
Fall. 2(0-6) P:M: (MT 436) Not open to students with credit in MT 832.  
Laboratory in molecular techniques with emphasis on clinical and diagnostic applications.
- 442 Education and Management in the Clinical Laboratory**  
Spring. 3(3-0) P:M: (MTH 116 or LBS 117) or (MTH 103 and MTH 114) or (STT 200 or STT 201 or STT 231 or STT 351 or STT 421) R: Open only to students in the Clinical Laboratory Sciences major.  
Basic principles and concepts in education and management in clinical laboratories. Systematic approach to instructional design, delivery and evaluation. Principles of leadership, personnel management, fiscal management, and regulatory compliance.
- 450 Eukaryotic Pathogens**  
Spring. 3(3-0) P:M: (BS 111) RB: (MMG 205 or MMG 301)  
Medically important fungi and parasites. Host-parasite relationships, life cycles, culture, identification, and associated diseases.
- 455 Integrating Clinical Laboratory Science Discipline (W)**  
Fall, Spring. 2(2-0) P:M: (MT 324 or concurrently and MT 417 or concurrently and MT 416 or concurrently and MMG 463 or concurrently and MT 435 or concurrently and CEM 332 or concurrently) and completion of Tier I writing requirement. R: Open only to seniors in the Medical Technology major or Clinical Laboratory Sciences undergraduate major.  
Problem oriented approach integrating topics from Medical Technology courses with emphasis on writing experience in the major and on critical thinking skills.
- 471 Advanced Clinical Chemistry Laboratory**  
Fall, Spring, Summer. 3 credits. P:M: (CEM 333)  
Application and integration of theory and technical skills in clinical chemistry and biochemistry.
- 472 Advanced Clinical Chemistry**  
Fall, Spring, Summer. 1 credit. R: Open only to seniors in the Clinical Laboratory Sciences major. C: MT 471 concurrently.  
Theoretical aspects of clinical chemistry, chemical and biochemical reactions, statistical analysis, and pathophysiologic relationships. Integration of cognitive material with clinical laboratory test results.
- 473 Advanced Clinical Hematology and Body Fluids Laboratory**  
Fall, Spring, Summer. 4 credits. P:M: (MT 424L)  
Application and integration of theory and technical skills in hematology, hemostasis, and body fluid analysis.
- 474 Advanced Clinical Hematology and Body Fluids**  
Fall, Spring, Summer. 1 credit. R: Open only to seniors in the Clinical Laboratory Sciences major. C: MT 473 concurrently.  
Theoretical aspects of advanced hematology, hemostasis and body fluid analysis. Integration of cognitive material with clinical laboratory test results.
- 475 Advanced Clinical Immunology and Immunochemistry Laboratory**  
Fall, Spring, Summer. 2 credits. P:M: (MT 433)  
Application and integration of theory and technical skills in immunology and immunochemistry.
- 476 Advanced Clinical Immunology and Immunochemistry**  
Fall, Spring, Summer. 1 credit. R: Open only to seniors in the Clinical Laboratory Sciences major. C: MT 475 concurrently.  
Theoretical aspects of immunology and immunochemistry. Integration of cognitive material with clinical laboratory test results.
- 477 Advanced Clinical Microbiology Laboratory**  
Fall, Spring, Summer. 3 credits. P:M: (MMG 464 and MT 450)  
Application and integration of theory and technical skills in clinical microbiology and infectious disease.
- 478 Advanced Clinical Microbiology**  
Fall, Spring, Summer. 1 credit. R: Open only to seniors in the Clinical Laboratory Sciences major. C: MT 477 concurrently.  
Theoretical aspects of clinical microbiology and infectious disease. Integration of cognitive material with clinical laboratory test results.
- 482 Advanced Diagnostic Molecular Science**  
Spring. 2 credits. R: Open only to students in the Diagnostic Molecular Science major. C: MT 483 concurrently, MT 484 concurrently, MT 485 concurrently, MT 486 concurrently.  
Integration of principles and concepts in diagnostic molecular science with diagnostic laboratory test results.
- 483 Molecular Diagnostic Experience in Hematopathology and Oncology**  
Spring. 2 credits. P:M: (MT 438 or concurrently) R: Open only to students in the Diagnostic Molecular Science major. C: MT 482 concurrently.  
Clinical experience in molecular diagnostic laboratories with applications in hematopathology and oncology

**484 Molecular Diagnostic Experience in Infectious Disease**  
2 credits. P:M: (MT 438 or concurrently) R: Open only to students in the Diagnostic Molecular Science major. C: MT 437 concurrently.

Clinical experience in molecular diagnostic laboratories with applications to infectious disease diagnosis.

**485 Molecular Diagnostic Experience in Inherited and Predictive Genetics**  
Spring. 2 credits. P:M: (MT 438 or concurrently) R: Open only to students in the Diagnostic Molecular Science major. C: MT 482 concurrently.

Clinical experience in molecular diagnostic laboratories with applications in inherited and predictive genetics.

**486 Molecular Diagnostic Experience in Genotyping and Individual Identification**  
Spring. 2 credits. P:M: (MT 437 or concurrently and MT 438) R: Open only to students in the Diagnostic Molecular Science major. C: MT 482 concurrently.

Clinical experience in molecular diagnostic laboratories with applications to genotyping and identification of individuals.

**495 Directed Study**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to students in the Clinical Laboratory Sciences or Medical Technology major or LBS Medical Technology coordinate major.

Faculty directed study including assigned readings, reviews of appropriate scientific periodicals, research and laboratory experience.

**496 Integrative Correlations in Clinical Laboratory Science I**  
Fall, Spring. 1(2-0) P:M: (MT 213) R: Open only to juniors or seniors in the Medical Technology or Clinical Laboratory Science and Lyman Briggs coordinate majors.

Application of the principles and concepts of clinical laboratory science in a problem-based learning format. Ethics, diagnostic value of laboratory tests, social-economic impact of laboratory tests and their regulation.

**497 Integrative Correlations in Clinical Laboratory Science II**  
Fall, Spring. 1(2-0) P:M: (MT 496) R: Open only to juniors or seniors in the Medical Technology or Clinical Laboratory Science and Lyman Briggs coordinate majors.

Continuation of MT 496.

**498 Integrative Correlations in Clinical Laboratory Science III**  
Spring. 2(1-2) P:M: (MMG 463 or concurrently and MMG 464 or concurrently and MT 496) R: Open only to students in the Clinical Laboratory Sciences major. SA: MT 454

Continuation of MT 496 with emphasis on cases of medical microbiology, hematology, and clinical chemistry.

**801 Medical Technology Seminar**  
Spring. 1(1-0) A student may earn a maximum of 2 credits in all enrollments for this course. R: Open only to graduate students in Clinical Laboratory Sciences.

Current research topics in clinical laboratory sciences.

**812 Advanced Clinical Chemistry**  
Spring of even years. 2(2-0) Interdepartmental with Pathology. RB: (BMB 462 and MT 414 and MT 416)

Biochemical basis of selected pathologic conditions including inborn errors of metabolism, endocrine and other genetic disorders. Emphasis on current diagnostic techniques.

**820 Advanced Human Hematology**  
Spring of odd years. 2(2-0) Interdepartmental with Pathology. RB: (MT 424)

Pathogenesis, mechanisms, and morphological pictures. Laboratory tests and interpretation of results.

**830 Concepts in Molecular Biology**  
Fall, Spring. 2(2-0) Interdepartmental with Pathology. RB: One course in biochemistry or concurrently.

Techniques and theories of molecular biology, nucleic acid synthesis and isolation, enzymatic digestion and modification, electrophoresis, hybridization, amplification, library construction, and cloning.

**831 Clinical Application of Molecular Biology**  
Spring, Summer. 2(2-0) P:M: (MT 830) RB: Basic biochemistry, medical or research laboratory experience

Molecular diagnostic principles. Diagnostic outcomes in traditional and non-traditional laboratory disciplines.

**831L Molecular Pathology Laboratory**  
Summer. 2(0-4) P:M: (MT 831 or concurrently)

Equipment operation, DNA extraction and measurement, electrophoresis, hybridization and transfers, amplification and detection including SSOP, ARMS, RFLP and SCP as well as automated sequencing will be covered with specific emphasis on clinical applications.

**842 Managing Biomedical Laboratory Operations**  
Fall. 2(2-0) R: Open only to Biomedical Laboratory Operations majors or approval of department.

Integration of the roles of legislative, regulatory, technological and economic factors that influence the practice and management of biomedical laboratory operations.

**844 Topics in Biomedical Laboratory Operations**  
Spring. 1(1-0) P:M: (MT 842) R: Open only to Biomedical Laboratory Operations majors or approval of department.

Current issues relevant to biomedical laboratory operations from an interdisciplinary perspective with an emphasis on efficient laboratory operations.

**846 Decision Processes for Biomedical Laboratory Operations**  
Fall. 2(2-0) P:M: (MT 842) R: Open only to Biomedical Laboratory Operations majors or approval of department.

Integrative case studies presented in a problem-based learning format. Strategies for decision making in the operations of a biomedical laboratory. Cases integrate scientific principles, management principles and regulatory factors.

**850 Concepts in Immunodiagnosics**  
Fall, Spring. 2(2-0) RB: An undergraduate course in biochemistry or cell biology.

Immunology principles and theory applied to diagnostic evaluation of the host immune response during health and disease.

**851 Clinical Application of Immunodiagnostic Principles**  
Spring, Summer. 2(2-0) P:M: (MT 850)

Immunodiagnostic theories and principles applied to clinical assay development and method evaluation.

**851L Immunodiagnosics Laboratory**  
Summer. 2(2-0)

Performance of immunopurifications, invitro diagnostic assays and basic flow cytometry. Data analysis and quality control evaluation.

**860 Clinical Laboratory Diagnosis of Infectious Diseases**  
Fall of odd years. 2(2-0) Interdepartmental with Pathology. RB: (MMG 451 and MMG 464)

Laboratory techniques for diagnosing infectious diseases in humans. Emphasis on differential diagnosis and correlation of microbiological results with serology, hematology, and clinical chemistry.

**890 Selected Problems in Clinical Laboratory Science**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Clinical Laboratory Sciences.

Non-thesis research for Plan B master's students.

**895 Projects in Biomedical Laboratory Operations**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to Biomedical Laboratory Operations majors or approval of department.

Students complete a significant on-site project in cooperation with an industrial/clinical partner.

**899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 10 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to graduate students in Clinical Laboratory Sciences.

Master's thesis research.

## MEDICINE

## MED

### Department of Medicine College of Human Medicine

**608 Internal Medicine Clerkship**  
Fall, Spring, Summer. 2 to 18 credits. A student may earn a maximum of 42 credits in all enrollments for this course. RB: (FMP 602) R: Open only to graduate-professional students in College of Human Medicine.

Community hospital clerkship. Interviewing skills, history, physical examination. Problem solving and therapy. Care of the whole patient leading to independence in patient management.

**609 Hematology Clerkship**  
Fall, Spring, Summer. 2 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course. RB: (MED 608) R: Open only to graduate-professional students in College of Human Medicine.

Data collection, problem solving, and management related to common hematologic disorders of children and adults.