### Descriptions — Medical Technology of Courses

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>465. Clinical Immunology</strong></td>
<td>1</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
<td></td>
</tr>
<tr>
<td>Clinical Laboratory Sciences majors, approval of Medical Technology Program.</td>
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<tr>
<td>Application of theoretical and technical aspects of clinical immunology in a clinical laboratory.</td>
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<thead>
<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>466. Clinical Hemostasis</strong></td>
<td>1</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
<td></td>
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<tr>
<td>Clinical Laboratory Sciences majors, approval of Medical Technology Program.</td>
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<tr>
<td>Clinical experience in the area of hemostasis. Structured to achieve proficiency in psychomotor skills, instrumentation, quality assurance, test evaluation and comprehension of concepts and principal in coagulation.</td>
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<thead>
<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>467. Clinical Body Fluid Analysis</strong></td>
<td>1</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
<td></td>
</tr>
<tr>
<td>Clinical Laboratory Sciences major, approval of Medical Technology Program.</td>
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<tr>
<td>Application of the theory and technical skills used in the analysis of body fluids in a clinical laboratory.</td>
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<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>495. Independent Study</strong></td>
<td>1 to 5</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
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<tr>
<td>4 independent study including assigned reading and reviews of appropriate scientific periodicals. Approval of department.</td>
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### MEDICINE — MED

#### College of Human Medicine

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>512. Infectious Diseases</strong></td>
<td>6</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
<td></td>
</tr>
<tr>
<td>Infectious diseases of humans, including biology of the causative microorganism, epidemiology, pathogenesis, host-parasite relationships, clinical and laboratory diagnosis, and clinical management.</td>
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<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td><strong>580. Special Problems in Medicine</strong></td>
<td>1 to 6</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
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<tr>
<td>Human Medicine students or approval of department.</td>
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<tr>
<td>Each student will work under direction of a faculty member on an experimental, theoretical or applied problem.</td>
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<tr>
<th>Course Title</th>
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<tbody>
<tr>
<td><strong>607. Ambulatory Care Clerkship</strong></td>
<td>1 to 3</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
<td></td>
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<tr>
<td>Office based experience with a dermatologist to learn clinical skills in dermatology and develop observational and diagnostic skills in skin disease.</td>
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<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>613. Dermatology Clerkship</strong></td>
<td>3 to 12</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
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</tr>
<tr>
<td>A clerkship covering four aspects of skin diseases: cutaneous, diagnostic, therapeutic, and management. The student works with medical residents, utilizing outpatient and hospital facilities.</td>
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<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>616. Allergy Clerkship</strong></td>
<td>3 to 12</td>
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<tr>
<td>Fall, Winter, Spring, Summer</td>
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<tr>
<td>Office and hospital based experience to learn clinical skills in allergy with a review of basic therapeutic agents that serve as either inpatients or outpatients. Many long term problems are pursued. Patients with psychosocial problems are seen conjointly with Social Service.</td>
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<tr>
<td><strong>617. Neurology Clerkship</strong></td>
<td>3 to 12</td>
</tr>
<tr>
<td>Fall, Winter, Spring, Summer</td>
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<tr>
<td>A combined office and inpatient experience that will provide the student with an opportunity to learn the concepts of evaluation and management of neurological disease.</td>
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### METALLURGY, MECHANICS, AND MATERIALS SCIENCE — MMM

#### College of Engineering

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>160. Engineering Communications</strong></td>
<td>12</td>
</tr>
<tr>
<td>(EGR 160) Fall, Winter, Spring, 4(3-4) MTH 108 or MTH 111 or concurrently. Engineering graphics, descriptive geometry, freehand sketching, graphical and computer problem solutions. Written technical reports and oral technical presentations.</td>
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<thead>
<tr>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>201. Introduction to Engineering Mechanics</strong></td>
<td>3</td>
</tr>
<tr>
<td>Fall, 4(4-0) PHY 237.</td>
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</tr>
<tr>
<td>Laws of mechanics governing the behavior of rigid and deformable bodies emphasizing how these laws influence engineering design. Extensive use of demonstrations.</td>
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</table>
205. **Mechanics I**  
Fall, Winter, Spring, Summer. 4(4-0)  
MTH 215 or concurrently.  
Vector description of forces and moments. Two and three dimensional equilibrium problems. Stresses of frames and machines. Friction. Shear and moments in beams and shafts.

211. **Mechanics of Deformable Solids I**  
Fall, Winter, Spring, Summer. 4(4-0)  
MTH 205, MTH 310 concurrently. MTH 215 concurrently.  

215. **Solid Mechanics Laboratory**  
Fall, Winter, Spring. Summer. 1(0-2)  
MTH 211 concurrently.  
Instrumentation, physical properties of materials, comparison of experiment and theory.

230. **Introduction to Materials Science**  
Spring. 4(4-0) Non-Materials Science majors only.  
A qualitative survey of metals, ceramics, and polymers. The relationship of electronic, molecular, and crystal structure to the physical, mechanical, thermal, electrical and magnetic properties.

250. **Introduction to Metallurgy**  
(370.) Fall, Winter, Summer. 4(3-2)  
CPS 120, MTH 113.  
Structure-property relationships in metals and alloys. Mechanical properties, crystal structure, phase diagrams, iron-carbon system. Laboratory includes mechanical property tests, heat treatment, microstructural observations.

270. **Computer Graphics**  
(EGR 270.) Fall. 3(3-0) MTH 160, CPS 130 or approval of department.  
Use of computer controlled display systems for the solution of multidimensional problems.

306. **Mechanics II**  
Fall, Winter, Spring. Summer. 4(4-0)  
MTH 205, MTH 316.  
Dynamics of particles and particle systems. Energy and momentum principles. Two and three dimensional rigid body dynamics.

330. **Metallurgical Thermochmistry**  
Fall, Winter, Spring, Summer. 3(3-0) CEM 152 or approval of department.  

350. **Mechanical Properties of Materials I**  
Fall. 3(3-0) MTH 211, MTH 250.  

351. **Mechanical Properties of Materials II**  
Winter. 3(3-0) MTH 350.  

352. **Mechanical Property Laboratory**  
Spring. 1(0-3) MTH 350.  
Laboratory experiments related to the topics covered in MTH 350.

360. **Physical Metallurgy I**  
Winter. 3(3-0) MTH 360.  
Complex binary and ternary phase diagrams. Solidification structures, precipitation, clustering, order-disorder transformation. Recovery, recrystallization and grain growth.

361. **Physical Metallurgy II**  
Spring. 3(3-0) MTH 360.  

362. **Physical Metallurgy Laboratory**  
Spring. 1(0-3) MTH 360.  

400. **Special Problems**  
Fall, Winter, Spring, Summer. 1 to 3 credits. May be repeated for a maximum of 9 credits. Approval of department.  
Individualized reading and research.

405. **Experimental Mechanics**  
Spring. 3(3-0) MTH 211, MTH 215 or approval of department.  
Techniques to measure stress, strain, vibration, motion, includes strain gauges, accelerometers, photoelasticity, holography and moire techniques.

406. **Design of Manufacturing Systems**  
Winter. 3(2-0) MTH 350 or approval of department.  
Operation scheduling and control. Optimization of discrete unit single-stage and multiple-stage manufacturing systems. Applications of artificial intelligence.

423. **Computer-Aided Manufacturing**  
Spring. 4(3-2) CPS 120, MTH 421 or approval of department.  
Application of computer-controlled elements in manufacturing systems, including NC tools, robots, process and production control, group technology and flexible manufacturing systems. An overview of the interface of these with management software.

425. **Nondestructive Evaluation and Quality Control**  
Spring. 3(2-0) MTH 421, STT 315.  
Non destructive evaluation techniques, sampling, reliability, product liability. Ultrasonic, eddy-current, X-ray, dye penetrant inspection.

430. **X-Ray Crystallography**  
Winter. 3(3-0) MTH 350.  
Symmetry, elementary crystallography, general properties of X-rays, introduction to radiation safety, interaction of X-rays with matter, application of X-ray diffraction to materials problems.

431. **Corrosion and Oxidation**  
Fall. 3(3-0) MTH 360 or approval of department.  

440. **Nonmetallic Composite Materials**  
Winter. 3(3-0) MTH 350.  

452. **Diffusion in Solids**  
Spring. 3(3-0) MTH 330.  

453. **Phase Transformations**  
Winter. 3(3-0) MTH 330.  
Springs of even-numbered years. 3(3-0) MTH 330, MTH 361.  

454. **Electron Theory of Solids**  
Fall. 3(3-0) PHY 259, MTH 430.  
Atomic theory of metals and alloys, free electron theories of metals, electrons in a periodic field and electromagnetic behavior.
456. Strengthening Mechanism in Solids
Spring. 3(3-0) MMM 351.

461. Heat Treatment and Properties of Ferrous Alloys
Winter. 3(3-0) MMM 360.
Relations between microstructure, mechanical or physical properties of steels; effect of alloying elements, high strength low-alloy steel, tool steels, stainless steels, hardenability of steels, T-T diagrams, carburizing, case hardening. Design of a heat-treating process for an alloy.

462. Metal Fabrication
Spring. 3(3-0) MMM 350.

463. Welding Metallurgy
Fall. 3(3-2) MMM 350 or concurrently.

465. Failure Analysis and Prevention
Spring. 4(3-3) MMM 211, MMM 215, MMM 250.
Modes and causes of failures of mechanical components. Analysis illustrated through student projects requiring integration of knowledge from several areas.

476. Alloy Development and Design
Winter of even-numbered years. 3(3-0) MMM 360 or concurrently.
Fundamental principles which determine the structure and application of ferrous and nonferrous alloys. Economic analysis of alloy development.

480. Process Metallurgy
Winter. 3(3-0) MMM 330.

481. Powder Technology
Spring of even-numbered years. 3(3-0) MMM 350.

499. Senior Research and Design Project
Fall, Winter, Spring. Summer. 2 or 3 credits. May be renewed for a maximum of 9 credits. Approval of department. Investigation on subject approved by a faculty member. Results to show student's ability to solve problems pertaining to metallurgy and materials science. Regular conferences and final examination.
853. Advanced Topics in Oxidation and Corrosion
Winter of even-numbered years. 3(3-0)
MMM 431 or approval of department.
Effects of metallurgical and environmental factors on the kinetics of aqueous and solution of electrochemical corrosion and solvent-less metal redox reactions.

861. Theory of Metals
Fall of odd-numbered years. 3(3-0)
MMM 825.
Metallic bonding, wave aspects of electrons, Schrödinger equation, free-electron model, zone theory of metals. Brillouin zone, zone surface, crystal structure, Fermi surfaces, electrical and thermal conductivity, specific heat, magnetism, superconductivity.

863. Advanced Rate Theory and Diffusion
Fall of even-numbered years. 3(3-0)
MMM 825 or approval of department.

871. Advanced Physical Metallurgy
Spring of even-numbered years. 3(3-0)
MMM 825 or approval of department.
Quasichemical theory of alloy phases, crystal defects, ordering and second order transitions, thermal effects, surface tension, solid state reactions, nonequilibrium, recovery, recrystallization, grain growth, crystallographic transformations, solidification, interfaces.

872. Advanced Mechanical Metallurgy
Spring of odd-numbered years. 3(3-0)
MMM 825 or approval of department.
Dislocation-obstacle interactions, thermally-activated dislocation motion, recovery and recrystallization, deformation of polycrystals, Taylor theory, deformation and recrystallization textures, dynamic effects, high-temperature deformation, radiation effects.

885. Seminar
Spring. 1(1-0) May enroll for a maximum of 3 credits. MMM graduate student.
Detailed laboratory investigation of a specialized aspect of materials science or teaching of materials science to graduate students. Participation generally required each term of residence.

900. Special Problems
Fall, Winter, Spring, Summer. 1 to 6 credits. May enroll for a maximum of 8 credits. Approval of department.
Individualized reading and research compatible with the student's interest and ability.

Microbiology and Public Health — Descriptions of Courses

909. Elastic Thin Shells
Spring. 4(4-0) MMM 815 or C E 804 or approval of department. MTH 421: Interdepartmental with and administered by Civil Engineering.
Elements of differential geometry, membrane theory of shells, Puecher's stress function, deformation and bending of shells in revolution and shallow shells.

911. Theory of Elastic Stability
Winter of odd-numbered years. 4(4-0)
MMM 815 or approval of department. MTH 422: Interdepartmental with Civil Engineering.
Theory and methods of determining buckling strength and post-buckling behavior of bar, plate and shell elements and of elastic systems.

912. Theory of Plates
Winter. 4(4-0) MMM 815 or C E 804 or approval of department. MTH 422: Interdepartmental with Civil Engineering.
Bending of thin elastic plates with various shapes and boundary conditions: application of energy principles and approximate methods of solution; thick plates; large deflection theory; sandwich plates.

914. Theory of Elasticity II
Spring of odd-numbered years. 3(3-0)
MMM 815 or approval of department.
Further topics in linear elasticity including complex variable solutions, elastodynamics, variational principles, St. Venant's principle, anisotropic material behavior.

915. Theory of Elasticity III
Spring of even-numbered years. 3(3-0)
MMM 815 or approval of department.

916. Fracture Mechanics
Fall of even-numbered years. 3(3-0)
MMM 813.

917. Fatigue of Engineering Structures
Spring of even-numbered years. 3(3-0)
MMM 441 or approval of department.

918. Theory of Viscoelasticity
Fall of even-numbered years. 3(3-0)
MMM 810; MTH 422 or approval of department.

940. Modern Problems in Materials Science
Fall, Spring. 3(3-0) May enroll for a maximum of 9 credits. Approval of department. Current field of research in ceramics, martensitic transformations, oxidation and corrosion, electron microscopy, recrystallization and textures.

941. Crystal Defects
Winter of even-numbered years. 3(3-0)
MMM 835 or approval of department.
Defects in thermodynamic equilibrium. Vacancies, Interstitials, color centers. Role of defects in diffusion, radiation damage. Geometrical and elastic properties of dislocations, dislocation reactions, grain boundary structures and kinetics.

942. Advanced Topics in Phase Transformations
Winter of odd-numbered years. 3(3-0)
MMM 835 or approval of department.
Precipitation and ripening, gradient energy term, spinodal decomposition, surface and strain effects, allotropic and polytropic transformations, martensitic transformations, electronic effects, charge density waves, thermoelastic and shape memory alloys.

990. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Microbiology and Public Health

MPH

College of Human Medicine
College of Natural Science
College of Osteopathic Medicine
College of Veterinary Medicine

200. Elementary Microbiology
Fall, Winter, 4(3-2) Three terms of Natural Science. Primarily for majors outside the College of Natural Science.
Description of bacteria and related forms of microorganisms, their growth and nature, their application in industry, and their control in public health.

234. Elementary Medical Microbiology Laboratory
Fall, Winter, Spring. 2(0-4) Three terms of Osteopathic Medicine. 3 credits. CEM 242, CEM 244 or BCH 500.
Survey of the microbiology of the human body. Surveys of bacteria and related forms of microorganisms, antigens, antibody, and laboratory diagnosis.

301. Introductory Microbiology
Fall, Spring, Summer, Given at W. K. Kellogg Biological Station Summer term. Fall, Spring, 3(3-0) Summer: 3 credits. CEM 242, CEM 244 or BCH 500.
Fundamentals of microbiology. Range of cell structure and activities; nutrition, growth, and importance of major microbial groups.

302. Introductory Microbiology Laboratory
Fall, Spring, Summer, Given at W. K. Kellogg Biological Station Summer term. Fall, Spring; 2(0-4) Summer: 2 credits. MPH 301 or concurrently.
Laboratory methodology. Methodology of microbiology including microscopy, staining, asepsis, cultural media and quantification.

303. Microbiology I: General
Fall, 4(4-0) BCH 451 or concurrently.
Principles of microbiology emphasizing cell structure and function, metabolism, growth and death, differentiation, diversity, and microbial interaction.