of Courses

939. Commutative Algebra III
   Spring of odd-numbered years. 3(3-0)
938. Continuation of 938.

948. Fluid Dynamics III
   Spring of odd-numbered years. 3(3-0)
885. General theory of perfect fluids including motion of incompressible fluids in two and three dimensions and applications to problems of wing profiles. Viscous and compressible fluids discussed briefly.

951. Approximation Theory I
   Fall of odd-numbered years. 3(3-0)
623 or approval of department.
Tchebycheff, approximation with polynomials, rational functions and general linear families; the Unicity problem; degree of approximation; Berstein Polynomials; Remez algorithm, uniform approximation with constraints.

952. Approximation Theory II
   Winter of even-numbered years. 3(3-0)
951. Continuation of 951.
Generalized methods of measuring error: Approximation in L_1 and L_p norms, least-square approximation and orthogonal functions; spline functions; approximation in normed linear spaces.

953. Approximation Theory III
   Spring of even-numbered years. 3(3-0)
952. Continuation of 952.

961. Topological Groups
   Winter of even-numbered years. 3(3-0)
962. General properties of topological groups, classical groups and Lie groups.

962. Point Set Topology
   Fall of odd-numbered years. 3(3-0)
873, 861.
Hausdorff continua, Hahn-Mazurkiewicz cyclic element theory, monotone decompositions, indecomposable continua, homogeneity.

964. Algebraic Topology I
   Fall. 3(3-0) 834, 862.
Simplicial and singular homotopy theory, Eilenberg-Steenrod axioms, chain complexes, cell complexes, applications to Euclidean spaces.

965. Algebraic Topology II
   Winter. 3(3-0) 864.
Continuation of 964 including category and functor theory, general coefficient and cohomology theory.

966. Algebraic Topology III
   Spring. 3(3-0) 865.
Continuation of 965 including homotopy groups of products, Eilenberg-Zilber theorems, cohomology products, differential topology.

982. Methods of Complex Analysis II
   Winter of odd-numbered years. 3(3-0)
983. Methods of Complex Analysis III
   Spring of odd-numbered years. 3(3-0)
982. Continuation of 982.

991. Advanced Topics in Geometry
   Fall, Winter, Spring, Summer. Variable credit.

992. Advanced Topics in Analysis
   Fall, Winter, Spring, Summer. Variable credit.

993. Advanced Topics in Algebra
   Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Structure of rings and algebras, Lie algebras, Jordan algebras, advanced algebraic number theory, advanced matrix theory, and advanced topics in group theory, Lattice theory.

994. Advanced Topics in Applied Mathematics
   Fall, Winter, Spring, Summer. Variable credit. Approval of department.

996. Advanced Topics in Topology
   Fall, Winter, Spring, Summer. Variable credit. Approval of department.
Topological groups, topology of Euclidean spaces, automaton homology theory, homotopy theory, function spaces.

999. Research
   Fall, Winter, Spring, Summer. Variable credit. Approval of department.

MECHANICAL ENGINEERING M E

College of Engineering

201. The Science of Sound I: Block, Bach and Oscillators
   Winter. 3(3-0) or 4(4-0). Interdepartmental with and administered by the Department of Physics.

202. The Science of Sound II
   Spring. 3(3-0) or 4(4-0). PHY 201.
Interdepartmental with the Department of Physics.

255. Computer Models in Science and Engineering
   Spring. 3(3-0). CPS 110 or 120 or equivalent FORTRAN. Interdepartmental with the Department of Computer Science.
Problem-solving; development of student’s ability to formulate computable models based on finite physical elements, examples from statics, dynamics, electrical resistance, and conduction heat transfer.

250. Manufacturing Processes
   Fall, Winter, Spring. 3(3-0)
An introduction to the materials and processes used in manufacturing, to convert ideas into products, machines, and structures for the use of mankind. Extensive use is made of audio-visual techniques.

300. Technology and Utilization of Energy
   Winter. 3(3-0). Initial course in any sequence of courses in the Department of Natural Science. Interdepartmental with the Department of Engineering.
Problems of energy technology and its impact: energy sources, conversion, waste and environmental effects, future outlook for mankind.

303. Thermal-Fluid Phenomena
   Spring. 3(3-0). MTH 215 or approval of department.
Concepts and principles used to describe, predict, or explain thermal and fluid phenomena. Constraints, approximations, engineering problem solving. Application to socio-technical questions.

311. Thermodynamics I
   Fall, Winter, Summer. 3(3-0) MTH 215 or concurrently.
Zerith, first and second laws of thermodynamics. General energy equation, Process relations. Concepts of equilibrium, reversibility, and irreversibility. Applications of these to systems describable by two independent properties.

312. Thermodynamics II
   Winter, Spring. 3(3-0) 311.
Continuation of 311. Gas and vapor relations, reactive and non-reactive mixtures. Thermodynamic principles as applied to gas and vapor power and refrigeration cycles for reciprocating and turbo machinery.

315. Thermodynamics Laboratory I
   Fall, Winter, Summer. 1(0-3) 311 concurrently.
Laboratory experiments applying the basic laws of thermodynamics.

316. Thermodynamics Laboratory II
   Winter, Spring. 1(0-3) 312 concurrently.
Laboratory experiments investigating gases and liquid behavior and combustion from a thermodynamic viewpoint.

320. Kinematics of Machines I
   Fall, Spring, Summer. 4(3-3) EGR 260; MTH 306 or concurrently.
Absolute and relative displacements, velocities, and accelerations in rigid body systems; analysis and synthesis of multi-bar linkages and rotational mechanisms.

332. Fluid Mechanics I
   Winter, Spring. 4(3-3) 311, 351 or concurrently; MTH 306.
Fluid statics, Bernoulli’s equation; nondeformable control volume applied to conservation of mass, momentum and energy; derivation of differential equations of continuity and momentum; similarity.

333. Fluid Mechanics II
   Fall, Spring. 4(3-3) 332.
Fluid flow phenomena; laminar flow; turbulent flow; pipe flow; inviscid flows; boundary layers; external flow, an introduction to compressible flow.

341. Computer Aided Manufacturing
   Spring. 4(3-2). CPS 110 or 120. Interdepartmental with the Department of Computer Science.
Numerical control, Computer-Aided Numerical Control, Direct Numerical Control, and adaptive control applied in present day manufacturing. Use of the APT language to control NC machines.
120

I. Mechanical Engineering

351. Mechanical Engineering Analysis
Fall, Winter, Summer. 4(4-0) CPS 130 or concurrently, MTH 215.
Application of analytical and numerical methods to the solution of problems encountered in mechanical engineering.

352. Introduction to Systems and Control
Winter, Spring. 4(4-0) MTH 315 or concurrently.
Modeling of a variety of physical systems, using state-variable concepts. Time and frequency response of low-order linear systems. Primary applications to mechanics and hydraulics.

405. Automotive Engines
Spring. 3(2-3) 312.
Analysis of internal combustion engines for vehicular propulsion.

407. Automotive Vehicles
Fall. 3(3-3) MMM 306.
Analysis of the propulsion, braking, steering, and suspension requirements.

410. Thermomechanical Continua
Fall. 3(3-0) MTH 311.
Reexamination of the continuum concept in the modeling of the deformation of solids and the flow of fluids. Cartesian tensor formulation of the basic physical laws involving stress and strain.

411. Heat Transfer I
Fall. 3(3-0) 311.

412. Heat Transfer II
Winter, Spring. 3(3-0) 333.
Natural and forced convection based on boundary layer theory. Heat transfer in fluids with phase change. Heat exchangers, mass transfer.

414. Energy Conversion
Winter. 3(3-0) 312.
Fundamental principles of energy conversion systems. Direct energy conversion. Thermoelectric, thermionic, nuclear, fuel cells, magnetohydrodynamic, and other methods of power generation.

418. Statistical Thermodynamics
(213). Spring. 3(3-0) 311.

417. Propulsion
Winter. 3(3-0) 333.
Thermodynamics and fluid mechanics will be used to study rockets, turbosets, reciprocating engines, propellers, turboprops, and turbosets; a specific propulsion system will be designed.

421. Mechanical Design
Fall. 3(3-0) MMM 211.
Introduction to design, the design process, design considerations and design procedures. Applications of design principles to machine elements.

422. Mechanical Design Projects
Winter. 3(3-0) 421.
Application of design concepts, such as optimization, economics and reliability, through several projects drawn from the basic areas of mechanical engineering (thermodynamics, heat transfer, fluid and solid mechanics).

424. Dynamics of Machines
Winter. 3(3-0) 320.
Analysis of static and dynamic forces in rigid body systems; balancing of rotating and reciprocating system elements; inertial guidance; critical speeds.

432. Aerodynamics
Spring. 3(3-0) 333.
Fundamentals of fluid mechanics, potential flows about bodies and airfoils, compressible flow, perturbation methods, viscous flow, boundary layers, transition, turbulence, separation, aerodynamics of wings and bodies.

436. Cooling Processes
Winter. 3(3-0) 312.
Thermodynamic principles applied to the design of cooling systems in range of normal temperatures to ultra-low cryogenic temperature conditions. Psychrometric principles as applied to air conditioning and evaporating systems.

442. Industrial Engineering
Spring. 3(3-2) 290.
Theory and techniques used by industry in planning for manufacturing. Process selection and design, work methods planning, production time standards, materials handling, and plant layout planning.

455. Mechanical Vibrations
Winter, Summer. 4(4-0) MTH 306.
Oscillatory phenomena for linear systems with one and two degrees of freedom, non-linear systems, time varying systems with deterministic excitation, and time-invariant systems with non-deterministic excitations.

458. Control Theory
Spring. 4(4-0) 352.
Closed-loop control systems; application of transfer function analysis; design for a definite degree of stability; on-and-off controllers.

463. Computer Assisted Design
Spring. 3(3-2) 322, 411.

471. Flight Dynamics
Fall. 3(3-0) MTH 306.
Particle and rigid body dynamics; orbit theory; aerodynamic forces; propulsion; longitudinal, directional and lateral stability and control; range; payload; a specific vehicle will be designed.

490. Special Topics
Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 8 credits. Approval of department.
Special topics in mechanical engineering of current interest and importance.

499. Independent Study
Fall, Winter, Spring, Summer. 1 to 6 credits. May re-enroll for a maximum of 12 credits. Approval of department.

810. Intermediate Heat/Mass Transfer
Fall. 4(4-0) Approval of department.

813. Convective Heat Transfer
Winter. 3(3-0) 412; MTH 421.
Analysis of convective transfer of heat, mass and momentum in boundary layers and induced flows. Heat transfer with phase change of fluids.

814. Radiative Heat Transfer
Spring. 3(3-0) Approval of department.

815. Advanced Classical Thermodynamics
Fall of odd-numbered years. 3(3-0) 416; MTH 422 or 424 or concurrently.

817. Conductive Heat Transfer
Fall. 3(3-0) 411, 531.

823. Theory of Vibrations I
Fall. 4(4-0) 455. Interdepartmental with the Department of Metallurgy, Mechanics and Materials Science.
Discrete and continuous parameter systems with linear and non-linear characteristics. Variational principles; equations of motion. Matrices, quadratic forms; self-adjoint operators; eigenvalues. Transient and random excitations. Theory developed through physical problems.

826. Kinematics of Machines II
Fall. 3(3-0) 330.

827. Machine Design III
Spring, Summer. 3(3-0) 421.
Stress energy method for analyzing statically indeterminate machine members, theories of failure, fatigue, use of statistics in selection of tolerances for parts in mass production. Optimum design.

828. Machine Design IV
Winter. 3(3-0) 421.
Application of design theory to the synthesis of complete mechanical and hydraulic systems. Stress wave due to impact loading. Critical speed.

832. Refrigeration
Spring. 3(3-0) 436.
Characteristics of refrigerants; application details pertaining to comfort cooling, food refrigeration, and ultra-low temperature units; refrigeration controls, and control systems.

840. Intermediate Fluid Mechanics
Fall. 3(3-0) 332 or C E 321.
Deformable control volumes, Navier-Stokes equations, dimensionless variables, vorticity and circulation, turbulent flow, inviscid flow, and boundary layer theory.
841. Advanced Gas Dynamics
Spring. 3(3-0) 412; MTH 322 or 413 or approval of department.
Compressible subsonic and supersonic flow, shock waves, expansion fans, inviscid equations, perturbation theory, similarity rules, methods of measurement, method of characteristics, hodograph methods.

842. Inviscid Fluids
Spring. 3(3-0) MMM 810; MTH 322 or 413.
Kinetostatics; dynamical equations; potential flows, transformations, Holmhoits flows; added masses, forces and moments, vortex motion; wave motion.

843. Turbulence
Winter, Summer. 4(4-0) MMM 810 or approval of department.
Basic equations of turbulent motions including momentum, kinetic energy, scalar contaminants, correlation and spectrum functions. Basic elements of statistical descriptions, isotropy and shear flows, phenomenological theories and hot-wire anemometry.

850. Advanced Space and Orbit Ballistics
Fall of odd-numbered years. 3(3-0) MMM 308; MTH 215, 308.
Particle motion; missile trajectories; motion of a rocket, orbits; effects of oblateness on satellite orbit; orbital lifetime; rendezvous in earth-moon system; optimization; low thrust space propulsion systems; trip to Mars.

851. Modeling of Engineering Systems
Fall. 4(4-0) 455 or E E 455. Interdepartmental with Systems Science.
Modeling of engineering devices and components; assembly into systems; bond graph representation; prediction of dynamic behavior by linear, nonlinear and simulation methods; applications to mechanical, electrical, fluid, ionic, thermal systems.

853. Fluid Mechanics
Fall, Winter, Spring, Summer. 4(4-0) MTH 322 or 413.
Elements of fluid mechanics and aerodynamics: free surface, laminar, and turbulent flows, wall flows, boundary layers, perturbation theory, similarity rules, use of dimensional analysis and of dimensional models, wave motion, vortex motion, boundary-layer flow, jet and wakes; potential flow, applied to ship and aircraft hydrodynamics, and to water and air flow in pipelines and in the atmosphere; application to ship and aircraft hydrodynamics, and to water and air flow in pipelines and in the atmosphere; and to problems of heat transfer and mass transfer.

890. Special Topics
Fall, Winter, Spring, Summer. 3 to 4 credits. May re-enroll for a maximum of 9 credits. Approval of department.
Special topics in mechanical engineering of current interest and importance.

899. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

920. Theory of Vibrations II
Winter of odd-numbered years. 4(4-0) MTH 422; or approval of department.

921. Theory of Vibrations III
Spring of odd-numbered years, Summer. 4(4-0) MMM 920 or approval of department. Interdepartmental with and administered by the Department of Metallurgy, Mechanics and Materials Science.

925. Mechanical Engineering Problems
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 9 credits. Approval of department. Analysis of advanced engineering problems involving design, thermodynamics, fluid dynamics, gas dynamics, space.

942. Viscous Fluids
Fall of even-numbered years. 3(3-0) MMM 810 or CHE 841.
Exact solutions of Navier-Stokes equations, i.e., Oscillatory Motion, Laminar, Converging Channel, etc.; Hydrodynamic Stability including free convection, surface tension, gravitational and free-surface instabilities, and Tollmien-Schlichting waves.

999. Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

MEDICINE MED

College of Human Medicine

512. Infectious Diseases
Fall. 4(3-3) PPH 511, or approval of department. Interdepartmental with and administered by the Department of Microbiology and Public Health.
Infectious diseases of man, including biology of the causative microorganism, epidemiology, pathogenesis, host-parasite relationships, clinical and laboratory diagnosis, and clinical management.

590. Special Problems in Medicine
Fall, Winter, Spring, Summer. 1 to 3 credits. May re-enroll for a maximum of 12 credits. Human Medicine students or approval of department. Each student will work under direction of a faculty member on an experimental, theoretical or applied problem.

608. Senior Medical Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 43 credits. Primary clerkship, third year Human Medicine students.
Based in community hospitals, this clerkship will stress interviewing skills, history, physical examination, along with problem solving and therapy, and care of the whole patient leading to independence in patient management.

609. Hematology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 608.
Development of skills in data collection, problem solving and management related to common hematologic disorders of children and adults.

610. Oncology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 608.
Development of skills in data collection, problem solving and management of the more prevalent cancers in children and adults.

611. Cardiology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 602.
A clinical clerkship in which students evaluate in depth patients with cardiac diseases. This includes experiences with special diagnostic procedures including cardiac catheterization, phonocardiography, echocardiography and electrocardiography.

612. Nephrology/Urology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 602.

613. Dermatology Clerkship
Fall, Winter, Spring, Summer. 1 to 17 credits. May re-enroll for a maximum of 34 credits. 602.
Office based experience with a dermatologist to learn clinical skills in dermatology and develop observational and diagnostic skills in skin disease.