residual stresses; plastic forming of metals.


7753 Thermodynamics of Solid Materials (3) Prereq.: ME 2723 or 2733 and any first level course in thermodynamics. Thermodynamic properties of materials; equilibrium; chemical reactions in reactions; solid solutions and phase diagram enunciation; reaction kinetics; applications of thermodynamics.

7763 Advanced Corrosion Science and Engineering (3) Prereq.: ME 4763 or equivalent. Advanced topics in corrosion science, high temperature corrosion, hydrogen embrittlement, etc.; thermodynamics of surfaces and corrosion.

7813 Computation of Boundary Layer Flows and Heat Transfer (3) Prereq.: ME 3834 and 4435 or equivalent. Finite-difference methods for the solution of parabolic or boundary layer equations; use of a computer program for two-dimensional boundary layers; wall boundary layers, jets and wakes, flows in pipes, annuli, nozzles, and diffusers.

7823 Computation of Fluid Flow and Heat Transfer (3) Prereq.: ME 3834, 4433 and ME 4533 or equivalent. Finite-difference methods for solving equations of fluid motion. Computer program used to solve complex problems involving fluid flow, heat transfer, and chemical reaction; mechanical models for turbulence, radiation, and heat transfer; their computing implementation; application of prediction procedures for practical situations.

7833 Inviscid Fluid Flow (3) Prereq.: ME 7683 or equivalent. Fluid dynamics as continuum mechanics; potential flow using complex variables in two and three dimensions; vortices; Stokes and Oseen approximations for low Reynolds number flows; incompressible laminar boundary layer theory; transition; turbulent boundary layers, compressibility effects, and numerical methods.

7853 Advanced Boundary Layer Theory (3) Prereq. ME 7683 or equivalent. NonNewtonian and turbulent fluid mechanics.

7863 Fluid Dynamics (3) F Prereq.: credit or registration in MAT 5313 or equivalent. Fluid dynamics as continuum mechanics; potential flow using complex variables in two and three dimensions; vortices; Stokes and Oseen approximations for low Reynolds number flows; incompressible laminar boundary layer theory; transition; turbulent boundary layers, compressibility effects, and numerical methods.

9701 Seminar (1) All graduate students are expected to attend this course every semester; only 1 sem. hr. of credit in this course allowed toward degree. Pass-fail grading.

9703 Independent Study in Mechanical Engineering (3) May be taken for a max. of 6 sem. hrs. Directed independent study for graduate students.

9733, 7943 Mechanical Engineering Problems (3,3) F,S. Prereq.: credit in required courses. Problems on a specific area of interest. May be taken for a max. of 6 sem. hrs. of credit when topics vary, with consent of department. Mechanical engineering treatment of analysis, design, and applications of theories and phenomena. 8000 Thesis Research (1-12 per sem.) S/U grading.

9000 Dissertation Research (1-12 per sem.) S/U grading.

MEDICAL PHYSICS • MEDP

General education courses are marked with stars (*).

★ 2051 Radiation Science for Medical Applications (3) F,S. Prereq.: PHYS 2002 or equivalent. Structure of the atom and nucleus; properties of ionizing radiation; instruments for detection and measuring radiation, and biological effects; radiation detection and safety.

★ 2061 Radiation Physics and Exposure Evaluation (3) F Prereq.: PHYS 2702 or equivalent. Control and evaluation of radiation exposure in experimental and clinical situations. X-ray imaging, computer tomography, magnetic resonance imaging, ultrasound, and nuclear medicine; clinical applications of radiation therapy.

4331 Radiation Protection and Exposure Evaluation (3) F Prereq.: PHYS 2702 or equivalent. Control and evaluation of radiation exposure in experimental and clinical situations. X-ray imaging, computer tomography, magnetic resonance imaging, ultrasound, and nuclear medicine; clinical applications of radiation therapy.

4332 Radiation Protection and Exposure Evaluation (3) F Prereq.: credit or registration in MEDP 4351. 3 hrs. lab. Laboratory exercises covering fundamental principles of radiation detection systems and data analysis techniques used for radiation detection in medical physics, radiation therapy, radiological imaging, and medical health physics.

4351 Radiation Detection and Instrumentation (2) F Prereq.: credit or registration in MEDP 4351 or equivalent; consent of instructor. Introduction to the physics of detection, instrumentation, and data acquisition; the fundamentals of detection systems used in radiation therapy, radiological imaging, and health physics.

4991 Special Problems in Medical Physics and Health Physics (1-4) Prereq.: thorough knowledge of mathematics, science, and engineering related to the topic or proposed problem; and consent of instructor. May be taken for a max. of 12 sem. hrs. of credit when topics vary. Theoretical or experimental problems involving the application of medical physics and health physics technology.

4995 Seminar (1) F,S Elective seminar especially for undergraduate minors in nuclear science, and undergraduate majors in physics and astronomy with a concentration in medical physics. Course may be repeated on audit basis only.

7101 Advanced Trajectory Methodology for Biological Sciences (3) F,S Prereq.: MEDP 4301. 2 hrs. lecture/3 hrs. lab. Quantitative and analytical aspects of tracer applications in modern biological research; combining tracer techniques with other analytical methods.

7111 Advanced Medical Imaging Physics (3) F Prereq.: MEDP 4111, MATH 3532. Topics related to advanced research in medical imaging and radiation therapy: theory of image formation; quantitative analysis of imaging systems by Fourier methods and Q/C acceptance testing; radon transform and theory of image reconstruction; tracer methodology for quantitative imaging.

7121 Radiobiology (3) S Prereq.: MEDP 4531 or consent of instructor. 3 hrs. lab. Effects of ionizing radiation on cellular, molecular, and organ systems levels of biological organization: study of x-rays, gamma rays, accelerator beams, and neutrons in interaction with living systems; cohesive treatment of radiation biology with applications in medical physics and radiation oncology.

7210 Clinic Radiation Therapy (3) S Prereq.: MEDP 7211, 7331. Open only to students currently enrolled in the Master of Science in Medical Physics and Health Physics program. Introduction to practice radiation oncologists to the evolution of radiation therapy, general oncology considerations, tumor radiobiology, non-intentional effects of radiation, and altered fractionation. Discussion of tumor biopsy and behavior, normal tissue effects, and treatment planning and delivery techniques for specific organ systems.

7260 Clinical Radiation Therapy Physics Rotation (3) F Prereq.: MEDP 7331. Open only for students currently enrolled in the Master of Science in Medical Physics and Health Physics program. Under the direction of clinical staff, introduction to the radiation therapy clinic and clinical duties of the student in radiation treatment planning, monitor unit calculations, treatment of aids, treatment delivery techniques, in vivo dosimetry, dose measurements, patient examination, and associated with external beam photon and electron therapy.

7270 Advanced Radiation Therapy Physics (3) F Prereq.: MEDP 7331. 3 hrs. lecture. Basic principles of clinical indications, radiation delivery, treatment planning, dose calculations, dose measurements, and quality assurance for advanced treatment techniques used in radiation therapy (external beam electron, proton, and photon therapy and brachytherapy).

7280 Advanced Clinical Radiation Therapy Physics Rotation (2) S Prereq.: MEDP 7260, MEDP 7270. Open only for students currently enrolled in the Master of Science in Medical Physics and Health Physics program. Under the supervision of clinical staff, introduction to the planning, delivery, and dosimetric aspects of advanced radiation therapy treatments such as brachytherapy, stereotactic radiotherapy, intensity modulation radiotherapy, and image guided radiotherapy and to the advanced physical practices of accelerator quality assurance and radiation therapy shield design.

7331 Radiological Protection (3) S Prereq.: MEDP 4351. Fundamental physical principles, operation of delivery equipment, treatment planning, methods of dose calculations, determination of irradiation time from dose prescription, dose measurements, and quality assurance for external beam therapy (photons and electrons) and internal brachytherapy.

7530 Radiation Shielding (2) S Prereq.: MEDP 4351, 7531. Calculation of source term, geometric transformations, and attenuating factors associated with photon, neutron, and charged particle shielding; calculation of dose and dose equivalents; current governmental regulations and professional recommendations for shielding; shielding design for medical radiation facilities.

7537 Radiation Interactions and Transport (3) F Prereq.: PHYS 7251; credit or registration in CIS 2202 or equivalent experience in computer programming. Also offered as PHYS 7537.Photon, neutron, and electron interactions and energy transfer, the Boltzmann equation, elementary analytical solutions; deterministic computational methods including spherical harmonics and discrete ordinates techniques; continuous slowing down and Fokker-Planck approximations.

7538 Monte Carlo Simulation of Radiation Transport (3) S Prereq.: PHYS 7537; credit or registration in CIS 2202 or equivalent experience in computer programming. Also offered as PHYS 7538. Radiation transport simulation by the Monte Carlo method; phase-space tracking; dose response estimators, biasing methods; integral form of the Boltzmann equation; condensed-history method for charged particles; neutron, photon, and electron transport calculations for shielding and medical physics applications.

7991 Advanced Projects in Medical Physics and Health Physics (1-3) Prereq.: MEDP 4111 or 7331 and consent of instructor. May be taken for a max. of 6 sem. hrs. credit. Medical physics or health physics projects that study particular aspects of radiation therapy, medical imaging, or medical health physics.

7992 Advanced Topics in Medical Physics and Health Physics (1-3) Prereq.: consent of instructor. May be taken for a max. of 6 sem. hrs. credit. Advanced treatment of a specific area of medical physics or health physics technology of current interest.

7993 Research Project (1) F,S Research project for master degree candidates in medical physics and health physics. Only 1 sem. hr. of credit may be counted toward degree.

7999 Independent Research (1-3) F,S Independent research in MEDP 4111 or 7331 and consent of instructor. May be taken for a max. of 12 sem. hrs. credit. Detailed investigation of a research topic or a technical design project.

8000 Thesis Research (1-12 per sem.) S/U grading.

MILITARY SCIENCE • MILS

Nonimmigrant aliens require approval from their governments prior to enrollment in these courses.

1010 Rifle and Pistol Marksmanship (1) 1 hr. lecture; 1 hr. lab. Restricted to freshmen and sophomores or permission of instructor. Rifle and pistol safety; breathing techniques; zeroing; physical and mental conditioning; sighting and aiming; standard firing positions; practical application of practice firing.

1011 Leadership and Personal Development (1) F,S Prereq.: credit or registration in MILS 1011 and 1012 or permission of instructor; 2 hrs. lecture; 1.5 hrs. lab. Introduction to the personal challenges and competencies required for military leadership. Focus on developing basic knowledge and comprehension of Army leadership dimensions while providing an understanding of the Army’s purpose in the Army, and its advantages for students.

1012 Intro to Tactical Leadership (1) F,S Prereq.: MILS 1011 and permission of instructor; 2 hrs. lecture; 1.5 hrs. lab. Overview of leadership fundamentals, including setting direction, problem-solving, listening, presenting briefs, providing feedback, and engaging in interactive student exercises.

1016 Foundations of Tactical Leadership (2) F,S Prereq.: MILS 2161. 1 or 2 hrs. lecture; 1.5 hrs. lab. Examines the challenges of leading tactical teams in the complex contemporary operating environment (COE). Comprehensively, the historical basis of the Army leadership framework explores the dynamics of adaptive leadership in the context of military operations.

3071 Adaptive Tactical Leadership (4) F,S Prereq.: MILS 2161 and 2162 or equivalent; 3 hrs. lecture; 3 hrs. lab. Study, practice, and application of adaptive team leadership skills as presented with the demands of the ROTC Leadership Development and Assessment Course (LDAC). Critical thinking scenarios related to adaptive leadership operations are used to develop self awareness and critical thinking skills.
Secondary Applied Music Courses

These courses are for students whose declared major or minor is the specific instrument designated by the course number.

Primary Applied Music Courses

2130 Secondary Voice (2-3)
2131 Secondary Piano (2-3)
2132 Secondary Harpsichord (2-3)
2133 Secondary Organ (2-3)
2134 Secondary Harp (2-3)
2135 Secondary Violin (2-3)
2136 Secondary Viola (2-3)
2137 Secondary Cello (2-3)
2138 Secondary String Bass (2-3)
2139 Secondary Flute (2-3)
2140 Secondary Oboe (2-3)
2141 Secondary Clarinet (2-3)
2142 Secondary Saxophone (2-3)
2143 Secondary Bassoon (2-3)
2144 Secondary Trumpet (2-3)
2145 Secondary French Horn (2-3)
2146 Secondary Euphonium (2-3)
2147 Secondary Trombone (2-3)
2148 Secondary Tuba (2-3)
2149 Secondary Percussion (2-3)
2150 Secondary French Horn (2-3)
2151 Secondary Composition (2-3)
2152 Secondary Guitar (2-3)
2153 Secondary Electroacoustic Composition (2-3)
2154 Secondary Jazz Study (2-3)

MUSIC • MUS

Applied Music and Ensemble Courses

Admission to applied music courses is by audition only. Secondary primary and applied courses, MUS 2130-2154 and 3130-3154, are offered for 2 or 3 credits. Students who elect 2 credits will receive 30 minutes of individual instruction per week, and those who elect 3 credits will receive 45 minutes of individual instruction per week. Graduate applied courses are offered for 2-6 credits.

All applied music and ensemble courses may be repeated for credit every semester.

APPLIED MUSIC COURSES

All students registering for 2130-54 and 3130-54 may be required to participate concurrently in one of the following major performing organizations: MUS 4232, 4233, 4234, 4255, 4256, 4250, 4252, 4253, 4254, or 4261.

Secondary Applied Music Courses

These courses are for students who are not qualified to either major or minor in the specific instrument designated by the course number.

2130 Secondary Voice (2-3)
2131 Secondary Piano (2-3)
2132 Secondary Harpsichord (2-3)
2133 Secondary Organ (2-3)
2134 Secondary Harp (2-3)
2135 Secondary Violin (2-3)
2136 Secondary Viola (2-3)
2137 Secondary Cello (2-3)
2138 Secondary String Bass (2-3)
2139 Secondary Flute (2-3)
2140 Secondary Oboe (2-3)
2141 Secondary Clarinet (2-3)
2142 Secondary Saxophone (2-3)
2143 Secondary Bassoon (2-3)
2144 Secondary Trumpet (2-3)
2145 Secondary French Horn (2-3)
2146 Secondary Euphonium (2-3)
2147 Secondary Trombone (2-3)
2148 Secondary Tuba (2-3)
2149 Secondary Percussion (2-3)
2150 Secondary French Horn (2-3)
2151 Secondary Composition (2-3)
2152 Secondary Guitar (2-3)
2153 Secondary Electroacoustic Composition (2-3)
2154 Secondary Jazz Study (2-3)

4220 Piano Ensemble (1) May be repeated for a max. of 2 sem. hrs. for degree credit.
4221 Vocal Chamber Music (1)
4222 Woodwind Chamber Music (1)
4223 Brass Chamber Music (1)
4224 String (or Piano and Strings) Chamber Music (1)
4225 Collegium Musicum (1)
4226 Percussion Ensemble (1)
4227 Harp Ensemble (1)
4228 Contemporary Music Ensemble (1)
4229 Harp Ensemble (1)
4230 Gospel Choir (1)
4231 Swing Choir (1)
4232 Men’s Chorus (1)
4233 Women’s Chorus (1)
4234 University Chorus (0-1)
4235 Chamber Choir (1)
4236 A Cappella Choir (1)
4240 Opera (1)
4245 Mandolin Band (1)
4246 Tiger Marching Band (1)
4250 Wind Ensemble (0-1)
4251 Symphonic Band (0-1)
4252 Jazz Band (1)
4254 Symphonic Winds (0-1)
4255 Chamber Jazz (1)
4260 Philharmonia (1)

*4261 Symphony Orchestra (0-1)

**GENERAL COURSES**

General education courses are marked with stars (*).

1001, 1002 Voice Class (2, 2) Open to nonmajors with consent of instructor. Group instruction in voice production.
1010 In Concert (1) 2 hr. lab. May be taken for a max. of 3 hrs. of credit. An elective course open to all University students designed to develop proper audience etiquette and to expose students to a wide variety of music performances.
1018 Diction for Singers I (1) 2 hr. lab. Entry level course covering pronunciation of Latin and Italian for singing. Utilizing the International Phonetic Alphabet, pronunciation concepts will be supported by recitation and performance of representative song repertoire. Required of all vocal music education and voice performance majors.
1019 Diction for Singers II (1) 2 hr. lab. Entry level course covering pronunciation of German and French for singing. Utilizing the International Phonetic Alphabet, pronunciation concepts will be supported by recitation and performance of representative song repertoire. Required of all vocal music education and voice performance majors.
1020 Performance Craft for Singers (1) Preparatory for MUS 4240. May be taken for a max. of 2 hrs. of credit. Technology in all voice environment classes. Workshop exploring performing artistry for the singer through individual coaching and class exercises such as movement, dance, and improvisation; stage terms; stage deportment, and stage etiquette; performance anxiety.
1108, 1109 Piano Class (2, 2) MUS 1108 or consent of instructor is prerequisite for 1109. Open only to nonmajors. Instruction for the beginner and lower intermediate student.
1110, 1113, 1132, 1133 Group Piano I, II, III, IV (1 each) Open only to music majors. Required of all non-keyboard music majors who do not meet proficiency requirements. Functional use of the piano.
1700 Recital Hour (0) May be repeated. Pass-fail grading. Weekly student recital and music seminar.
1701 Foundations of Music Study (1) A concise survey of the elements of aural and written music theory, musicianship, and related skills. Intended to prepare majors and minors in the School of Music for Theory I and subsequent courses.
1740, 1741 Introduction to Music History I, II (2, 2) Fundamental elements of music from historical and cultural perspectives; introduction to historical trends, musical genres, major composers, and score reading; cultivation of studying and writing skills.
1751 Music Appreciation (3) Primarily for nonmusic majors. Credit will not be given for this course and MUS 1755. The art of music, with emphasis on listening skills, a non-technical approach to understanding vocabulary and materials of music; correlation of musical literature with other disciplines in the humanities.
1755 HONORS: Music Appreciation (3) Primarily for qualified students not majoring in music. Credit will not be given for this course and MUS 1751. Study of the musical art emphasizing the development of critical listening skills and a non-technical, but thorough musical vocabulary; additional emphasis placed on the history and description of both vernacular and art music to corresponding developments in the other fine arts disciplines.
1799 Rudiments of Music (3) Not open to music majors. The grammar of music, including basic notation and elementary construction leading to a study of tonal harmony.
1800 Technology in Music Education (2) Music majors only. Introduction to the uses of technology in school music programs; includes discussion of the role and application of technology in K-12 school music settings.
2000 History of Jazz (3) Open to nonmajors. Survey of the evolution of jazz and jazz styles.
2018 Diction for Singers III (1) Required of all voice performance majors. Advanced study of phonetics and pronunciation for German and French songs; utilizing the International Phonetic Alphabet; pronunciation concepts supported by recitation and performance of representative song repertoire.
2033 Diction for Singers IV (1) 1 hr. lecture; 1 hr. lab. The phonetic alphabet and French diction.
2035 Survey of Music History I (3) Prereq.: grade of ‘C’ or better in MUS 1740 and study of Western civilization to ca. 1750.
2054 Survey of Music History II (3, 3) Prereq.: grade of ‘C’ or better in MUS 1740 and study of Western civilization from ca. 1750 to the present.
2170 Music Education in the Elementary School I (3) Music fundamentals, materials, methods, and skills