**APPENDIX – E (Course descriptions)**

**Core Courses:**

BMVS 5094 (FST 5094) (CHEM 5094) - Grant Writing and Ethics (3 credits)

A framework for writing clear, concise grant proposals in a team-oriented, multidisciplinary approach from concept development through submission to a funding agency. Potential ethical dilemmas that may arise in academic, industrial, or federal research settings will be discussed.

BMVS 5594 - Current Methods and Technologies in Biomedical Research (1 credit)

Current methodologies and techniques for hypothesis-driven scientific experimentation in biomedical research. Cutting-edge and novel approaches for designing experiments and interpreting the resulting data, and important considerations for the appropriateness and limitations of specific methods, approaches, and experimental models. PHS 5984 – Lab for Epidemiology and Quantitative Methods (1 credit)- designed for students specializing in population health sciences. Design, analyze, draw conclusions from, and write about epidemiological and public health research projects. Develop hands-on practice for building the skills needed to conduct epidemiological and public health research and evaluate the research of others.

BIOL 5884 - Molecular Biology of the Cell (3 credits)

Current concepts of the molecular organization of animal and plant cells. Topics include membrane structure and function, organelle biosynthesis and function, intracellular signaling, the cytoskeleton, the cell cycle, tissue formation and modern experimental methodologies / PHS 5004 (VM 5004) - Fundamentals Public Health (3 credits). This course is for students specializing in public health. Theory, concepts, and practices related to public health; five major topics of public health including health services, epidemiology, social, behavioral science, public and environmental health and biostatistics; special emphasis placed on history of public health, biomedical basis for public health intervention, public health ethics.

STAT 5615 - Statistics in Research (3 credits)

Concepts in statistical inference, including basic probability, estimation, and test of hypothesis, point and interval estimation and inferences; categorical data analysis; simple linear regression; and one-way analysis of variance. 5616: Multiple linear regression; multi-way classification analysis of variance; randomized block designs; nested designs; and analysis of covariance. One year of Calculus. CMS. I, III/ PHS 5025 - Epidemiology & Quantitative Methods in Public Health (3 credits). This course is required for students specializing in public health. Investigation and analysis of dynamics and determinants of disease in communities and populations: philosophy of public health science, ethics, study design, and data analysis. Pre: Graduate Standing. PHS 5026: Investigation and analysis of dynamics and determinants of disease in communities and populations; constructing survey instruments, establishing power and effect sizes; exploration of databases; methods of outbreak investigation; communication of population health data.

BMVS 5944 - Seminar in Biomedical and Veterinary Sciences (1 credit)

Presentations by graduate students on current topics in Biomedical and Veterinary Sciences. Topics and responsibility for seminars is rotated among the professional departments of the college.

GRAD 5004 - GTA workshop (1 credit)

Graduate Teaching Assistants (GTAs) are required to attend and be enrolled in the GTA Workshop, P/F) in the first fall semester of their teaching appointment at Virginia Tech. Other students who hope to qualify for a GTA appointment in the future should take the workshop in their first semester at Virginia Tech. The workshop consists of Phase I (two half days, Monday and Tuesday of the week before classes start in August) a wide variety of Phase II sessions during fall semester.

Grad 5144 Communicating Science – (2 Credits)

Practice-based pedagogy techniques for effective communication about scientific, technical, and health research. Application of communication techniques across public and professional audiences and a variety of oral and written. The goal of the course is to help budding scientists and engineers better communicate their research to diverse audiences, including to those in their fields.

BMVS 5174 Responsible Research Conduct (1 credit)

Issues relating to scientific integrity and the responsible conduct of research as related to the studies in the life sciences, physical sciences, engineering, and the humanities. The topics covered include conflict of interest, human and animal subjects in research, mentor/mentee responsibilities, collaborative research, peer review, research misconduct, responsible authorship and publication, data management, sharing, and ownership, and legal issues in research. Pre: None. Required of all trainees, fellows, participants, and scholars who are supported by NIH Institutional Research Training Grants, Individual Fellowship Awards, Career Development Awards (Institutional and Individual), Research Education Grants, Dissertation Research Grants, and any other program that requires such training as identified in the NIH Funding Opportunity Announcement.

BMVS 7994 - Research and Dissertation (> 30 credits)

**TRACKS-Related Courses:**

In addition to the core courses, each student must complete track specific courses in their area of research focus. In consultation with their mentors and the PhD advisory committees, all students must complete at least 12 credit hours of the track-related courses listed below. Note several of these courses are common to the four tracks, and hence are integrative.

**Pathogenic Microbiology and Immune-mediated and Inflammatory Diseases Track:**

BMVS 5005 (VM 9085) - Emerging Infectious Diseases (1 credit)

Stand-alone, fully on-line, asynchronous distance and distributed learning course, accessible as streaming videos on the internet or on CDs. 5005: The course defines and discriminates amongst numerous factors influencing the emergence of infectious diseases. Selected emerging food-borne, bacterial, viral, zoonotic diseases of animals and humans are described and analyzed. 5006: The course expands the pathology of emerging infectious diseases. Additional viral, parasitic and zoonotic diseases of animals and humans are described and analyzed. Xenotransplantation is also discussed from the perspective of zoonotic diseases. Third year standing in the DVM curriculum, or good standing in a graduate studies program is required.

BMVS 5006 (VM 9086) - Emerging Infectious Diseases (1 credit)

Stand-alone, fully on-line, asynchronous distance and distributed learning courses, accessible as streaming videos on the internet or on CDs. 5005: The course defines and discriminates amongst numerous factors influencing the emergence of infectious diseases. Selected emerging food-borne, bacterial, viral, zoonotic diseases of animals and humans are described and analyzed. 5006: The course expands the pathology of emerging infectious diseases. Additional viral, parasitic and zoonotic diseases of animals and humans are described and analyzed. Xenotransplantation is also discussed from the perspective of zoonotic diseases. Third year standing in the DVM curriculum, good standing in a graduate studies program is required.

BMVS 5224 (BMES 5024) - Biomedical Engineering and Human Disease (3 credits)

Comprehensive overview of a variety of human diseases, including neurological disorders, cardiovascular disease, infectious disease, and cancer, designed primarily for graduate students majoring in engineering and other related areas who have a long-term academic and professional goal in the field of biomedical engineering and life sciences. Introduction to state-of-the-art biomedical engineering approaches used for the study of early detection/diagnosis, treatment and prevention of human disease. Graduate standing required.

BMVS 5284 - Cellular Pathology (3 credits)

This course presents the mechanisms involved in cellular reaction to injury, inflammation, tissue repair and regeneration, circulatory disturbances (thrombosis, embolism, infarction, hemorrhage, edema, congestion, shock) and neoplasia and other alterations of cell growth. Emphasis will be placed upon disease processes at the cellular and tissue levels.

BMVS 5364 - Ultrastructure Methodology in Biological Sciences (3 credits)

An introduction to the methodology of transmission electron microscopy as it applies to the life sciences. The goal of the course is to provide students who expect to use ultrastructure as a research tool with the fundamental principles behind the techniques, and hands-on experience in preparing and examining them in the electron microscope. Students prepare tissues and will generate a final project in the form of a journal article. Because of the intensive nature of the laboratory portion, course enrollment is limited to 15 students, and permission of the instructor is required.

BMVS 5564 (VM 8534) - Introduction to Clinical Research (2 credits)

Design of studies in veterinary related clinical research, planning and implementation of experimental and survey data collection, management and analysis of data, evaluation of analysis and critical evaluation of published information. Instructor approval required.

BMVS 5624 - Molecular Virology (2 credits)

The principles and mechanisms of virus replication at the molecular level including transcription, translation and posttranslational modifications of virus genes, virus interaction with host, antivirals, vaccines and host defense mechanisms against virus infections. The replication and pathogenesis mechanisms of several important DNA and RNA virus families including biothreat viruses. Graduate standing required.

BMVS 6714 - Immunology in Health & Disease (3 credits)

Analysis of emerging, cutting edge and paradigm changing concepts of cellular and molecular immunology in human and animal health and disease. Innate immunity, adaptive immunity, developmental immunology, autoimmunity, immunodeficiency, cancer immunology, and transplantation immunology.

BMVS 6724 – Molecular Mechanisms of Pathogenic Bacteria (3 credits)

Molecular mechanisms employed by pathogenic bacteria to cause infection. Classical and contemporary methods for studying host-pathogen interactions at the molecular level. Hypothesis-driven scientific experimentation in pathogenic bacteriology.

BCHM 5124 - Biochemistry for the Life Sciences (3 credits)

Basic principles of biochemistry including protein structure, enzymology, gene expression, bioenergetics, and pathways of energy metabolism. Not available to Biochemistry majors.

BCHM 5224 - Protein Structure and Function (3 credits)

Structure and function of proteins. Topics include special techniques in protein purification and characterization, techniques for studying protein structure, posttranslational modification of proteins and selected topics to study the structure-function relationship of proteins. Taught alternate years.

BCHM 5344 (PPWS 5344) - Molecular Biology for the Life Sciences (3 credits)

A multi-disciplinary treatment of gene organization and expression in animal and plant systems. Emphasis on the applications of molecular biology to current problems in applied biology and biotechnology. II.

BCHM 5784G - Advanced Applications in Molecular Life Sciences (3 credits)

Synthesis and application of biochemistry, cell biology, genetics, genomics, physiology, immunology concepts and techniques to address medical and agricultural problems. Genre characterization and manipulation, protein-based drugs, diagnostics, vaccines, transgenic plants/animals. Advanced analysis, critique, application of research in molecular life science.

BMES 5054 - Quantitative Cell Physiology (3 credits)

Mathematical modeling, simulation, quantitative description of cell physiology and control. Numerical simulation of cellular physiologic processes including reaction kinetics, inhibition and cooperativity, passive transport, facilitated and carrier-mediate reaction kinetics. Cell resting membrane potential, and nerve and muscle tissue. Modeling of neural cell processes including voltage-gated channels, neurotransmitter kinetics, and postsynaptic cell membrane potentials.

BIOL 5184 - Prokaryote Recombinant Proteins (3 credits)

Concepts of bacterial recombinant protein expression, purification, and handling. Protein bioinformatics resource and the functional characteristics of proteins with biochemical and biophysical techniques. Discussion of research articles related to class topics.

BIOL 5564 - Advanced Infectious Disease Ecology (3 credits)

Advanced overview of the principles of infectious disease dynamics from ecological and evolutionary perspectives. Examines a variety of wildlife hosts and disease-causing agents. Selective coverage of specific host and pathogen models to illustrate underlying principles of wildlife disease emergence, maintenance, and spread, as well as connections between wildlife and human health.

BIOL 5624 - Advanced Microbial Genetics (4 credits)

Molecular genetics of bacteria and their associated plasmids and phages. Review of research from the current literature for methodology and standards of data analysis.

BIOL 5634 - Microbial Physiology (4 credits)

The study of the structure, function and metabolic activities of prokaryotic microorganisms. Topics covered include cell composition and growth, metabolic unity and diversity, patterns of regulation, transport mechanisms, environmental sensing and response and cellular differentiation processes. Students will give presentations and critically analyze current literature in the field.

BIOL 5664G - Advanced Virology (3 credits)

Classification, structure, replication, and pathogenesis of viruses of animals, plants and bacteria. Epidemiology, prevention, and treatment.

BIOL 5674 - Advanced Pathogenic Bacteriology (4 credits)

Characteristics of bacteria that cause human disease, nature of infectious processes, virulence factors, epidemiology, resistance, immunization. Review of publications in the current literature related to data and statistical analysis and methods.

BIOL 5734 - Advanced Inflammation Biology (4 credits)

Cellular and molecular pathways controlling human responses to inflammatory challenges. Regulation of immune cells during inflammation. Interaction of host cells and tissues with environmental risk factors that cause inflammation. Pathogenesis of inflammatory diseases including cardiovascular diseases, diabetes, multi-organ failure, neurological diseases and sepsis. Therapeutic intervention of inflammatory diseases. Discussion of current literature. Integrative approached to study of inflammation will be critically evaluated and synthesized.

BIOL 5824G - Advanced Bioinformatic Methods (3 credits)

Application of bioinformatics methods in biological research. Methods to access bioinformatics data. Theory and methods for analysis fo DNA sequences, and analysis of complex data sets including whole genome sequences and gene expression data. Use of standard bioinformatics software and databases.

BIOL 5834G – Advanced Practical Analysis Protein Structure and Function (3 credits)

Application of biophysical and biochemical methods to characterization of protein structure and function, macromolecular interactions and conformational changes. Strategies, experimental design, practical considerations, troubleshooting, data analysis.

BIOL 5844 - Advanced Proteomics and Biological Mass Spectrometry (4 credits)

Introduction to mass spectrometry (MS) instrumentation and advanced proteomic methods for systems biology applications. Peptide mass fingerprinting, tandem MS, quantitation, phospho/glyco proteomics, and bioinformatics tools for evaluation and interpretation of mass spectrometry data. Includes three 4-hour lab sessions.

BIOL 5854G - Advanced Cytogenetics (3 credits)

Structure and function of eukaryotic chromosomes, with emphasis on (i) use of model systems to study specific chromosomes substructures or functions; (ii) techniques used to indentify and classify both normal and aberrant chromosomes; and (iii) diseases caused by defective chromosome structure and/or function.

HNFE 5144 - Molecular Aspects of Nutrition and Disease (3 credits)

The role of specific nutrients in human and animal health at a physiologic and molecular level. Emphasis is placed on the influence of nutrients on gene expression especially with regard to pathophysiology of diseases. Physiological and molecular aspects of nutrition and immune function will also be discussed.

TBMH 5054 - Fundamentals of Immunity and Infectious Disease (8 credits)

A comprehensive survey of human immunity, infectious agents and disease across scales: genetic, molecular, cellular, tissue, organism, society. Diagnosis, treatment, and prevention of infectious and immune diseases. Social and economic aspects of infectious disease and immunity.

**Neuropathobiology Track:**

BMVS 5224 (BMES 5024) – Biomedical Engineering and Human Disease (3 credits)

Comprehensive overview of a variety of human diseases, including, neurological disorders, cardiovascular disease, infectious disease, and cancer, designed primarily for graduate students majoring in engineering and other related areas who have a long-term academic and professional goal in the field of biomedical engineering and life sciences. Introduction to state-of-the-art biomedical engineering approaches used for the study of early detection/diagnosis, treatment and prevention of human disease.

BMVS 5324 - General Neurochemistry (3 credits)

Biochemical mechanisms involved in normal and abnormal nervous system function including discussions of experimental techniques, structural components, neurotransmitters, cerebral blood flow and metabolism, sensory systems, learning, mental disorders, and neuropharmacological agents.

BMVS 5284 - Cellular Pathology (3 credits)

This course presents the mechanisms involved in cellular reaction to injury, inflammation, tissue repair and regeneration, circulatory disturbances (thrombosis, embolism, infarction, hemorrhage, edema, congestion, shock) and neoplasia and other alterations of cell growth. Emphasis will be placed upon disease processes at the cellular and tissue levels.

BMVS 5364 - Ultrastructure Methodology in Biological Sciences (3 credits)

An introduction to the methodology of transmission electron microscopy as it applies to the life sciences. The goal of the course is to provide students who expect to use ultrastructure as a research tool with the fundamental principles behind the techniques, and hands-on experience in preparing and examining them in the electron microscope. Students prepare tissues and will generate a final project in the form of a journal article. Because of the intensive nature of the laboratory portion, course enrollment is limited to 15 students, and permission of the instructor is required.

BMES 5314 (VM 8534) - Introduction to Regenerative Medicine (3 credits)

Current state of the field of regenerative medicine with specific emphasis on the technological challenges that limit the efficacy and clinical translation of engineered tissues and therapies. Life science (e.g., call biology, organ physiology, biochemical methods) and engineering perspectives (e.g., stem cells, biologically-inspired materials, gene therapies)

BMVS 5564 (VM 8534) - Introduction to Clinical Research (2 credits)

Design of studies in veterinary-related clinical research, planning and implementation of experimental and survey data collection, management and analysis of data, evaluation of analysis and critical evaluation of published information. Instructor approval required.

BCHM 5124 - Biochemistry for the Life Sciences (3 credits)

Basic principles of biochemistry including protein structure, enzymology, gene expression, bioenergetics, and pathways of energy metabolism. Not available to Biochemistry majors.

BCHM 5224 - Protein Structure and Function (3 credits)

Structure and function of proteins. Topics include special techniques in protein purification and characterization, techniques for studying protein structure, posttranslational modification of proteins and selected topics to study the structure-function relationship of proteins. Taught alternate years.

BCHM 5784G - Advanced Applications in Molecular Life Sciences (3 credits)

Synthesis and application of biochemistry, cell biology, genetics, genomics, physiology, immunology concepts and techniques to address medical and agricultural problems. Genre characterization and manipulation, protein-based drugs, diagnostics, vaccines, transgenic plants/animals. Advanced analysis, critique, application of research in molecular life science.

BMES 5054 - Quantitative Cell Physiology (3 credits)

Mathematical modeling, simulation, quantitative description of cell physiology and control. Numerical simulation of cellular physiologic processes including reaction kinetics, inhibition and cooperativity, passive transport, facilitated and carrier-mediate reaction kinetics. Cell resting membrane potential, and nerve and muscle tissue. Modeling of neural cell processes including voltage-gated channels, neurotransmitter kinetics, and postsynaptic cell membrane potentials.

BIOL 5105 – Advanced Developmental Biology (4 credits)

Morphological, Physiological and molecular in embryological and developmental systems, including the regulation at the level of transcription, translation, enzyme or hormone activation. Review of the current literature.

BIOL 5404 – Neuroethology (3 credits)

Overview of Neuroethology, the study of the neural basis of animal behavior. Topics include: organization of the nervous system, control and coordination of movement, sensory transduction, visual and auditory prey detection and recognition, visual communication, matched filters/predictive coding of sensory information, learning templates, computational maps, sensory integration, behavioral plasticity, spatial cognition, neural plasticity, and lateralization of neural function.

BIOL 5434 - Behavioral Endocrinology (3 credits)

Overview of the hormonal basis of animal behavior. Topics: include: sex differences in behavior, male and female reproductive behavior, parental behavior, aggressive and other social behaviors, stress, affective disorders, learning and memory, homeostasis, and biological rhythms.

BIOL 5824G - Advanced Bioinformatic Methods (3 credits)

Application of bioinformatics methods in biological research. Methods to access bioinformatics data. Theory and methods for analysis fo DNA sequences, and analysis of complex data sets including whole genome sequences and gene expression data. Use of standard bioinformatics software and databases.

BIOL 5834G – Advanced Practical Analysis Protein Structure and Function (3 credits)

Application of biophysical and biochemical methods to characterization of protein structure and function, macromolecular interactions and conformational changes. Strategies, experimental design, practical considerations, troubleshooting, data analysis.

BIOL 5844 - Advanced Proteomics and Biological Mass Spectrometry (4 credits)

Introduction to mass spectrometry (MS) instrumentation and advanced proteomic methods for systems biology applications. Peptide mass fingerprinting, tandem MS, quantitation, phospho/glyco proteomics, and bioinformatics tools for evaluation and interpretation of mass spectrometry data. Includes three 4-hour lab sessions.

BIOL 5854G - Advanced Cytogenetics (3 credits)

Structure and function of eukaryotic chromosomes, with emphasis on (i) use of model systems to study specific chromosomes substructures or functions; (ii) techniques used to indentify and classify both normal and aberrant chromosomes; and (iii) diseases caused by defective chromosome structure and/or function.

BMVS 6114 - Neurogenesis in the Developing and Diseased Brain (3 credits)

Development, maintenance and injury-induced response of stem cells in the brain. Key epigenetic and signal transduction pathways required for the proper development and adaptive response of stem cells in the neurogenic compartments after brain injury in rodents and larger animal species.

TBMH 5014 - Fundamentals of Brain and Cognitive Science (8 credits)

Fundamental and translational neuroscience across multiple levels of analysis including molecular, cellular, neural network, computational and whole brain function, as well as individual and social cognition in normal and pathologic states. Impact of brain disease burden on individuals, families and society

**Integrative Oncology and Comparative Medicine Track**

BMVS 5224 (BMES 5024) – Biomedical Engineering and Human Disease (3 credits)

Comprehensive overview of a variety of human diseases, including, neurological disorders, cardiovascular disease, infectious disease, and cancer, designed primarily for graduate students majoring in engineering and other related areas who have a long-term academic and professional goal in the field of biomedical engineering and life sciences. Introduction to state-of-the-art biomedical engineering approaches

BMVS 5284 - Cellular Pathology (3 credits)

This course presents the mechanisms involved in cellular reaction to injury, inflammation, tissue repair and regeneration, circulatory disturbances (thrombosis, embolism, infarction, hemorrhage, edema, congestion, shock) and neoplasia and other alterations of cell growth. Emphasis will be placed upon disease processes at the cellular and tissue levels.

BMVS 5364 - Ultrastructure Methodology in Biological Sciences (3 credits)

An introduction to the methodology of transmission electron microscopy as it applies to the life sciences. The goal of the course is to provide students who expect to use ultrastructure as a research tool with the fundamental principles behind the techniques, and hands-on experience in preparing and examining them in the electron microscope. Students prepare tissues and will generate a final project in the form of a journal article. Because of the intensive nature of the laboratory portion, course enrollment is limited to 15 students, and permission of the instructor is required.

BMVS 5564 (VM 8534) - Introduction to Clinical Research (2 credits)

Design of studies in veterinary related clinical research, planning and implementation of experimental and survey data collection, management and analysis of data, evaluation of analysis and critical evaluation of published information. Instructor approval required.

BMVS 6714 - Immunology in Health & Disease (3 credits)

Analysis of emerging, cutting edge and paradigm changing concepts of cellular and molecular immunology in human and animal health and disease. Innate immunity, adaptive immunity, developmental immunology, autoimmunity, immunodeficiency, cancer immunology, and transplantation immunology.

BIOL 5734 - Advanced Inflammation Biology (4 credits)

Cellular and molecular pathways controlling human responses to inflammatory challenges. Regulation of immune cells during inflammation. Interaction of host cells and tissues with environmental risk factors that cause inflammation. Pathogenesis of inflammatory diseases including cardiovascular diseases, diabetes, multi-organ failure, neurological diseases and sepsis. Therapeutic intervention of inflammatory diseases. Discussion of current literature. Integrative approached to study of inflammation will be critically evaluated and synthesized.

BMES 5054 – Quantitative Cell Physiology (3 credits) Mathematical modeling, simulation, quantitative description of cell physiology and control. Numerical simulation of cellular physiologic processes including reaction kinetics, inhibition and cooperativity, passive transport, facilitated and carrier-mediate reaction kinetics. Cell resting membrane potential, and nerve and muscle tissue. Modeling of neural cell processes including voltage-gated channels, neurotransmitter kinetics, and postsynaptic cell membrane potentials.

BIOL 5824G - Advanced Bioinformatic Methods (3 credits)

Application of bioinformatics methods in biological research. Methods to access bioinformatics data. Theory and methods for analysis fo DNA sequences, and analysis of complex data sets including whole genome sequences and gene expression data. Use of standard bioinformatics software and databases.

BIOL 5434 - Behavioral Endocrinology (3 credits)

Overview of the hormonal basis of animal behavior. Topics: include: sex differences in behavior, male and female reproductive behavior, parental behavior, aggressive and other social behaviors, stress, affective disorders, learning and memory, homeostasis, and biological rhythms.

BIOL 5834G – Advanced Practical Analysis Protein Structure and Function (3 credits)

Application of biophysical and biochemical methods to characterization of protein structure and function, macromolecular interactions and conformational changes. Strategies, experimental design, practical considerations, troubleshooting, data analysis.

BIOL 5844 - Advanced Proteomics and Biological Mass Spectrometry (4 credits)

Introduction to mass spectrometry (MS) instrumentation and advanced proteomic methods for systems biology applications. Peptide mass fingerprinting, tandem MS, quantitation, phospho/glyco proteomics, and bioinformatics tools for evaluation and interpretation of mass spectrometry data. Includes three 4-hour lab sessions.

BIOL 5854G - Advanced Cytogenetics (3 credits)

Structure and function of eukaryotic chromosomes, with emphasis on (i) use of model systems to study specific chromosomes substructures or functions; (ii) techniques used to indentify and classify both normal and aberrant chromosomes; and (iii) diseases caused by defective chromosome structure and/or function.

HFNE 5144- Molecular Aspects of Nutrition and Disease (3 credits)

The role of specific nutrients in human and animal health at a physiological and molecular level. Emphasis is placed on the influence of nutrients at the gene expression especially with regard to pathophysiology of diseases. Physiological and molecular aspects of nutrition will also be discussed.

BMVS 5305 - Veterinary Oncology (2 credits)

These companion courses are designed to provide intensive study of the biology of neoplasms, their diagnosis, clinical presentation and treatment. 5305: Introductory/review lectures: factors in protooncogene mutation, methods of diagnosis, and cancer epidemiology. A second portion of this course discusses important neoplasms of various animal species and body systems, and classical methods of treatment. 5306: In-depth discussion of cancer chemotherapy, immunotherapy, and new advances in therapy such as gene replacement/modification. Pre: third-year standing in the DVM curriculum.

TBMH 5024 - Fundamentals of Cancer (8 credits)

Comprehensive survey of neoplastic diseases across scales: genetic, molecular, cellular, tissue, organism, society. Causes diagnosis and treatment of cancer. Social and economic aspects of cancer.

BMES 5314 - Introduction to Regenerative Medicine (3 credits)

Current state of the field of regenerative medicine with specific emphasis on the technological challenges that limit the efficacy and clinical translation of engineered tissues and therapies. Life science (e.g., call biology, organ physiology, biochemical methods) and engineering perspectives (e.g., stem cells, biologically-inspired materials, gene therapies)

BMVS 5794 - Clinical Neuropathology (1 credit)

This course uses necropsy tissues of clinical cases to present the mechanisms involved in neurologic disease of animals. Gross, microscopic, and radiologic approaches will be employed. Emphasis will be placed upon the correlation of clinical and pathological findings. May be repeated.

BMVS 5814 (VM 8254) - Functional Morphology and Natural History of Reptiles and Birds (1 credit)

Anatomical features will be described that are unique to, or are characteristic of, each major group covered. Adaptation and successful exploitation of habitat. Use of anatomical features and functions. Selected attributes of the group's natural history, members of the group common to the local and extended area, those commonly kept as pets.

BMVS 5824 - Small Animal Nutrition (1 credit)

Practical feeding guidelines for companion animals. Special consideration also given to the relationship of diet to nutrient excesses and deficiencies that result in clinical disorders. Diagnosis, treatment, and prevention of metabolic disorders of companion animals will be discussed.

BMVS 5834 - Food Animal Nutrition (2 credits)

Practical feeding guidelines for food animals. Special consideration also given to the relationship of diet to nutrient excesses and deficiencies that result in clinical disorders. Diagnosis, treatment, and prevention of metabolic disorders of food animals will be discussed.

BMVS 5844 - Equine Nutrition (1 credit)

The course is designed to provide practical feeding guidelines for different classes of horses. The relationship between nutrition and clinical disorders of the horse is explored including their nutritional management. Students will be expected to complete a problem-solving nutrition project during the course.

BMVS 6064 - Advanced Topics in Veterinary Medicine (1-6 credits)

Students will critically review and actively participate in discussion of current and important historic veterinary and comparative medical literature relevant to student's residency specialty. DVM degree is required. May be repeated with different content for a maximum of 12 credit hours.

BMVS 6084 - Veterinary Specialty Clinics (3 credits)

Practical, advanced training in specialty medicine. Students will learn advanced diagnostic and therapeutic techniques applicable to the specialty and species being studied. An in-depth knowledge of the pathophysiology of animal disease processes and clinical problem solving will be developed. Students will be given responsibility for case management with faculty guidance. DVM degree is required. May be repeated for a maximum of 12 credits with different content.

BMVS 6114 - Neurogenesis in the Developing and Diseased Brain (3 credits)

Development, maintenance and injury-induced response of stem cells in the brain. Key epigenetic and signal transduction pathways required for the proper development and adaptive response of stem cells in the neurogenic compartments after brain injury in rodents and larger animal species.

BMVS 6534 - Mechanisms of Disease in Veterinary Medicine (3 credits)

Advanced study of topics concerning the pathophysiology, diagnosis, and current therapy of diseases in Veterinary Medicine. Pre: DVM or equivalent, or consent of instructor. May be repeated to a maximum of 18 credits.

Corequisite(s):

**Population Health Science track (Public Health) Track:**

PHS 5034 - Health Behavior and Health Education (3 credits)

This course has two main purposes: (1) to familiarize students with historical, theoretical and methodological aspects of health psychology, and (2) to acquaint health education students with the social, psychological, and cultural determinants of health behaviors which form the underpinnings of health education practice.

PHS 5026 – Epidemiology & Quantitative Methods in Public Health (3 credits)

Investigation and analysis of dynamics and determinants of disease in communities and populations: philosophy of public health science, ethics, study design, and data analysis. Pre: Graduate Standing. PHS 5026: Investigation and analysis of dynamics and determinants of disease in communities and populations; constructing survey instruments, establishing power and effect sizes; exploration of databases; methods of outbreak investigation; communication of population health data.

PHS 5024 – Epidemiology (3 credits)

Epidemiology is the study of the distribution and determinants of the varying rates of diseases, injuries, or other health states in human and animal populations. This course consists of an introduction to epidemiological terminology, concepts and research methodology.

PHS 5014 (VM 7014) - Environmental Health (3 credits)

Exploration of major environmental health concepts and issues, environmental policies and regulations. Topics include world population and pressures on the environment, healthy environment; environmental determinants of public health, including biological, physical and chemical factors; disease vectors and their control; air and water quality; waste management; the built environment, work environments and recreational area; food protection and safety; occupational health; tools for environmental evaluation, planning and safety.

PHS 5044 (HNFE 5694) - Public Health Administration (3 credits)

This course will focus on relevant and timely public health administration concepts. The major topics covered include health policy, health care planning, health care economics, health law, and managerial functions as they relate to health care and public health settings.

PHS 5204 - Principles of Community Health Education (3 credits)

Public health issues and concepts are analyzed and evaluated in relationship to existing principles of health education.

PHS 5214 (HNFE 5684) - Program Development in Health Education (3 credits)

Theory, trends, and design of community health education programs implemented in communities, health agencies, hospitals, and industry.

PHS 5224 - Comp Health Systems (3 credits)

Comprehensive examination of the structure and function of worldwide healthcare and public health systems. National health services with central funding, social insurance programs, decentralized systems, and private insurance systems.

PHS 5244 (HD 5244) (WGS 5244) – Sexual Health and Human Rights

Sexual and reproductive health from human development, public health, and critical feminist perspectives, with special attention to human rights issues, Sexually transmitted infections HIV/AIDS; unintended pregnancy; population policies; eugenics; sexual and reproductive rights; positive sexuality, sex education; and health promotion.

PHS 5254 (HD 5254) - Social Epidemiology and Health Inequities (3 credits)

Social determinants of health through the life-course. Relationship of social injustice to public health. Interplay of major social factors such as poverty, race and gender to influence health domestically and globally. Application of social epidemiology to a range of health outcomes. Inform effective solutions to health inequities.

PHS 5304 (VM 7304) - Zoonoses and Infectious Diseases Common to Humans and Animals (3 credits)

Epidemiology of bacterioses, mycoses, chlamydioses, rickettsioses, parasitosis, viroses and prion diseases that are transmissible between animals and humans and/or are aquired by animals and human from the same source and that have great impact on public health. Cultural, social and economic factors and impacts; modes of inter - and intra- species transmission including roles of vectors and environmental factors; concepts of emergence and re-emergence; pathogenesis in various hosts and host adaptation; temporal and spatial dynamics and risk factors for exposure, infection and expression of clinical disease; modes of detection, control/mitigation and prevention; biosecurity, including food safety and security.

PHS 5314 (VM 7314) - Infectious Disease Epidemiology (3 credits)

Dynamics and determinants of infectious diseases and their assessment on the molecular to population continuum in a systems-based approach. Infectious disease transmission mechanisms; population susceptibilities; environmental, social, cultural and economic contributors to infectious disease propagation; detection and surveillance; geographic information systems; epidemiologic study design; and infectious disease modeling.

PHS 5324 – Public Health Infect Control & Prevention (3 credits)

Assessment, policies, and procedures for control and prevention of infectious diseases in communities and populations. Sources, transmission mode, and local community to international dissemination of infectious disease agents; antimicrobial and chemical resistance; vaccine development, safety, and coverage; community and hospital-based needs and interventions; and regulatory frameworks

PHS 5334 - Principles of Infectious Diseases (3 credits)

Principles of infectious diseases important for local, national, and global public health. Bacterial, viral, fungal, and parasitic pathogens; mechanisms of disease; host immune response to pathogens.

PHS 5354 - Modeling Infectious Diseases (3 credits)

Mathematical modeling of infectious diseases in humans and animals. Deterministic susceptible-infectious-recovered (SIR) and related models, estimation of reproductive number, host heterogeneities, multi-pathogen/multi-host models, spatio-temporal models, stochastic dynamics, and modeling for public health policy.

PHS 5504 - Epidemiology and Biostatistics in Public Health for Veterinarians (2 credits)

Statistical assessment of dynamics and determinants of disease in communities and populations; study design and statistical analyses; exploration of databases; problem based for students to integrate veterinary and public health domains.

PHS 5644 (HD 5644) - Program Evaluation (3 credits)

Methods of conducting program evaluations for prevention and intervention programs that promote public health and human development. Major dimensions of evaluation strategies, including process evaluation, impact assessment, and cost analysis.

PHS 5714 - Health of the Elderly (3. Credits)

The health needs and problems of the elderly, the implications for those working with the elderly, and possible health care delivery systems.

PHS 5034 - Health Behavior and Health Education (3 credits)

This course has two main purposes: (1) to familiarize students with historical, theoretical and methodological aspects of health psychology, and (2) to acquaint health education students with the social, psychological, and cultural determinants of health behaviors which form the underpinnings of health education practice.

FST 5604 - Advances in Food Microbiology **(**3 credits)

Critical review of current topics in food microbiology. Foodborne pathogens, toxins, analytical methodology, food spoilage, inhibition and destruction of bacteria, standards, and fermentations.

FST 5614: Food Safety and Security **(**3 credits)

Identification and prevention of food safety and security hazards that may result in intentional or unintentional contamination. Development and implementation of plans to enhance food safety and security in the processing, distribution, transportation, and retail segments of the food supply chain.

FST 5624 - Applied Food Microbiology and Sanitation **(**3 credits)

Overview of the causes, transmission, and epidemiology of major environmental, food-, and water-borne diseases in the food industry. Detection, monitoring, and control of important environmental pathogens. Chemical, physical, and biological sanitation to control pathogens in food, water, and the environment.

FST 5634G- Advances Epidemiology, Food & Water Diseases **(**4 credits)

Overview of the causes, transmission, and epidemiology of major environmental, food, and waterborne diseases. Outbreak and sporadic detection, source tracking, and control of pathogens. Overview of the impact of food-borne outbreaks on regulatory activities at the national and international level.

GEOG 5074G - Advanced Medical Geography (3 credits)

Geographic patterns of disease and health care at various scales. Ecological, holistic approach to health problems emphasizes interrelationships of population-habitat-culture. Mapping of disease patterns and health services delivery and utilization. Field experience included.

**GEOG 5084G - Advanced Modeling with Geographic Information Systems (1 credit)**

**Use of automated systems for geographic data collection, digitization, storage, display, modeling and analysis. Basic data flow in GIS modeling applications, Development of proficiency in the use of current GIS software**

**HFNE 5604 - Principles of Public Health Nutrition (3 credits)**

**This course provides knowledge of community assessment, planning, implementation, and evaluation as related to nutrition services in health programs, It presents a conceptual background for viewing dietary as well as social, economic, and environmental factors influencing health and nutritional status of populations.**

UAP 5764G - Advanced International Development Planning and Policy (3 credits)

Examination of major development theories and contemporary issues and characteristics of low-income societies (industrialization, urbanization, migration, rural poverty, hunger, foreign trade, and debt) that establish contexts for development planning and policy-making. Graduate standing required

UAP 5784 Economic Development Planning Topics (3 credits)

An introduction to local economic development programs. Covers intergovernmental relations, financing techniques, federal and local subsidies, advertising, marketing, public relations, labor market issues, tax considerations, fiscal impact analysis, and land use planning issues. May be repeated with different topics for a maximum of 9 credits

UAP 5214 Topics in Natural Resources and Natural Hazards Planning (3 credits)

Concepts, theory, and practice of resilience-based, climate- change integrated natural resources management and hazards planning. Effects of land, water, soil, and ecosystem management on quality of life for present and future generations. Natural resources and natural hazards planning process and tools for local communities and policies at state and federal levels. May be repeated for a maximum of 9 credit hours.

PAPA 5254 Homeland Security & Terrorist Threat (3 credits)

A multidisciplinary introduction to theory, strategy, decision making, and doctrine of Homeland Security as practiced in the U. S. Describes the threat, nature of current global conflicts in which the U. S. is engaged, America's foreign and domestic policy responses to 9/11, and strategic and operational homeland security functions.

PPWS 5624 Animal and Plant Biosafety and Biosecurity (3 credits)

Principles, tools, and techniques of disease detection, early warning, and containment of animal and plant pathogens. Regulatory agencies and guidelines used to ensure the biosafety and biosecurity of the U.S. food supply from accidental introductions and potential bioterrorism

PSYC 5374 - Health Psychology (3 credits)

Theoretical and methodological contributions of the behavioral sciences to problems in the health sciences. Topics include psychosocial factors contributing to health and disease, health promotion, and psychological approaches to the prevention and treatment of physical disabilities.

SOC 6524 - Sociology of Health (3 credits)

Examination of sociological theory and research on how social structures and social processes influence the health of individuals and populations. Emphasis on the health consequences of social inequalities by race, class, and gender; the effects of social contexts, networks, and institutions on health; and issues in health care