VTTP 605 Systemic Veterinary Physiology I  
Credits 5. 5 Lecture Hours.  
Aspects of cellular physiology, physiology of excitable membranes, physiology of body fluids, neurophysiology, and the physiology of smooth, cardiac and skeletal muscle; provides a basic understanding of mammalian physiology essential as a framework for advanced graduate studies.  
**Prerequisite:** Graduate classification.

VTTP 606 Systemic Veterinary Physiology II  
Credits 5. 5 Lecture Hours.  
In-depth study covering cardiovascular, respiratory, renal physiology, gastrointestinal and endocrine physiology; provides a basic understanding of mammalian physiology essential as a framework for advanced graduate studies.  
**Prerequisite:** VTPP 605.

VTTP 610 Physiology I  
Credits 6. 5 Lecture Hours. 2 Lab Hours.  
Introduction to physiology: cell physiology, cell signaling, cell cycle, body fluids, translocation of materials, membrane potentials, neurophysiology, autonomic nervous system, thermoregulation, cardiovascular, and muscle physiology.  
**Prerequisites:** Enrollment in MS/PhD program in Veterinary Physiology and Pharmacology; approval of instructor.

VTTP 612 Physiology II  
Credits 6. 5 Lecture Hours. 2 Lab Hours.  
Blood and lymph, respiration, renal physiology, and acid-based balance, gastrointestinal physiology, metabolism, endocrinology, and reproduction.  
**Prerequisites:** Enrollment in MS/PhD program in Veterinary Physiology and Pharmacology; approval of instructor.

VTTP 623 Biomedical Physiology I  
Credits 4. 3 Lecture Hours. 2 Lab Hours.  
Physiological principles, review of cellular physiology, and development of an understanding of the nervous system and muscle, cardiovascular, and respiratory physiology; clinical applications related to organ systems.  
**Prerequisites:** Graduate classification; BICH 410 and VIBS 305 recommended.

VTTP 624/VIBS 624 Endocrinology  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Neuroendocrine control of puberty menstruation, ovulation, pregnancy, labor, lactation, female reproductive cycles, male reproductive functions, thyroid and parathyroid, adrenal and kidney, diabetes, obesity, sleep, memory, learning and aging, and their endocrine disorders; overview on biosynthesis, transport and signaling of peptide and neuropeptide hormones, steroids and prostaglandins.  
**Prerequisite:** Graduate classification.  
**Cross Listing:** VIBS 624/VTPP 624.

VTTP 625 Pharmacology  
Credits 3. 3 Lecture Hours.  
Introduction to pharmacokinetics and pharmacodynamics; survey of major pharmaceutical classes; uses, mechanisms of action and adverse reactions of selected agents.  
**Prerequisites:** Graduate classification; VTPP 423 or approval of instructor.

VTTP 627 Biomedical Physiology II  
Credits 4. 3 Lecture Hours. 2 Lab Hours.  
Continuation of VTPP 623. Fluid balance and acid-base balance; development of an understanding of renal, gastrointestinal, endocrine and reproductive physiology using human and other mammalian models; clinical applications related to organ systems.  
**Prerequisites:** Graduate classification; VTPP 623.

VTTP 628 Pharmacology I  
Credits 5. 4 Lecture Hours. 2 Lab Hours.  
Pharmacokinetics, pharmacodynamics, CNS pharmacology, autonomic pharmacology, antineoplastic agents, immunopharmacology, recombinant products, fluid and electrolyte therapy, diuretics, pharmacology of the integument.  
**Prerequisite:** Approval of instructor.

VTTP 629 Pharmacology II  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Antimicrobials, endocrine pharmacology, eicosanoids, anti-inflammatory agents, respiratory pharmacology, anticoagulants and hematinics, GI pharmacology, cardiovascular pharmacology.  
**Prerequisite:** Approval of instructor.

VTTP 630 Pharmacology/Toxicology  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Management and treatment of toxicosis, antidotal pharmacology, toxic plants, mycotoxins, chemical toxicants, metals, euthanasia.  
**Prerequisite:** Approval of instructor.

VTTP 634 Physiology for Bioengineers I  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
Cellular anatomy, cellular physiology and biochemistry; systems analysis of digestive, endocrine and musculoskeletal system function including information related to gross anatomy, histology and disease states; quantitative aspects of physiology and engineering applications to clinical medicine.  
**Prerequisite:** Biomedical Engineering major or approval of instructor.

VTTP 635 Physiology for Bioengineers II  
Credits 4. 3 Lecture Hours. 3 Lab Hours.  
A systems analysis of nervous, cardiovascular, respiratory and urinary function including information related to gross anatomy, histology and disease states; quantitative aspects of physiology and engineering applications to clinical medicine.  
**Prerequisite:** VTPP 634.

VTTP 638 Analysis of Genomic Signals  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Overview of current high throughput technology for data acquisition and analysis of genomic signals (e.g., mRNA or proteins); emphasis on microarray technology, methods for analyzing microarray data, and approaches to model the underlying phenomena from the systems biology perspective.  
**Prerequisites:** BIOL 451 or GENE 320/BIMS 320/BIMS 320/GENE 320 or equivalent; STAT 651 or equivalent; or approval of instructor.

VTTP 639 Non-Coding RNAs  
Credits 3. 3 Lecture Hours.  
Roles of non-coding RNAs in regulating gene expression for physiological functions, development and diseases; includes a brief history of the field, various categories and definitions of non-coding RNAs, research methodologies and animal models, and break-through advances in clinical applications.  
**Prerequisite:** Approval of instructor.
VTTP 650 Stem Cell Biology
Credits 3. 3 Lecture Hours.
Wide-range of topics related to stem cells and tissue engineering, including a brief history of the field, various categories and definitions of stem cells, research methodologies and animal models, as well as breakthrough advances in the area of engineered stem cells.
Prerequisite: Approval of instructor.

VTTP 651 Epigenetics & Systems Physiology
Credits 3. 3 Lecture Hours.
Epigenetics & Systems Physiology. Journal club format focusing on epigenetic regulation of physiological systems; assignment of papers from primary literature and weekly oral presentations detailing opinions on research; emphasis on fundamental concepts in epigenetics, physiology and the molecular techniques employed to address research hypotheses, discussions of scientific ethics and fraud.
Prerequisite: Graduate classification.

VTTP 652 Fetal and Embryo Physiology
Credits 3. 3 Lecture Hours.
Introduction to the physiologic processes driving embryonic development and pregnancy; focus on embryo implantation, establishment of the placenta, development of the fetal circulatory systems and the molecular processes governing embryo differentiation and development; special emphasis on the major organ systems affected by pediatric disease and on the actions of teratogens.
Prerequisites: Graduate classification.

VTTP 653 Molecular Endocrinology
Credits 3. 3 Lecture Hours.
Structure-function relationships of hormones, their receptors and biologic activities.
Prerequisites: VTPP 653 or BIOL 649 and BICH 410 or equivalent or approval of instructor.

VTTP 654 Vascular Physiology
Credits 4. 4 Lecture Hours.
Structure and function of blood vessels and vascular beds; molecular and cell biology of endothelium and vascular smooth muscle; microcirculation; capillary exchange; regulation of blood flow by local, neural and humoral signals.
Prerequisite: MPH 901 or approval of department head.

VTTP 655 Physiology of the Heart
Credits 4. 4 Lecture Hours.
Structure and function of the heart; molecular and cell biology of cardiac myocytes; electrophysiology of myocardium, pacemaker cells and conducting tissue; cardiac mechanics; control of cardiac performance; coronary circulation.
Prerequisite: MPH 901 or MPH 604 or approval of department head.

VTTP 656 Cardiovascular Physiology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Physiological considerations of the circulatory system including general and integrative aspects of the heart and blood vessels.
Prerequisites: Approval of instructor.

VTTP 657 Gamete and Embryo Physiology
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Physiology of gametes and preimplantation embryos in livestock and laboratory animals; oocyte growth and maturation in-vivo and in-vitro, fertilization in-vivo and in-vitro, embryo transfer, cryopreservation, nuclear transfer, chimera formation, gene transfer.

VTTP 658 Directed Studies
Credits 1 to 4. 1 to 4 Other Hours.
Problems in physiology, pharmacology or toxicology.
Prerequisite: Approval of instructor.

VTTP 659 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.
Selected topics in an identified area of veterinary physiology and pharmacology. May be repeated for credit.
Prerequisite: Approval of instructor.

VTTP 660 Theory of Research
Credits 3. 3 Lecture Hours.
Theory and design of research related to current biomedical problems especially those involving study of animal disease; philosophical perspectives underlying historical advances in research pertaining to the study, prevention and treatment of disease.
Prerequisite: Graduate classification.
Cross Listing: VIBS 690 and VPAT 690.
VTPP 691 Research
Credits 1 to 23. 1 to 23 Other Hours.
Original investigations in veterinary physiology, pharmacology or toxicology to be submitted by writing of thesis or dissertation as partial fulfillment for MS or PhD degree.
Prerequisite: Approval of department head.

VTPP 910 Physiology I
Credits 6. 5 Lecture Hours. 2 Lab Hours.
Introduction to physiology: cell physiology, cell signaling, cell cycle, body fluids, translocation of materials, membrane potentials, neurophysiology, autonomic nervous system, thermoregulation, cardiovascular, and muscle physiology.
Prerequisite: Enrollment in first year of professional curriculum.

VTPP 912 Physiology II
Credits 5. 4 Lecture Hours. 2 Lab Hours.
Respiration, renal physiology, acid-base physiology, reproductive physiology, molecular biology and gastrointestinal physiology.
Prerequisite: Enrollment in the first year of professional DVM curriculum.

VTPP 914 Professional & Clinical Skills I
Credits 3. 1 Lecture Hour. 6 Lab Hours.
Professional & Clinical Skills I. Integration and reinforcement of foundational knowledge offered in concurrent courses through critical thinking exercises, professional skills application activities (ethics/contextual decision-making, leadership, skills for well-being, personal/practice financial literacy, core communication skills) and application of technical skills; opportunities for learning include didactic, hands-on and case-based interactions utilizing simulation, models, animals, actors and case scenarios; part I of a VI part series.
Prerequisite: Enrollment in the first year of professional DVM curriculum.

VTPP 924 Pharmacology
Credits 3. 3 Lecture Hours.
Drug disposition, pharmacodynamics, drug regulations, critical appraisal of evidence about use of drugs, drugs that affect respiratory, reproductive, gastrointestinal, endocrine, immune, urinary, integumentary, cardiovascular, musculoskeletal, and nervous systems, and drugs for pain, anti-inflammatories, antineoplastics, antibiotics, and other antiinfectives in animals.
Prerequisite: Enrollment in the second year of professional DVM curriculum.

VTPP 925 Pharmacology/Toxicology II
Credits 3. 5 Lecture Hours. 2 Lab Hours.
Antimicrobials, endocrine pharmacology, eicosanoids, antiinflammatory agents, respiratory pharmacology, anticoagulants and hematinics, GI pharmacology, cardiovascular pharmacology.
Prerequisite: Enrollment in the second year of professional curriculum.

VTPP 926 Pharmacology/Toxicology III
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Management and treatment of toxicoses, antidotal pharmacology, toxic plants, mycotoxins and mycotoxicoses, chemical toxicants, metals, euthanasia.
Prerequisite: Enrollment in the second year of professional curriculum.

VTPP 948 Didactic Elective in Veterinary Physiology and Pharmacology
Credits 1 to 12. 1 to 12 Lecture Hours.
Elective course in physiology and pharmacology for professional students who wish to supplement required curriculum. May be repeated for credit.
Prerequisite: Enrollment in the fourth year of professional curriculum.

VTPP 985 Directed Studies
Credits 1 to 4. 1 to 4 Other Hours.
Directed, individual study of selected problems in physiology, pharmacology or toxicology. May be repeated for credit.
Prerequisite: Approval of instructor and department head.

VTPP 989 Special Topics In...
Credits 1 to 4. 1 to 4 Lecture Hours. 1 to 4 Lab Hours.
Selected topics in an identified area of veterinary physiology and pharmacology. May be repeated for credit.