

**REVISED CURRICULUM  
OF  
VETERINARY ANATOMY**

**Curriculum Development Project**  
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## **PREFACE**

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum of a subject, one can judge the state of intellectual development and the state of progress of a nation. The world has turned into a global village, new ideas and information are pouring in a constant stream. It is, therefore, imperative to update our curricula by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by Sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide Notification No.D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the Competent Authority to look after the Curriculum Revision Work beyond Class XII at Bachelor level and onwards to all Degrees, Certificates and Diplomas awarded by Degree Colleges, Universities and other Institutions of higher education.

In pursuance of the above decisions and directives, the Commission is continually performing curriculum revision in collaboration with the Universities. According to the decision of the 44<sup>th</sup> Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various Committees are constituted at the national level comprising senior teachers nominated by the Universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these Committees.

The Curriculum Revision Committee on Veterinary Anatomy in its meeting held in June, 2001 at the UGC, Regional Centre, Lahore finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the Curriculum Revision Committee duly approved by competent authority is being circulated for implementation by the Universities.

**(PROF. DR. ALTAF ALI G. SHAIKH)**  
**ADVISER (C&T)**

June, 2001





## INTRODUCTION

A meeting of the National Curriculum Revision Committee for Veterinary Anatomy to finalize the draft syllabus prepared in its preliminary meeting was held on June 18-20, 2001 at UGC, Regional Centre, Lahore. Following attended the meeting:

1. Dr. Miandad Pardehi, Convener  
Professor & Chairman,  
Department of Anatomy & Histology,  
Sindh Agriculture University, Tandojam.
2. Dr. Anas Sarwar Member  
Assistant Professor,  
Department of Veterinary Anatomy,  
University of Agriculture, Faisalabad
3. Dr. Mashooq Ali Member  
Senior Research Officer,  
Veterinary Research Institute,  
Peshawar
4. Dr. Muhammad Safdar Anjum Member  
Asstt. Professor,  
Department of Animal Husbandry  
University College of Agriculture,  
Rawalakot (AJK).
5. Dr. Muhammad Asad, Member  
Lecturer,  
Department of Veterinary Anatomy,  
Institute of Animal Husbandry and  
Veterinary Sciences  
Gomal University, D.I. Khan.
6. Prof. Dr. Faqir Hussain Saga Member  
Nominee of PVMC, Islamabad  
28-Arjan Street  
Poonch Road, Lahore.

7. Dr. Saleem Qaisar Member/Secretary  
Lecturer  
Department of Veterinary Anatomy,  
College of Veterinary Sciences, Lahore.

The meeting started with recitation from the Holy Quran.

Mr. Muhammad Javed Khan, Director Curriculum, UGC, welcome the participants and briefed them of the obligations of the Commission for review, revision and development of curricula as per provisions of the Act of Parliament, 1976. He suggested the committee to go through the curriculum of anatomy taught in D.V.M., M.Sc. (Hons.) and Ph. D. degrees as proposed in first meeting held in April, 2001 and review the same in light of comments and suggestions received from different universities/institutions for improvement and finalize its recommendations to make it available to universities before 30<sup>th</sup> June, 2001. He stated that the objectives behind the whole exercise of reviewing Vet. Sciences curricula to **inculcate the latest knowledge** amongst the future graduates in the field of Veterinary Anatomy, which is use of the core subject. The Director informed the members that the present exercise of curriculum revision for Agriculture, Basic Sciences, Applied Sciences, Engineering and Technology, Animal Husbandry and Veterinary Sciences is being carried out with the financial support of Ministry of Science and Technology.

Prof. Dr. Altaf Ali G. Shaikh, Adviser (Curriculum and Training) introduced the members of the committee of the different academic programmes of the commission aimed at enhancing the academic capabilities of in-service university/ college teachers. He suggested to the members to devise the minimum baseline curriculum which every university/college imparting education in this economically important sector should offer. He emphasized inclusion of latest books in list of suggested readings so that new concepts and ideas are imparted future graduates.

The Committee unanimously appointed Prof. Dr. Miandad Pardehi as its convener and Dr. Saleem Qaisar as Secretary. Prof. Miandad in his opening remarks thanked the members and the University Grants Commission for reposing confidence in him and for providing this national forum wherein Veterinary Anatomists can discuss wide range of issues they are confronted with and suggest measures for resolution of

their common problems. He assured the commission of his own and on behalf of the members of the committee of full cooperation and intellectual contribution in revamping the curriculum. He stressed the members to avail this unique opportunity for developing lasting bonds of friendship and close interaction amongst them. The committee, after discussing the existing curricula of Vet. Anatomy both at under- and postgraduate levels agreed to the uniform draft curricula as detailed below:

**SCHEME OF STUDIES  
FOR  
GRADUATE COURSES OF VETERINARY ANATOMY**

<b><u>Course No.</u></b>	<b><u>Title of Course</u></b>	<b><u>Credit Hours</u></b>
V.An.301	Introductory Veterinary Anatomy	3(2-2)
V.An.302	Gross Anatomy-I	5(1-8)
V.An.303	General Histology and Embryology	4(2-4)
V.An.304	Gross Anatomy-II	4(1-6)
V.An.305	Systemic Histology	4(2-4)
V.An.306	Avian Anatomy	1(0-2)
V.An.507	Applied Anatomy	1(0-2)

## DETAIL OF COURSES

**V.An-301    INTRODUCTORY VETERINARY ANATOMY    3(2-2)**

### **Theory**

Anatomical terminology, classification and functions of skeleton. Introduction to various bones and joints of the body of domestic animals. Classification of muscular, nervous, epithelial and connective tissues.

Related readings. Muscle contraction mechanism, levers. Neurons, Receptors. The Reflex Arc.

**Digestive System:** The oral cavity, teeth, tongue, pharynx, esophagus, rumen, reticulum, omasum, abomasum and simple stomach, small and large intestines and rectum. Accessory digestive glands; salivary glands, pancreas, liver and gall bladder.

**Respiratory System:** The nostrils, nasal cavity, nasopharynx, larynx, trachea and lungs. The pleurae.

**Urinary System:** The kidneys, ureters, urinary bladder, male and female urethrae.

**Reproductive System:** The male reproductive organs including scrotum, testes, spermatic cord, vesiculae seminalis, prostate, uterus masculinus, bulbourethral glands and the penis. Female reproductive organs including ovaries, fallopian tubes, uterus, vagina and vulva, its different types in animals.

**Endocrine Glands:** Site, gross structure and functions each of hypophysis cerebri, epiphysis cerebri, thyroid, parathyroid, adrenal, pancreas, ovaries and testes.

**Cardiovascular and lymphatic systems:** Introduction to cardiovascular system. Study of heart and major arteries and veins. Introduction to lymphoid organs.

**Aesthesiology.** Introduction to sense organs. Anatomy of skin and udder.

### **Practical**

Identification of various bones of different domestic animals. Ligaments, tendons and their attachment to the bones. Form, structure and topographical study of various organs located in the thoracic, abdominal and pelvic cavities of different domestic animals.

### **Books Recommended**

1. Molgaard. 1999. Veterinarian Anatomy and Physiology. Delmar Publishers, USA.
2. Gillospie and Gillospie. 1998. Animal Science Anatomy and Physiology. Dolmar Publishers, U.K.
3. Banks, W. J. 1994. Anatomy and Physiology of Farm Animals. Mosby-year Book, USA.
4. Bone, F.J., 1990. Animal Anatomy and Physiology. Reston Publishing Co. Inc. Reston, Virginia.

**V.An-302**

**GROSS ANATOMY-I**

**5(1-8)**

### **Theory**

Study of form and structure of the small animal's body (Dog/Sheep/Goat). Introduction and importance of the subject. Role of Anatomy. Theoretical consideration of the form and structure of the body as given in the practical.

### **Practical**

Demonstration and explanation of anatomical terminology.

**Osteology:** Classification, functions, physical and chemical compositions of bone.

**Skeleton:** Main divisions, functions and identification of all the bones forming the hard frame work.

**Syndesmology:** Definition, classification, anatomical, physiological and combined foregoing considerations to recognize all the joints of the body.

**Myology:** Pattern of muscle development. Definition of various terms used to study the description of muscle. Dissection and demonstration of muscles of head. Muscles of dorsolateral and ventrolateral cervical region. Muscles of thorax, trunk, abdomen, tail and limbs (thoracic and pelvic).

**Splanchnology:** Demonstration of the various organs of different systems in the cranial, oral, thoracic, abdominal and pelvic cavities: their arteries, veins, lymph glands and nerves. Brain, spinal cord and meninges.

**Aesthesiology:** Study of the sense organs including eye, ear, skin and its appendages.

### **Books Recommended**

1. Haward E., E. D. Alexander. 2000. Guide to the Dissection of the Dog. W.B Saunders Co. USA.
2. Miller, M.E., 2000. Guide to the Dissection of the Dog. Ithaca, New York. Litho Printed by Edwards Brothers, Ind. Ann Arbor, USA.
3. Phillip, G.D., 1988/Latest Edition. Guide to Ruminant Anatomy Based on the Dissection of the Goat. Iowa State University Press. Ames, USA.
4. Getty, R., 1986/Latest Edition. Sisson and Grossman's. The Anatomy of the Domestic Animals. W.B. Saunders Co. Philadelphia and London.

### **V.An-303 GENERAL HISTOLOGY AND EMBRYOLOGY 4(2-4)**

#### **Theory**

**Cell biology.** Ultra structure of cell. Intercellular, adhering and communicating junctions. Specializations of free surface: cilia, flagella, microvilli, stereocilia. Specialization of basal surface: basement

membrane. Cell Divisions. Cell types and cell differentiation. The cellular environment: Intercellular substances and tissue fluids. Primary tissues, and their embryonic origin. Programmed cell death (apoptosis).

**Epithelial Tissue:** Important terms related to epithelium: Classification, surface epithelia. Glands: unicellular, multicellular endocrine, exocrine, simple and compound glands. Types of secretory units; serous, mucous, seromucous. Mode of secretion: merocrine, apocrine, holocrine and cytotrine, myoepithelial cells, neuroepithelial cells.

**Connective Tissue:** Classification: Embryonal, adult. Connective tissue fibers, ground substance. Adult connective tissue: Loose connective tissue: dense connective tissues cells, fibers and ground substances, reticular and adipose tissue. Adult supportive: Histology of cartilage and bone.

**Muscular Tissue:** Classification: smooth, skeletal and cardiac muscles. Sarcoplasmic reticulum and transverse tubules, contractile elements and muscle contractions.

**Nervous Tissue:** Microscopic and ultrastructure of neuron. Types of neurons. Nerve fiber. Peripheral nerves, ganglia, nerve endings, synapse. Neuroglial cells. The reflex Arc.

**Embryology:** Male and female Gonads. Gametes. Fertilization; Cleavage, morula, blastula formation and gastrulation in mammals and fowl. Formation of different germ layers and their embryonic importance. Formation of notochord, primitive streak, neural tube, head fold, fore-gut. The establishment of body and laying down of organ system. Placentation, formation of connective tissue, skeleton and muscles. Fetal circulation.

## **Practical**

Preparation of histological sections and staining for light microscopy. Components of light microscope. Units of measurement. Study of electron micrographs of different components of animal cell. Microscopic examination and identification of cells of different types and sizes. Preparation of blood smear, staining and identification of cellular components and platelets. Microscopic examination and identification of different types of epithelia, connective tissue, muscular tissue, and

nervous tissue. Identification of various developmental stages of mammalian and fowl embryos.

### **Books Recommended**

1. Bacha, W.J. and L. M. Bacha. 2000. Color Atlas of Veterinary Histology, Lippincott William and Wilkins, USA.
2. Dellmann, H. D., J. Eurell. and C. Ann. 1999. Atlas of Veterinary Embryology, William and Wilkins, USA.
3. Dellmann, H. D. 1998. Textbook of Veterinary Histology. 5<sup>th</sup> Ed. Lippincott, Williams and Wilkins, USA.
4. Chaudhry, M.N. and A. S. Qureshi, 1996. Illustrated Veterinary Histology (Laboratory Manual). Mas Publishers, Faisalabad, Pakistan.
5. Patten, B.M. 1994. "Foundations of Embryology. McGraw Hill Book Co, New York.
6. Dellaman, H.D. 1993. Text Book of Veterinary Histology. 4th Ed. Williams and Willkins, Baltimore.
7. Lee and Febiger, Banks, W.J.,1992. Applied Veterinary Histology. (3<sup>rd</sup> Ed). Williams and Willkins, Baltimore.

**V.An-304**

**GROSS ANATOMY-II**

**4(1-6)**

### **Theory**

Theoretical consideration of the form and structure of the body as given in the practical.

### **Practical**

Comparative study of the following bones of ox, horse and dog.

**Axial Skeleton:** The skull including the bones of the face and the cranium. The paranasal sinuses. The vertebral column. Form and

structure of a typical vertebra. Regional characteristics of cervical, thoracic, lumbar, sacral and coccygeal vertebrae.

**Appendicular Skeleton:** Bones of the pectoral and pelvic limbs.

**Arthrology:** Definition and classification of joints. Synarthroses, diarthroses, amphiarthroses and their classification. Movements of joints.

**Myology:** Study of the following groups of muscles of ox, horse and dog, their origin, insertion, action and relations. Muscles of the eye, lips and nostrils; muscles of respiration and mastication; muscles of neck, back, loins and the tail Muscles of the thorax, abdomen, and pelvis; Muscles of the thoracic and pelvic limbs.

**Splanchnology:** Topographical study of the various organs located in the thoracic, abdominal and pelvic cavities, arteries, veins, lymph glands and nerves, brain, spinal cord and meninges.

Detailed regional study through dissection of the following parts of the animal's body; head, neck, abdomen, thorax, thoracic and pelvic limbs.

**Aesthesiology:** The study of the sense organs, eye, ear, skin and its appendages.

### **Books Recommended**

1. Dyoe, K. M. M., S. Q. Wolfgang and C.J. Weneing. 1999. Textbook of Veterinary Anatomy. Saunders W. B. Co.
2. Raymond R. A., S. H. Done, S. W. Barnett. 1996. Color Atlas of Veterinary Anatomy. Mosby-Year Book, Inc. USA.
3. Ashdown. 1995. Color Atlas of Veterinary Anatomy: Horse Vol-II. Mosby-Year Book, USA.

**Theory**

**Digestive System:** Histology of oral cavity, oropharynx, esophagus, rumen, reticulum, omasum, abomasum and simple stomach. Small and large intestine, liver, pancreas and salivary glands, histogenesis of digestive system and accessory digestive glands.

**Respiratory System:** Histology of nasal cavity, nasal sinuses, nasopharynx, larynx, trachea, lungs, bronchi, bronchiole, respiratory bronchiole, alveolar duct, alveolar sac and alveoli. Blood air barrier.

**Cardiovascular System:** Histology of heart, elastic and muscular arteries, arterioles, capillaries, venules, small, medium and large sized veins, vasa vasorum.

**Urinary System:** Histology and histogenesis of kidneys, ureters, urinary bladder. Male and female urethrae.

**Reproductive System:** Histology of gonads and duct system of male and female reproductive systems.

**Endocrine System:** Histology of pituitary, pineal, thyroid, parathyroid, pancreas and adrenal glands.

**Lymphatic system:** Lymphoid tissue. Histology of thymus, lymph nodes, spleen, and tonsils.

**Integumentary System:** Histology of skin of animals. Hair follicles, sweat and sebaceous glands. Microscopic structure of udder.

**Nervous system:** Histology of cerebrum, cerebellum and spinal cord. Special sense organs.

**Practical**

Microscopic study and Identification of various organs of following systems.

Digestive, respiratory, cardiovascular, urinary, male and female reproductive, endocrine, integumentary, lymphatic and nervous systems.

### **Books Recommended**

1. Bacha, W.J. and Wood L.M., 2000. Color atlas of Veterinary Histology. Lee and Febiger, London.
2. Dellmann, H. D., J. Eurell. and C. Ann. 2000. A Color Atlas of Veterinary Histology, William and Wilkins, USA.
3. Aughey, E and F. L. Frye. 2000. A Color Handbook of Comparative Veterinary Histology and Clinical Coorelates. Iowa State University Press. USA.
4. Dellmann, H. D. 1998. Textbook of Veterinary Histology. 5<sup>th</sup> Ed. Lippincott, Williams and Wilkins, USA.
5. Chaudhry, M.N. and Qureshi, A.S., 1996. Illustrated Veterinary Histology (Laboratory Manual). Mass Publishers, Faisalabad, Pakistan.
6. Dellaman, H.D.,1993. Text Book of Veterinary Histology. 4th Ed. Lee and Febriger, London..
7. Banks, W.J., 1992. Applied Veterinary Histology. 2<sup>nd</sup> Ed. Williams and Willkins, Baltimore.

**V.An-306**

**AVIAN ANATOMY**

**1(0-2)**

### **Practical**

Introduction to anatomical and histological terms. Skeletal system including appendicular and axial skeletons. Myology and arthrology of chick.

Anatomy and histology of the following systems:-

Digestive system

Respiratory system and air sacs

Cardiovascular and lymphatic systems

Urinary system

Male and female reproductive systems.

Developmental stages of chick embryo

### **Books Recommended**

1. McLelland. 1997. Color Atlas of Avian Anatomy. W. B. Saunders, Co. USA.
2. Dellaman, H.D., 1993. Text Book of Veterinary Histology. 4th Ed. Lee and Febriger. Phaladelphia.
3. Bacha, W.J. and Wood L.M., 1990. Color Atlas of Veterinary Histology. Lee and Febiger, London.

**V.An-507**

**APPLIED ANATOMY**

**1(0-2)**

### **Practical**

Introduction and importance of the subject. Demonstration of various surgical sites of the following body parts of different domestic animals:-

Site for dental, maxillary, mandibular nerve blocks. Landmarks to obtain cerebrospinal fluid by lumbosacral puncture. Trephine opening for dorsal nasal meatus, frontal, maxillary, sphenopalatine, and caudal maxillary sinuses. Dehorning and Cornual nerve blocks. Anesthesia of orbit for enucleation, passage of stomach tube. Site for tonsillectomy and guttural pouches.

Site for radial, median, ulnar, and digital nerve blocks.

Peroneal, tibial, and plantar nerve blocks, string halt, luxation of different joints.

Site for epidural anesthesia, sites of injection for abdominal wall anesthesia. Structures of Inguinal canal and ring in each species. Trocarization of stomach in cow and horse. Surface anatomy of abdominal organs.

Site for tracheotomy, boundaries of the normal area for percussion and auscultation of lungs in each species. Pleurocentesis.

Boundries of jugular groove, position of heart in the body, external landmarks to palpate heart beat, site of needle in heart of small animals.

Site for oesophagotomy, rumenotomy and abomasal displacement. Lepratomy. Position of abdominal organs in relation to skeletal landmarks. Hernia.

Site for urethrotomy in horse. Castration and vasectomy of teaser bulls. Ovaryhysterectomy. Rectal Palpation.

### **Books Recommended**

1. Alexander D.A, R. E. Habel. 1998. Applied Veterinary Anatomy. Saundere W.B.Co. USA
2. Christopher, F. A. Thames. 1994. Small Animals Thoracic Surgery. Williams and Wilkins, Baltimore, USA.
3. Miller, M.E., 1992. Anatomy of the Dog. W.B. Saunders Co. Philadelphia.
4. Piomattoi, D. L. 1992. An Atlas of Surgical Approaches to the Bones and Joints of the Dog and Cat. W. B. Saunders Co, USA.
5. Boyd, J. S. 1991. Color Atlas of Small Animal Applied Anatomy. Mosby-Year Book, USA.

**SCHEME OF STUDIES  
FOR  
POSTGRADUATE COURSES OF VETERINARY ANATOMY**

<b>Course No.</b>	<b>Title of Course</b>	<b>Credit Hours</b>
V.An-701	Histological and Histochemical Techniques	3(0-6)
V.An-702	Advanced Histology (General)	3(2-2)
V.An-703	Advanced Histology (Systemic)	4(2-4)
V.An-704	Comparative Anatomy of Endocrine Glands	3(2-2)
V.An-705	Surgical Anatomy	3(1-4)
V.An-706	Neuro Anatomy	4(2-4)
V.An-707	Mammalian Embryology	3(2-2)
V.An-708	Anatomy of the Reproductive System	3(2-2)
V.An-709	Experimental Embryology	3(0-6)
V.An-710	Techniques in Electron Microscopy	3(1-4)
V.An-711	Biological Ultrastructure	3(2-2)
V.An-712	Anatomy of Camel	3(2-2)
V.An-719	Special Problem	1(1-0)
V.An-720	Seminar	1(1-0)



**Theory**

Methods of study. Three dimensional visualization. Artifacts. Fractionation of subcellular particles.

Ultra-structure of the animal cell. The cell membrane; its structure and role. Mitochondria; occurrence, general characteristics, dynamics and functions. Structure of the nucleus and morphological aspects of nucleic acid metabolism. Lysosome's structure, types and functions. Multiplication of cells. Cell death (Apoptosis).

Formation, types and functions of the intercellular substance. The effects of aging. Formation, absorption and role of tissue fluid. Cell associations and formation of primary tissues.

Cellular elements, intercellular substance, classification, functions and nourishment of epithelium, connective tissue, muscular tissue and nervous tissue.

**Practical**

Preparation and study of various tissue sections. Special methods of staining for the connective and nervous tissues. Staining of cartilage and bone. Silver impregnation method of staining and its application. Methods for studying fresh or living tissues.

**Books Recommended**

1. Bacha, W.J. and L. M. Bacha. 2000. Colour Atlas of Veterinary Histology, Lippincott William and Wilkins, USA.
2. Dellmann, H. D., J. Eurell. and C. Ann. 2000. A Color Atlas of Veterinary Histology, William and Wilkins, USA.
3. Aughey, E and F. L. Frye. 2000. A Color Handbook of Comparative Veterinary Histology and Clinical Coorelates. Iowa State University Press. USA.

4. Dellmann, H. D. 1998. Textbook of Veterinary Histology. 5<sup>th</sup> Ed. Lippincott, Williams and Wilkins, USA.
5. Chaudhry, M.N. and Qureshi, A.S., 1996. Illustrated Veterinary Histology (Laboratory Manual). Mass Publishers, Faisalabad, Pakistan.
6. Banks, W.J., 1992. Applied Veterinary Histology. 2<sup>nd</sup> Ed. Williams and Willkins, Baltimore.

**V.An-703            ADVANCED HISTOLOGY (SYSTEMIC)            4(2-4)**

**Theory**

Microstructure of the heart, arteries, veins and capillaries, arteriovenous anastomosis and its probable role. Impulse conducting system of the heart. Nervous control of the arteries and veins. Histology of lymphatic organs.

Histology of the organs of respiration; namely, nasal passage, paranasal sinuses, larynx, trachea, bronchial tree and lungs.

Histology of integumentary system and udder.

Histology of the digestive system including the lips, tongue, hard and soft palate, pharynx, oesophagus, simple and compound stomach, small and large intestines, liver, pancreas and gall bladder.

Histology of unilobular and multilobular kidneys. Nephron and basic mechanism of excretion. Histology of the ureter, urinary bladder, male and female urethrae. Histology of male and female reproductive organs.

Histology of endocrine system.

**Practical**

The above mentioned subject matter will be studied with the help of natural models and preserved specimens. Histological sections of all these organs and tissues will be prepared in the laboratory and studied under the microscope.

### **Books Recommended**

1. Bacha, W.J. and L. M. Bacha. 2000. Colour Atlas of Veterinary Histology, Lippincott William and Wilkins, USA.
2. Dellmann, H. D., J. Eurell. and C. Ann. 2000. A Color Atlas of Veterinary Histology, William and Wilkins, USA.
3. Aughey, E and F. L. Frye. 2000. A Color Handbook of Comparative Veterinary Histology and Clinical Coorelates. Iowa State University Press. USA.
4. Dellmann, H. D. 1998. Textbook of Veterinary Histology. 5<sup>th</sup> Ed. Lippincott, Williams and Wilkins, USA.
5. Dellmann, H. D. J. A. Carithers and J. R. Carithers. 1995. Cytology and Microscopic Anatomy. Williams and Wilkins, USA.
6. Banks, W. J.1992.Applied Veterinary Histology, Mosby-year Book, Inc. USA.

**V.An-704**

### **COMPARATIVE ANATOMY OF ENDOCRINE GLANDS**

**3(2-2)**

#### **Theory**

Introduction, scope, limitations and methods of study of endocrine glands. Development, organization and types of secretory epithelium. Structure of the gland's cell and the secretory process. Classification of glands.

Evolution and comparative anatomy of pituitary gland. The hypothalamus and its relationship with the hypophysis. The portal vascular system and the innervation of the hypophysis and the cytology of neurohypophysis.

Evolution and comparative anatomy of thyroid, parathyroid glands and ultimobronchial bodies with their detailed histology.

Development, gross characteristics and microscopic appearance of adrenal glands. The cytology of adrenal cortex and medulla.

Development and distribution of the Islets of Langerhans in pancreas; their cytology, blood supply and innervation.

Gross and microscopic appearance of the ovary, with special emphasis on the changes that accompany puberty, sexual cycle, pregnancy and menopause. Development and histology of the follicles and corpus luteum.

Development and descent of testes. Microscopic changes from birth to puberty. Origin and histology of the interstitial cells.

The anatomy of the organs of uncertain endocrine function.

### **Practical**

Topography of all the endocrine glands of the body in different species of the domestic animals and fowl. Collection of materials and the preparation of permanent histological sections. Special staining and histochemical techniques employed in the study of endocrine glands. Biopsy studies and their use in the field of endocrinology.

### **Books recommended**

1. Aughey, E and F. L. Frye. 2000. A Color Handbook of Comparative Veterinary Histology and Clinical Coorelates. Iowa State University Press. USA.
2. Torrance A. G. and C.T. Mooney. 1998. Manual of Small Animal Endocrinology. (2<sup>nd</sup> Ed.). Blackwell Science, Oxford, U.K.
3. Laycok, J. F. and P. H. Wise, 1996. Essential Endocrinology. 3<sup>rd</sup> Ed. Oxford University Press, U.K.
4. Banks, W. J.1992.Applied Veterinary Histology, Mosby-year Book, Inc. USA.
5. Banks, W. J.1992.Applied Veterinary Histology, Mosby-Year Book, Inc. USA.

**V.An-705**

**SURGICAL ANATOMY**

**3(1-4)**

### **Theory**

Detailed topography of the following surgical sites;

Site studies for dehorning, cornual nerve block; sinus explorations, Guttural pouch drainage, thyroidectomy, dental nerve block, tracheotomy, salivary gland explorations, oesophagotomy, jugular venesection and hypophysectomy.

Surface anatomy and topography of the internal organs. Sites for percussion and auscultation of lungs, the heart puncture, leprotomy, ruminal fistula and leprohystrectomy.

Study of the common hernial sites. A detailed study of the stay apparatus of the thoracic and pelvic limbs. Nerve blocks and common neurectomy sites of both limbs. Amputation of limbs.

Demonstration of sites for urethral catheterization and urethrotomy. Sites for epidural and paravertebral anesthesia.

### **Practical**

The above mentioned subject matter will be studied through special dissections, natural models and live specimens.

### **Books Recommended**

1. Jean, M. D. 2000. The Equine Distal Limp, An Atlas of clinical Anatomy and Comparative Imaging. Iowa State University Press, USA.
2. Mast, J and W.P. Hamilton. 2000. Clinically Oriented Equine Anatomy. William and Wilkins, USA.
3. Goody, P. C. 1999. Horse Anatomy: A pictorial Approach to Equine Structure. Barnes and Noble, U.K.
4. Christopher, F. A. Thames. 1994. Small Animals Thoracic Surgery. Williams and Wilkins, Baltimore, USA.
5. Piomattoi, D. L. 1992. An Atlas of Surgical Approaches to the Bones and Joints of the Dog and Cat. W. B. Saunders Co, USA.
6. Constantinesen, G. M. 1991. Clinical Dissection Guide for Large Animals. Mosby-Year Book, USA.

**Theory**

Nervous system and its components. Structure and functions of the neuron. Structural and functional classification of nerve fibers. Synapses, receptors and various tracts.

Morphogenesis of the central nervous system, formation of ependyma, gray matter and white matter. Gross and histological structure of telencephalon, diencephalon, mesencephalon, metencephalon and myelencephalon. Structure of the spinal cord. Ventricular system; formation, mobilization and absorption of cerebrospinal fluid. Hypophyseal hypothalamic relationship. Origin, route and distribution of the cranial nerves. The meninges and their role. Blood supply of the central nervous system. The blood-brain barrier.

The autonomic nervous system. Body reflexes. Origin, route and distribution of sympathetic and parasympathetic nerve fibers. Special sense organs, their structure and functions.

**Practical**

Gross study, through special dissections of the nervous system of dog. Preparation, staining and embedding of the brain slices for macroscopic study. Special staining procedures for nerve cells, nerve fibers and nerve endings. Histochemical techniques used in neurologic studies.

**Books Recommended**

1. DeLahunta, A. 1999. Veterinary Neuroanatomy and Clinical Neurology. W.B. Saunders, USA.
2. King, A. S. 1999. Physiological and Clinical Anatomy of the Domestic Mammals. Blackwell Science, Oxford, U.K.
3. Haines, D. E. 1999. Neuroanatomy, An Atlas of Structure, Section and System. 5<sup>th</sup> Ed. Lippincott, Williams and Wilkins, USA.
4. Alexander D. L. 1995. Veterinary Neuroanatomy and Clinical Neurology. Saundere W.B. USA.

5. Fix, J. 1994. Neuroanatomy, 2<sup>nd</sup> Ed. Lippincott, Williams and Wilkins, USA.

**V.An-707**

**MAMMALIAN EMBRYOLOGY**

**3(2-2)**

### **Theory**

Introduction, scope, limitations, objectives, methods of study, processes and basic concepts of embryology. Development, growth, differentiation and integration of embryo.

Gametogenesis. Polyploidy and aneuploidy. Fertilization. Sequence and orientation of cleavage division. Formation of morula and blastula. Origin of germ layers. Formation. Origin of the primitive streak.

Basic body plan of young mammalian embryos. Changes in body configuration from primitive streak to 5 mm stage. Development of primitive nervous, digestive and respiratory systems.

Development of the extra-embryonic membranes, placenta and its types. Relationship between the mammalian embryo and the uterus. Formation of connective tissues and skeletal muscles. Development of the nervous system, sex organs, the face and oral regions, and the body cavities. Splanchnic developments. Blood flow in the fetal heart and changes which follow the birth.

### **Practical**

Special techniques for the preparation and staining of zygote, morula, blastula and gastrula. Staining and serial sectioning of different aged embryos.

### **Books Recommended**

1. Sadler, T. W. 2000. Langman's Medical Embryology. 8<sup>th</sup> Ed. Lippincott. Williams and Wilkins, USA.
2. Dudek, R. 1998. BRS Embryology, Lippincott, Williams and Wilkins, USA.

3. Patten, N.M. 1996. Foundations of Embryology, 2nd Ed. McGraw Hill Book Co., New York, Toronto and London.
4. Drews, U. 1995. A Color Atlas of Embryology. Thieme George, Berlin, Germany.

#### **V.An-708 ANATOMY OF THE REPRODUCTIVE SYSTEM 3(2-2)**

##### **Theory**

Embryonic development of the reproductive system in all domestic animals and poultry. Sex differentiation. Mesonephric ducts and their remnants. Origin of gonads, male and female duct systems. Descent of the testes. Formation of extraembryonic layers. Types of placenta and their relationship with uterus in different species of the domestic animals.

Gross anatomy and histology of the female reproductive organs; ovaries, oviduct, uterus, cervix uteri, vagina, clitoris, vulva and mammary glands in all the domestic species of livestock and poultry. The blood and nerve supply of the female reproductive organs and their suspensory apparatuses. Structural changes in the reproductive organs in different stages of the estrus cycle. Histology of the extraembryonic membranes.

Gross anatomy and histology of the male reproductive organs; scrotum, testes, epididymis, penis and the duct system in all the domestic species of livestock and poultry. The blood and nerve supply of the male reproductive organs; comparative anatomy and histology of the accessory sex glands, seminal vesicles, prostate and Cowper's glands.

##### **Practical**

The above mentioned subject matter will be studied by rectal palpation, through natural models and preserved specimens. Histological sections of all these organs and tissues will be prepared in the laboratory and studied under the microscope.

### **Books Recommended**

1. Goody, P. C. 1999. Horse Anatomy: A pictorial Approach to Equine Structure. Barnes and Noble, U.K.
2. Snape, A, D. W. Ramey (Eds.). 1999. The Anatomy of a Horse. Howell Books, USA.
3. Raymond R. A., S.H.Done, S.W.Barnett. 1996. Color Atlas of Veterinary Anatomy. Mosby-Year Book, Inc USA..
4. Ashdown. 1995. Color Atlas of Veterinary Anatomy: Horse Vol-II. Mosby-Year Book, USA.
5. Hilary M. C., P. F. Fleed and D. Manadeville. 1993. Color Atlas of Large Animal Applied Anatomy, Mosby Year Book, Inc. USA.
6. Clayton, H. M. and C. Farrow. 1993. Color Atlas of large Animal Applied Anatomy. Mosby-Year Book, USA.

**V.An-709**

**EXPERIMENTAL EMBRYOLOGY**

**3(0-6)**

### **Practical**

Introduction, limitations and scope. Instruments used in the embryological techniques, their preparation, sterilization and care. Special care of the experimental materials.

Identification of the different parts of developing embryo. Isolation of limb buds, tail seed, somites and neural crest.

Partial and total removal of the prospective heart regions, formation of two hearts. Exterpation of the parts of the eye-forming region in the neural tube. Partial and total exterpation of the optic vesicle, parabiosis.

Vital staining experiments on different primitive streak stages Chorioallantoic grafts. Intraembryonic transplantations. Coelomic grafts of the limb primordial. Flank graft of the eye primordia.

Transplantation of neural crest cells and demonstration of origin and migration of pigment cells.

### **Books Recommended**

1. Sadler, T. W. 2000. Langman's Medical Embryology. 8<sup>th</sup> Ed. Lippincott. Williams and Wilkins, USA.
2. Dudek, R. 1998. BRS Embryology, Lippincott, Williams and Wilkins, USA.
3. McLelland. 1997. Color Atlas of Avian Anatomy. W. B. Saunders, Co. USA.
4. Drews, U. 1995. A Color Atlas of Embryology. Thieme George, Berlin, Germany.

### **V.An-710      TECHNIQUES IN ELECTRON MICROSCOPY      3(1-4)**

#### **Theory**

Introduction to the electron microscopy. Historical review. Analogy between light and electron microscopes. Wave length. Magnification. Resolution. Electron optics and electron beam.

Structure of the electron microscope, the electron gun, the condenser lens system, the imaging optical system, the specimen stage, the image translating system, the vacuum system, ancillary and special attachment for the electron microscope.

#### **Practical**

Operation of the electron microscope. Alignment. Testing the performance of the electron microscope. Astigmatism and correction of astigmatism of objective lens. Loading of specimens, Focusing of image and photography. Contamination and other disturbances. Breaking of electron microscope column and cleaning of gun, and aperture. Interpretation of electron micrographs.

Preparation of biological specimens for electron microscopy, collection of specimens, fixation, perfusion, dehydration and embedding. Operation of vacuum evaporator. Preparation of glass knife. Ultramicrotomy. Grids and preparation of grids.

Special techniques; freeze drying, replica and shadow casting, negative staining and carbon coating.

### **Books Recommended**

1. Hayat, M. A. 2000. Principles and Techniques of Electron Microscopy, Cambridge University Press, U.K.
2. Dykstra, M. J. 1993. A Manual of Applied Techniques for Biological Electron Microscopy, Kluwer Academic Publishers Group, Netherlands.

**V.An-711**

**ADVANCED CELL BIOLOGY**

**3(2-2)**

### **Theory**

Historical review. Tools and techniques used in cytology. Electron micrographs and their interpretation. Cell shape, size and types. Relationship between cell structure and functions.

Ultrastructure of cells, membrane system, plasma membrane and its modifications, endoplasmic reticulum, Golgi complex, mitochondria, lysosomes, plastids, ribosomes, centrioles, vacuoles, microtubules, micro-filaments, secretory products, nuclear membrane, nucleus, nucleolus and chromatin. Cell surface. Functions of organelles and inclusions.

Extracellular substances. Cell division. Growth Differentiation. Integration. Aging. Cell replacement and cell death. Movement of material across cell membrane. Phagocytosis. Protein synthesis.

### **Practical**

Use and care of light and electron microscopes. Use of Cryostat. Ultramicrotomy. Preparation of tissues for light and electron microscopy. Use of special stains. Preparation of micrographs. Interpretation of micrographs. Identification of different cell types and organelles.

### **Books Recommended**

1. Campbell, T. 2000. Avian Hematology and Cytology, Blackwell Science, Oxford, U.K.
2. Goodman, S.T., 1997. Medical Cell Biology. 2<sup>nd</sup> Ed. Lippincott, Williams and Wilkins, USA.
3. Dellmann, H. D. J. A. Carithers and J. R. Carithers. 1995. Cytology and Microscopic Anatomy. Williams and Wilkins, USA.
4. Bruce, A., D. Bray, J. Lewis, M. Raff, K. Roberts, and J. D. Watson, 1994 Molecular Biology of the Cell. 3<sup>rd</sup> Ed. Garland Publishers, USA.

**V.AN-712**

**ANATOMY OF THE CAMEL**

**3(2-2)**

### **Theory**

Study of skeletal system of camel including appendicular and axial skeleton.

Pattern of muscle development. Muscles of different regions of body including head, neck, thorax, trunk, abdomen and limbs.

Definition and classification of joints. Movements of joints.

Comparison of anatomy and histology of different systems of camel with other domestic animals, including digestive, respiratory, cardio-vascular and lymphatic, urinary, male and female reproductive systems. Anatomy and histology of endocrine glands, nervous system and integumentary system including udder.

### **Practical**

Comparison of bones of skeleton of camel with other large animals. Dissection and demonstration of muscles of different parts of body of camel.

Form, structure and topographical study of various organs located in the thoracic, abdominal and pelvic cavities of camel.



## **RECOMMENDATIONS**

1. A composite degree programme in Veterinary Sciences/Animal Husbandry with the uniform course work should be adopted throughout the country in order to meet the demands of market and field. Moreover, to produce more competent and well equipped animal scientists.
2. Adequate number of teachers may be employed keeping in view the pyramidal structure and the student- teacher ratio (1:20) as has been laid down in UGC rules.
3. Budget allocations may be enhanced every year for the purchase of instruments, glass wares, chemicals, models specimens and experimental animals. The availability of recommended books and journals should be ensured in the libraries of universities/institutes.
4. Labs should be upgraded to improve efficiency of teacher and taught. In order to familiarize the students with morphological details of body and laboratories should be equipped with audio visual aids such as slide projector, overhead projector, multimedia and epidiascope. Departments should further be enabled to show movies on different themes of interest in order to familiarize the students with morphological details of organ and tissues.
5. Special budget should be allocated to train teaching and lab staff in the biomedical sciences.
6. Departmental budget may be kept on the discretion of the chairman/officer incharge of the department.
7. Study tours may be arranged to visit field farms, fields and abattoir for the benefit of students.
8. Before the approval of revised curricula for implementation, a meeting of conveners of all Curriculum Revision Committees should be arranged in Islamabad to discuss the strategies to implement revised curricula effectively.