Batch 2024-25

Syllabus

2nd Semester

M.Sc. (Zoology)

SCHEME A2: M.Sc. Zoology (w.e.f. Academic Session 2024-25)

Scheme: Semester 2nd

Course Code	Course Title	Course ID	L (Hrs)	T (Hrs)	P (Hrs)	L Credits	T Credits	P Credits	Total Credits	MARKS TI	MARKS TE	MARKS PI	MARKS PE	MARKS Total
Core Course(s)														
CC-A04	Diversity of Vertebrates		04	00	00	04	00	00	04	30	70	00	00	**100**
CC-A05	Molecular Cytogenetics		03	00	02	03	00	01	04	25	50	05	20	**100**
CC-A06	Biochemistry & Biotechniques		03	00	02	03	00	01	04	25	50	05	20	**100**
Discipline Specific Elective Courses (Select any one course from the following)														
DSE-02	Bioinformatics		02	00	02	02	00	01	03	15	35	05	20	**75**
	Molecular Endocrinology & Neural Physiology													
Multidisciplinary Course(s)														
MDC-02	One from the Pool		02	00	02	02	00	01	03	15	35	05	20	**75**
Ability Enhancement Course(s)														
AEC-02	One from the Pool		02	00	00	02	00	00	02	00	50	00	00	**50**
Skill Enhancement Course(s)														
SEC-01	One from the Pool		02	00	00	02	00	00	02	00	50	00	00	**50**
Total Credits									**22**					**550**

Note: *internship or field training or project of 4-6 weeks during summer vacation @ 4 credits.*

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241/Z00/CC204

ZOOLOGY: SEMESTER-II

Course Code	Course ID	Course Title	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
CC-A04	241/Z00/CC204	Diversity of Vertebrates	3	3	25	50	75	3 hrs.
		Practical	1	2	5	20	25	4 hrs.

Course Learning Outcomes (CLO)

1. The youth will be able to understand the evolution of life forms from primitive tomost advanced forms.
2. The study will help the students to know different vertebrates diversity around them
3. Even the course will help in understanding the adaptations and dentition in vertebrates

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Origin of Chordates, Protochordata, hemichordate & urochordata Classification of Vertebrates upto orders, Vertebrate integument and its derivatives: Development, general structure and functions of skin and its derivatives, Glands, scales, horns, claws, nails, hoofs,feathers and hairs Skeletal system: Types, function, body size and skeletal elements of the body, Comparative accountof jaw suspensorium, Vertebral column, Limbs and girdles	12
II	Digestive system: Comparative account of Dentition, Stomach, Digestive organs & Glands Respiratory system: Characteristics of respiratory tissue, Internal and External Respiration, Comparative account of respiratory organs	11
III	General plan & types of circulation in various groups, Blood, Evolution of heart, Evolution of aortic arches, and Portal systems , Evolution of Urinogenital system in vertebrate series	11
IV	Nervous system, Comparative anatomy of nervous system in relation to its functions, Comparative anatomy of brain & spinal cord, Nerves-Cranial, Peripheral and Autonomous nervous systems, Sense organs, Simple receptors, Organs of Olfaction and taste, Lateral line system, Electroreception	11
V Practical	1. Museum specimens and slides : Chondrichthyes: Zygaena, Pristis, Narcine, Trygon, Rhinobatus, Chimaera. Actinopterygii: Polypterus, Acipenser, Lepidosteus, Muraena, Mystus, Catla. Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Tetradon, Echeneis and Solea. Dipneusti (Dipnoi) : Protopterus (Lung fish) Amphibia: Uraeotyphlus, Necturus, Amphiuma, Ambystoma and its Axolotl larva. Triton,Salamandra, Hyla, Rhacophorus. Reptilia : Hemidactylus,,Calotes, Draco, Varanus, Phrynosoma,Chamaeleon. Typhlops, Python, Eryx, Ptyas, Bungarus, Naja, Hydrus, Vipera,Crocodilus, Gavialis, Chelone and Testudo. Aves: Casuarius, Ardea, Anas, Milvus, Pavo, Eudynamis, Tyto and Alcedo. Mammalia : Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaca,Manis, Hystrix, Funambulus, Panthera, Canis, Herpestes, Capra,Pteropus. 2. Demonstration of dissection of Labeo through video clipping/models/charts:Digestive and Reproductive systems Circulatory system: heart, afferent and	30

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	efferent branchial arteries. Nervous system: cranial nerves and internal ear. 3. Study of the skeleton of Labeo, Rana, Varanus, Gallus & Oryctolagus. 4. Demonstration of dissection of chick and white rat through video clipping/models/charts.Chick : Digestive, arterial, venous and urinogenital systems. White rat : Digestive, arterial, venous and urinogenital systems. 5. Study of the histology of different organs of frog and rat/rabbit through permanent stainedslides. 6. Study of poison apparatus in snakes through charts.	

Learning Resources

1. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver andBoyd,Edinbourgh.
2. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, New York.
3. Carter, G.S. Structure and habit in vertebrate evolution - Sedgwick and Jackson, London.
4. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates. Central Book Depot,Allahabad.
5. Kent, C.G. Comparative anatomy of vertebrates.
6. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc.,New York.
7. Sedgwick, A. A Students Text Book of Zoology, Vol. II.
8. Torrey, T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York andLondon.
9. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York.
10. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGraw HallBook Co., New York.
11. Messers, H.M. An introduction of vertebrates anatomy.
12. Montagna, W. Comparative anatomy. John Wiley and Sons Inc.
13. Andrews, S.M. Problems in vertebrate evolution. Academic Press, New York.

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241/200/CC205

ZOOLOGY: SEMESTER-II								
Course ID	**Course Code**	**Course Title**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A05	241/200/CC205	**Molecular Cytogenetics**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. Students will be able to study the molecular composition of the chromosomes.
2. They will gain the knowledge about mutations and molecular basis of cell cycle andits check points

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Biology of Chromosomes: Molecular anatomy of eukaryotic chromosomes;Metaphase chromosomes: Centromere, Kinetochore, Nucleolus organizers and rRNA genes, Telomere: structure and Functions, Heterochromatin and euchromatin, Giant Chromosomes: Polytene Chromosomes, Lampbrush Chromosomes	12
II	Sex Chromosomes: Sex determination and the Y Chromosome, Dosage compensation in *C. elegans*, *Drosophila* and Humans, Nature and mechanism of genomic imprinting, X- inactivation and imprinting, Sex specific imprinting	11
III	Genes in Pedigrees: Mendelian pedigree pattern, Inheritance of mitochondrial diseases, Complications to the basic pedigree patterns, Non-Mendelian traits. Somatic Cell Genetics: Cell fusion and somatic cell hybrids – agents and mechanism of fusion, Heterokaryon – Cell lines and selection systems and chromosome segregation,	11
IV	Gene Mutations : Spontaneous mutations – Base pair substitution and frame shift mutations Induced mutations – Radiation, chemical and environmental, In –vitro site specific mutagenesis. Detection of mutagens – The Ames test and sister chromatid exchanges, Genetics of Cell Cycle: Genetic regulation of cell division in yeast and eukaryotes, Molecular basis of cellular check points.	11
V Practical	1. Making karyological preparations from testicular material of suitable insects by squash and air drying techniques to study the structure and behaviour of chromosomes during mitosis and meiosis. 2. Study of chiasma frequency and terminalisation co-efficient. 3. Study of mitosis from hepatic ceacae of suitable insects and preparation of karyotype andidiogram. 4. Demonstration of banding techniques (C, G and T). 5. Study of NORs in insect chromosomes. 6. Making preparations from salivary glands of Chironomus larvae / Drosophila larvae tostudy polytene chromosomes. 7. Effect of temperature on polytene chromosomes. 8. Preparation of human buccal smear to study sex chromatin. 9. Nuclear sexing from polymorphonuclear leucocytes.	30

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	10. Identification of meiotic and mitotic stages from permanent slides. 11. Gel electrophoresis: Practical demonstration. 12. Isolation of genomic DNA. 13. PCR: Introduction and practical demonstration.	

Learning Resources

1. Atherly, A.C., J.R. Girton and J.F. McDonald. The Science of Genetics. Sauders CollegePublishing, Harcort Brace College Publishers, NY.
2. Brooker, R.J. Genetics : Analysis and Principles. Benjamin/Cummings, Longman Inc.
3. Fairbanks, D.J. and W.R. Anderson. Genetics – The Continuity of Life. Brook/ColePublishing Company ITP, NY, Toronto.
4. Gardner, E.J., M.J. Simmons and D.P. Snustad. Principles of Genetics. John Wiley andSons. Inc., NY.
5. Griffiths, A.J.F., J.H. Miller, D.T. Suzuki, R.C. Lewontin and W.M. Gelbart. AnIntroduction to Genetic Analysis. W.H. Freeman and company, NY.
6. Lewin, B. Genes. VI. Oxford University Press, Oxford, New York, Tokyo.
7. Snustad, D.P. and M.J. Simmons. Principles of Genetics. John Wiley and Sons. Inc., NY.
8. Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. MolecularBiology of Genes. The Benjamin/Cummings Publishing Company Inc., Tokyo.
9. Tom Strachan & Read, A.P. Human Molecular Genetics 3rd edition, Garland Publishing2004, London.

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ZOOLOGY: SEMESTER-II								
Course Code	**Course ID**	**Course Title**	**Credit**	**Contact Hours/Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
CC-A06	241/200/CC206	**Biochemistry & Biotechniques**	**3**	**3**	**25**	**50**	**75**	**3 hrs.**
		Practical	**1**	**2**	**5**	**20**	**25**	**4 hrs.**

Course Learning Outcomes (CLO)

1. Students will be able to understand the general reactions of various metabolicpathways.
2. It will make the students to understand the structure and classification ofbiomolecules.
3. This paper will provide the basic understanding of various biological techniques.
4. The youth will be able to understand the basics of various techniques
5. It will make the students to understand the applications of these techniques for animalkindness.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Amino acids and peptides-classification, chemical reactions and physical, properties,Sugars - classification and reactions, metabolism of carbohydrate, Heterocyclic compounds-and secondary metabolites in living systems -nucleotides, pigments, isoprenoids, Separation techniques for different biomolecules. Bio-energetics and oxidative phosphorylation. Blood clotting – biochemistry, body fluids –pH and acid base balance and their importance in clinical biochemistry, muscle contraction. Techniques in the study of proteins, carbohydrates and lipids.	12
II	Lipids- classification, structure and functions Proteins-protein and protein legand interactions, end group analysis, hierarchy in structure, Ramachandran map. Conformational properties of polynucleotides, Polysaccharides - types, secondary and tertiary structural features, analysis- theoretical and experimental; Protein folding – biophysical and cellularaspects, enzymes coenzymes, in born errors of metabolism.	11
III	Microscopy: Principles and applications of light, phase contrast, fluorescence microscopes, scanningand transmission electron microscopes. Centrifuge technique: Principle, types of centrifuge, density gradient centrifuge in isolation of cell, cellorganelles and biomolecules. Chromatography: Principles and applications of gel filtration, ion-exchange, affinity, thin layer, gas chromatography and high pressure liquid chromatography (HPLC) and FPLC. Application of chromatographic technique in biology. Electrophoresis and centrifugation: Principles and applications of agarose and polyacrylamide gel electrophoresis; ultracentrifugation (velocity and buoyant density).	11
IV	Spectroscopy: Fluorescence, UV, visible, Infarad, Atomic absorption spectroscopy, NMR and ESR spectroscopy; Mass spectrometery (LC-MS, GC-MS), X-ray diffraction. Tracer Biology: Principles and applications of tracer techniques in biology; radioactive isotopes and half-life of isotopes; autoradiography. Application of different spectroscopic technique in biology. Nature and types of radiation, preparation of labelling biological sample, detection and measurement of radiation, GM counter, Scientillation counter. Flow cytometery. Safety measurement in handling radioisotopes, ELISA, RIA and non-radiolabelling.	11

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V **Practical**	1. Titration of amino acids 2. Reactions of amino acids, sugars and lipids 3. Isolation of DNA and protein 4. Quantitation of Proteins and Sugars 5. UV, Visible, Fluorescence and IR spectroscopy, Absorption spectra 6. Demonstration of working of different types of microscopes. 7. Demonstration of Chromatography i.e. TLC, HPLC, GC. 8. To demonstrate the separation of proteins with the help of electrophoresis. 9. To study various molecular biology techniques i.e. PCR. 10. To demonstrate the use of spectrophotometer. 11. Purification of protein by column chromatography. 12. Visit of various laboratories in the university, preparation and submission of report.	30

Learning Resources

1. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics.Agrobios, Jodhpur, India.
2. Cooper, T.G. 1977. Tools in Biochemistry. John Wiley, New York, USA.
3. Dryer, R. L. and Lata, G. F. 1989. Experimental Biochemistry. Oxford University Press, NewYork.
4. Hames, B.D.(Ed.).1998. Gel Electrophoresis of Proteins: A Practical Approach, 8th edition.PAS, Oxford University Press, Oxford, UK.
5. Scott, R.P.W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., NewYork.
6. Wilson, K. and Walker, J. 1994. Practical Biochemistry: Principles and Techniques, 4th edition.Cambridge University Press, Cambridge, U
7. A Biologists guide to Principles and Techniques of Practical Biochemistry, K. Wilson and K.H.Goulding, ELBS Edn.
8. Lehninger AL, Nelson DL & Cox MM (1993) Principles of Biochemistry, 2nd edn. New York: Worth.
9. Stryer L (1995) Biochemistry, 4th edn. New York: WH Freeman.
10. Voet D, Voet JG & Pratt CW (1999) Fundamentals of Biochemistry. New York: Wiley.

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241/200/DS202

ZOOLOGY: SEMESTER-II								
Course Code	Course Code	Course Title	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
DSE-02	241/200/DS202	Bioinformatics	2	2	15	35	50	3 hrs.
		Practical	1	2	5	20	25	4 hrs.

Course Learning Outcomes (CLO)

1. The youth will be able to understand the basics of various techniques
2. It will make the students to understand the applications of these techniques for animalkindness

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Computers: An overview of computers, microcomputers, VDUs and printer; What is programming?Algorithms; Languages and packages: Introduction to MS Office, MS Access, introduction to SQL (structured querry language) Handling arrays, procedures. Colour, sound and graphics; Use of standard packages.	7
II	Introduction to PERL: Scalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O, Input from file named in command line, Regular expression, Pattern matching, Pattern modifiers.Applications of PERL in Bioinformatics: Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Generating random numbers, simulating DNA mutation, generating random DNA, Analyzing DNA	7
III	Biological Sequence Databases: Overview of various primary and secondary databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are GenBank, EMBL, DDBJ, Swiss Prot, PIR, and MIPS for primary sequences. Preliminary ideas of query and analysis of sequence information. Sequence Comparison Methods: Method for the comparison of two sequences viz., Dot matrix plots, NeedlemanWusch&SmithWaterman algorithms. Analysis of computational complexities andthe relative merits and demerits of eachmethod.Theory of scoring matrices and their use for sequence comparison.	8
IV	Database Search Algorithms: Methods for searching sequence databases like FASTA and BLAST algorithms. Statistical analysis and evaluation of BLAST results. Pattern Recognition Methods in Sequence Analysis: Concept of a sequence pattern, regular expression based patterns. The use of pattern databases like PROSITE and PRINTS. Concept of position specific weight matrices and their use in sequence analysis. Theory of profiles and their use with special reference to PSIBLAst. Markov chains and Markov models and their use in gene finding. Concept of HMMS, the Forward backward and the Viterbi algorithm.The Baum Welch algorithm for training a HMM.Use of profile HMM for protein family classification.	8
	1. Retrieve Nucleotide sequences from NCBI serve. 2. Retrieve Protein sequences from PDB. 3. Analysis of sequences Similarity using BLAST/pBLAST/nrBLAST 4. To predict protein secondary structures by using iPred.	

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V Practical	5. Perform phylogenetic analysis using PHYLIP. 6. Perform multiple sequence alignment by using ClustalW. 7. Primer design 8. Computational modeling of genomic, transcriptomic and proteomic	30

Learning Resources

1. Jin Xiong (2006) Essential Bioinformatics. Cambridge publisher
2. ZhumurGhosh and BibekanandMallick (2008) Bionformatics: Principles andApplications. Oxford University Press publisher
3. OrpitaBosu and SimminderKaurThukral(2007).Bioinformatics. Oxford University Presspublisher
4. M.Lesk (2002) Introduction to Bioinformatics. Oxford University Press publisher
5. Fundamental Concepts of Bioinformatics, Dan E. Krane, Michael L. Raymer, Michaeel L. Raymer, Elaine NicponMarieb, 2002, Benjamin/Cummings
6. P. Rastogi and N. Mendiritta (2013) Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Prentice-Hall of India Pvt.Ltd; 4th Revisededition
7. Mount and David W (2004) Bioinformatics: sequence and genome analysis. Cshl Press,2nd edition
8. Harisha S (2007) Fundamentals of Bioinformatics. I K International Publishing HousePvt. Ltd
9. Dan E. Krane (2003) Fundamentals concepts of bioinformatics. Dorling Kindersley (RS);First edition
10. David Edwards and Jason Stajich (2009) Bioinformatics: Tools and Applications.Published by Springer

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241/200/DS203

ZOOLOGY: SEMESTER-II

Course Code	Course ID	Course Title	Credit	Contact Hours/Week	Internal Assessment marks	End Term Marks	Max. Marks	Exam Duration
DSE-02	241/200/DS203	Molecular Endocrinology & Neural Physiology	2	2	15	35	50	3 hrs.
		Practical	1	2	5	20	25	4 hrs.

Course Learning Outcomes (CLO)

1. Essential for in depth understanding of the molecular synthesis, secretion and actionof hormones respectively and other regulatory substances of animals.
2. Students will understand its relatedness to various hormone base disorders and itsapplication to other fields of cell biology.
3. Students will understand the structure of brain and intricate network of nerveimpulse conduction

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Overview: Glands, cellular secretions (autocrine, exocrine, endocrine), Secretory mechanism, ways of secretion (Autocrine, merocrine, holocrine) and regulation of glandular secretion. Hormones: Types, nature, synthesis, release and action action. Receptor, molecular mechanism and signal transduction.	8
II	Role of hypothalamus in hormonal control. Anterior pituitary hormones, posterior pituitary hormones; thyroid gland and thyroid hormones, pancreas (insulin and glucagon). Endocrine control of food and fluid intake/obesity calcium regulation, adrenal gland. Reproductive organs and their hormonal control in male and females; estrogen and androgen; Reproductive cycle, parturition and pathologies	8
III	Introduction to evolution and development of Nervous system. Structural and functional aspects of nervous system (CNS,PNS&ANS). Anatomy of brain and its cellular composition (types of neurons, glia and their functions). Neuroganglia interaction.	7
IV	Structure of neuron, membrane proteins, channels (voltage gated and ligated), Na+, K+ pump, Na+, K+ ATPase. Bioelectricity, membrane excitability, nerve conduction. Neurohormones and neurotransmitters. Neuroendocrine regulations of physiological functions. Structure of synapse and synaptic transmission. Senses (vision, olfaction and touch).	7
V Practical	1. To identify the stage of oestrous cycle. 2. To show the endocrine glands in rat through charts/models/video clipping. 3. To study the histology of endocrine glands through permanent stained slides 4. To study the corrective measures for myopia, hypermetropia, astigmatism, cataract. 5. To study the structure of eye, ear and different types of neurons through charts/models.	30

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Learning Resources
1. *General Endocrinology* by **Turner, C.D. and Bagnars**, W.B. Saunders Company; 1976. 2. *Comparative Endocrinology of Invertebrates* by **Highnam, K.C.** and Hill, L. EnwaralArnold Ltd., London; 1981. 3. *Endocrinology* by Golds -**Worthy, G.J. Robinson, J. and Mordue**, W. John Wiley andSons, New York; 1981. 4. *An Introduction to Invertebrates Endocrinology* by **Tombes, A.S.** Academic Press, NewYork; 1970. 5. *Comparative Vertebrate Endocrinology* by **Bentley, P.J.** Cambridge Univ. Press; 1998. 6. *Endocrinology* (4th ed) by. **Hadley, M. E.** Prentice Hall; 1996.

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