



Curricular Guide for Podiatric Medical Education

**AACPM Council of Faculties
2020 Edition**

**Approved by the AACPM Board of Directors
February 18, 2020**

“The Curricular Guide for Podiatric Medical Education is designed to be a guidance document approved by the Board of Directors of the American Association of Colleges of Podiatric Medicine (AACPM) and represents a collaborative effort by AACPM’s member colleges. The contents of this document are a set of recommendations on what a comprehensive curriculum may look like. AACPM is not responsible for how the contents of this guide may be implemented or used.

The Guide is not prescriptive and is not necessarily representative of what is taught at any given institution, nor should it be taken as a set of requirements or standards, the contents of this document represent general guidance and recommendations. A school should consider its own unique facts and circumstances before adopting any of the guidance herein. An educational program not following the guidance contained herein should not be taken as evidence that an educational program is in any way deficient.”

**AACPM COUNCIL OF FACULTIES CURRICULUM PROJECT
CURRICULAR GUIDE
TABLE OF CONTENTS**

AACPM COUNCIL OF FACULTIES	2
ACKNOWLEDGEMENTS	3
AUTHORING GROUPS	4
BACKGROUND	8
COMPETENCIES (July 2016)	10
	13

STUDENT LEARNING OBJECTIVES FOR PRECLINICAL CONTENT AREAS

BIOCHEMISTRY (July 2017)	16
COMPOSITE HISTOLOGY (February 2020)	33
EMBRYOLOGY (February 2014)	42
GENERAL ANATOMY (August 2016)	46
LOWER EXTREMITY ANATOMY (July 2017)	58
MEDICAL GENETICS (February 2014)	66
MICROBIOLOGY/IMMUNOLOGY (July 2016)	73
NEUROSCIENCES (formerly Neuroanatomy) (February 2020)	98
PATHOLOGY (July 2016)	104
PHARMACOLOGY (July 2016)	137
PHYSIOLOGY (July 2018)	188

STUDENT LEARNING OBJECTIVES FOR CLINICAL CONTENT AREAS

BEHAVIORAL MEDICINE (February 2020)	219
COMMUNITY HEALTH (February 2020)	222
GERIATRICS (February 2014)	227
MEDICINE (July 2016)	229
ORTHOPEDICS (July 2018)	243
RADIOLOGY (July 2016)	278
SURGERY and ANESTHESIOLOGY (July 2016)	286
APPENDIX I: Bloom’s Taxonomy	315
APPENDIX II: Ranking Key	318
APPENDIX III: AACPM Council of Faculties	319

(...) indicates latest revision date or new content area added

ACKNOWLEDGMENTS

We would like to acknowledge the:

Council of Faculties: for establishing the goals, organization, timeline and vision for this project.

The Curriculum Committee: for updating the Guide, including standardization of ranking and content, maintaining the organization of the guide, recommending the addition of new areas and writing overarching competencies.

Faculty: for their collegial sharing of curriculum; the multiple conference calls and face-to face meetings, and the countless hours spent in ranking objectives.

Content Chairs: for coordinating each content area, for chairing the never-ending conference calls, for the thankless job of sifting through thousands of behavioral objectives, for overseeing the ranking process and in some cases assigning most of the ranking, and for the innumerable hours spent hounding colleagues to get their work in by the deadline.

Deans: for their continued support of this project.

American Association of Colleges of Podiatric Medicine Board of Directors: for financial support.

Collegial Organizations: for their willingness to share existing discipline competencies for this project:

- American Association of Clinical Anatomists (AACA). A clinical anatomy curriculum for the medical student of the 21st century: gross anatomy. *Clin Anat.* 1996;9:71-99.
- American Physiological Society - APS/ACPD 2000 Objectives and the 2006 Revised Objectives Version.
- Knowledge objectives developed by the American Society of Medical Pharmacology Chairs, with the permission of the president at that time, Bonnie Sloane.
- Booth SJ, Burges G, Justeman L, Knoop F. Design and Implementation of Core Knowledge Objectives for Medical Microbiology and Immunology. *J Int Assoc Med Sci Educ.* 2009;19:100-138.
- GRIPE, Group for Research in Pathology Education, with permission.
- McHanwell S, Davies DC, Morris J, et al. A core syllabus in anatomy for medical students – adding common sense to need to know. *Eur J Anat.* 2007;11:3-18.
- Hyland, KM et al. Medical School Core Curriculum in Genetics 2013. Association of Professors of Human and Medical Genetics.

American Association of Colleges of Podiatric Medicine Staff: we want to offer our personal thanks to AACPM for the logistical support of this project. Kelly Foster has kept us organized, facilitated conference calls and gently reminded us whenever we needed to forward materials to keep the project moving. We also want to offer a special thank you to Mori North, for her continued dedication to this project.

Eileen Chusid, PhD
Chair, Council of Faculties

Shanika Hill, DPM
Chair Elect, Council of Faculties

Authoring Group

The authoring groups listed in this edition include all faculty members that have participated in the current revision.

Content Area Participants (leaders are listed first, and bolded)

General Anatomy

Bruce Richardson, PhD	CSPM
Linda Walters, PhD	AZPod
Bibi Singh, DPM	BUSPM
Donald Matz, PhD	CPMS
Stephanie Belovich, PhD	KSUCPM
Maria Moschella, PhD	NYCPM
Derek Talbot, D.C.	SCPM
William Merbs, MSc	WUCPM

Neuroscience (formerly Neuroanatomy)

Donald Matz, PhD	CPMS
Christopher Heeseey, PhD	AZPod
Allen Smith, PhD	BUSPM
Rhea Kimpo, PhD	CSPM
Michael Landers, PhD	KSUCPM
Fortunato Battaglia, MD, PhD	NYCPM
Daniel Bareither, PhD	SCPM
William Robinson, PhD	TUSPM
Edie Sperling, PT, DPT, CMPT	WUCPM

Lower Extremity Anatomy

Bruce Richardson, PhD	SCPM
Lance Wissman, DPM	AZPod
Bibi Singh, DPM	BUSPM
Donald Matz, PhD	DMU-CPMS
Kathy Siesel, DPM	KSUCPM
Daria Dykyj, PhD	NYCPM
Derek Talbot, DC	SCPM
Nicole Griffin, DPM	TUSPM
Mathew Wedel, PhD	WUCPM

Biochemistry

Peter Barbosa, PhD	NYCPM
Gloria Yueh, PhD	AZPod
Graham Shaw, PhD	BUSPM
Mary Premenko-Lanier, PhD	CSPM
Martin Schmidt, PhD	DMU-CPMS
Tim Whittingham, PhD	KSUCPM
Robert Intine, PhD	SCPM
Kathleen Giangiacomo, PhD	TUSPM
Thomas Squier, PhD	WUCPM

Embryology

Bruce Richardson, PhD

Linda Walters, PhD
Donald Matz, PhD
Ronald Wright, PhD
Robert Bressler, PhD
Daniel Bareither, PhD
Judith Litvin Daniels, PhD
Craig Kuehn, PhD

CSPM

AZPod
DMU-CPMS
KSUCPM
NYCPM
SCPM
TUSPM
WUCPM

Genetics

Ronald Wright, PhD

Gloria Yueh, PhD
Gerhild Packert, PhD
Mary Premenko-Lanier, PhD
Martin Schmidt, PhD
Kenneth Astrin, PhD
Robert Intine, PhD
Ragbir Athwal, PhD
Katherine Mitsouras, PhD
Raj Kandpal, PhD

KSUCPM

AZPod
BUSPM
CSPM
DMU-CPMS
NYCPM
SCPM
TUSPM
WUCPM
WUCPM

Histology

Eileen Chusid, PhD

T. Bucky Jones, PhD
Allen Smith, PhD
Carol Gilson, PhD
Sarah Werning, PhD
Joann Eble, MS
Derek Talbot, DC
Judith Litvin Daniels, PhD
Mathew Wedel, PhD

NYCPM

AZPod
BUSPM
CSPM
DMU-CPMS
KSUCPM
SCPM
TUSPM
WUCPM

Physiology

John Becker, PhD

John VandenBrooks, PhD
Sanjay Sesodia, PhD
Carol Gilson, PhD
Kim Tran, PhD,
Ronald Wright, PhD
Patricia Wade, PhD
John S. Martin, PhD
Colleen Talbot, PhD

SCPM

AZPod
BUSPM
CSPM
DMU-CPMS
KSUCPM
NYCPM
TUSPM
WUCPM

Microbiology/Immunology

Kathryn Leyva, PhD

Mary Premenko-Lanier, PhD
Peter Barbosa, PhD
Ronald Wright, PhD
Michael Fennewald, PhD
Marion Chan, PhD
Gerald Thrush, PhD

AZPod

CSPM
NYCPM
KSUCPM
SCPM
TUSPM
WUCPM

Pathology

Mary Mooney, MD

Dana Devine, DO
Amiclar Castellano-Sanchez, MD
Henry Sanchez, MD
Kevin Carnevale, MD
Erin Klein, DPM
Aileen Grace Arriola, MD
Edward Yoon, MD
Chaya Prasad, MD

KSUCPM

AZPod
BUSPM
CSPM
DMU-CPMS
SCPM
TUSPM
TUSPM
WUCPM

Pharmacology

Pamela Potter, PhD

John Nelson, DPM
Richard Rocco, PhD
Matthew Henry, PhD
Kay Kyllonen, PharmD
Ann Snyder, PhD
Ziad Labbad, DPM, MD
Don Walters, PhD

AZPod

BUSPM
CSPM
DMU-CPMS
KSUCPM
SCPM
TUSPM
WUCPM

Geriatrics

Kent Myers, MD

Ben Zier, MD
Gregory Kolbinger, PA
Abe Osbourne, DPM
Anthony Iorio, DPM
Robert Joseph, PhD
Anna Yeung, PhD

AZPod

CSPM
DMU-CPMS
KSUCPM
NYCPM
SCPM
TUSPM

Medicine

Edweana Robinson, MD

William Finch, MD
Jacqueline Buchman, DPM
Ben Zier, MD
Richmond Robinson, DPM
Tracey Vlahovic, DPM

KSUCPM

AZPod
BUSPM
CSPM
SCPM
TUSPM

Professionalism and Cultural Competencies

Tanya Thoms, DPM

Irma Walker-Adame, MS
Rich Salas, PhD
Abe Osbourne, DPM
Johanna Godoy, DPM
Karona Mason, DPM
Lesly Robinson, DPM
Kathleen Satterfield, DPM

AZPod

CSPM
DMU-CPMS
KSUCPM
NYCPM
SCPM
TUSPM
WUCPM

Radiology

Larry Osher, DPM

Janna Kroleski, DPM
Albert Armstrong, DPM
Eric Stamps, DPM
James Mahoney, DPM
Jose Loor, DPM
Robert Joseph, DPM
Ebony Love, DPM
Robert Christman, DPM

KSUCPM

AZPod
BUSPM
CSPM
CPMS
NYCPM
SCPM
TUSPM
WUCPM

Orthopedics/Biomechanics

Tanya Thoms, DPM

Luis Rodriquez, DPM
Tim Dutra, DPM, MS, MHCA
Scott Spencer, DPM
Loretta Logan, DPM
Beth Jarrett, DPM
James Furmato, PhD
Jarrod Shapiro, DPM

AZPod

BUSPM
CSPM
KSUCPM
NYCPM
SCPM
TUSPM
WUCPM

Surgery/Anesthesia

Martin Yorath, DPM

Don Curtis, DPM
Louis Rodriguez, DPM
Ajitha Nair, DPM
Kevin Smith, DPM
Kevin Jules, DPM
Duane Ehredt, DPM
Jane Pontious, DPM
Jennifer D'Amico, DPM

SCPM

AZPod
BUSPM
CSPM
CPMS
NYCPM
KSUCPM
TUSPM
WUCPM

Community Health

Adam Fleischer, DPM

Andre Yorganson, DO
Jimmy Trang, DPM
J.D. Shih, DPM
John Bennett, DPM
Tom Brewer, PhD, M.Jur, CHC
Loretta Logan, DPM
Dyane Tower, DPM MS MPH
Jacqueline Troung, DPM

SCPM

AZPod
BUSPM
CSPM
DMU-CPMS
KSUCPM
NYCPM
SCPM
WUCPM

Behavioral Medicine (new content area)

James Mahoney, DPM

M. Elicia Nademin, PhD, ABPP
Edward Suarez, Jr., PsyD, LMHC
Sara West, MD
Richmond C.O. Robinson, DPM
Yadi Fernandez-Sweeney, PsyD, MS, CRNA

DMU-CPMS

AZPod
BUSPM
KSUCPM
SCPM
WUCPM

Background

The 2005 APMA House of Delegates adopted Resolution No. 2-05. This resolution charged APMA to do the following:

RESOLVED, That the APMA commit itself to achieving the goal by 2015 of podiatrist being defined as physicians who treat patients in the physician's specialty without restrictions; and RESOLVED, That the APMA create a master plan to accomplish this goal and report its progress to the House of Delegates starting in 2006 and in subsequent years.

A Plan to Obtain National Recognition of the Podiatric Physician Working Document reported in May 2009 the following:

Overall Mission

Podiatrists are universally accepted and recognized as physicians consistent with their education, training, and experience

Objectives

1. Evaluate and ensure that podiatric medical education is comparable to that of allopathic and osteopathic physicians.
2. Demonstrate to the entire health care community that the education, training, and experience of a podiatric physician are comparable to that of allopathic and osteopathic physicians.
3. Obtain state and federal government recognition that podiatrists are physicians.
4. Market and promote podiatrists as physicians.
5. Attract high quality applicants to colleges of podiatric medicine and thereby to the profession.

AACPM Council of Faculties Curriculum Review and Educational Objective Development Project

On March 4, 2009, the AACPM Council of Deans (COD) received the report of the March 2 meeting of the AACPM Council of Faculties (COF) which proposed a plan and timeline for completion of a comprehensive review of core competency criteria that might provide guidelines for the scope of concepts essential to present and future preparation of practitioners of Podiatric Medicine. The COF recommended that the currently examined areas of Part I and Part II of the National Board of Podiatric Medical Education serve as the organizing framework for the creation of a comprehensive set of educational objectives. The Deans approved the COF recommendations and the Board of Directors voted unanimously to fully fund the project.

Core Competency Review

Preclinical Science Areas	Clinical Areas
General Anatomy	General Medicine
Lower Extremity Anatomy	Radiology
Biochemistry	Orthopedics/Biomechanics/Sports Medicine
Physiology	Surgery/Anesthesia
Microbiology/Immunology	Community Health/Jurisprudence/Research
Pathology	Geriatrics**
Pharmacology	
Neuroanatomy**	
Embryology**	
Genetics**	
Histology**	

**Section added in 2014.

This living document contains a comprehensive set of weighted learning objectives in each of the content areas above.

Even as version 1.0 of the Curriculum Guide was being finalized, content areas that were not part of the original list were identified, with plans for starting work on them for inclusion in version 2.0. These additional content areas include Neuroanatomy, Histology, Embryology, Genetics and Geriatrics. Consideration was also given to separating the individual components in the area of Community Health, Jurisprudence and Research when that area is updated.

The weighted ranking of the learning objectives was carried out by content area experts from each of the schools and colleges of podiatric medicine with the aim of identifying those objectives important for each graduating podiatric medical student to master prior to beginning residency training. The ranking scale ranged from 0-4, with 4 being most important.

These objectives were developed using Bloom's *Taxonomy of Objectives for the Cognitive Domain* (1956), to categorize cognitive tasks, usually in increasingly sophisticated order.

Bloom's Taxonomy

Bloom's Taxonomy breaks education into 6 different areas: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. These levels are increasingly complex—that is, Knowledge is the most basic of areas and Evaluation is the most complex.

A comprehensive mix of learning objectives takes specificity and focus into account, as well as education areas and complexity. The mix also depends on the actual content; an introductory text will tend to be more heavily weighted on the Knowledge, Comprehension, and Application learning objectives, whereas a text on advanced thermodynamics will tend to be focused on Analysis, Synthesis, and Evaluation.

To provide more detail on Bloom's areas and the verbs often associated with each level, you can refer to the table in Appendix I.

COMPETENCIES

DOMAIN I: MEDICAL KNOWLEDGE

Competency Statement: Apply current and emerging knowledge of human structure, function, development, pathology, pathophysiology, and psychosocial development, and of pharmacology and microbiology to the foundation of podiatric clinical training, residency and practice.

1. Describe normal development, structure and function of the body with emphasis on the lower extremities.
2. Explain the genetic, molecular, biochemical and cellular mechanisms important to maintaining the body's homeostasis.
3. Relate the altered development, structure and function of the body and its major organ systems to diseases and pathological conditions.
4. Apply knowledge from pre-clinical and clinical sciences in simulated and clinical settings to patient care.
5. Use current and emerging knowledge of health and disease to identify and solve problems in patient care.

DOMAIN II: PATIENT CARE

Competency Statement: Provide effective, appropriate and compassionate patient-centered care that promotes overall health to diverse populations.

1. Apply medical knowledge to distinguish between wellness and disease.
2. Perform and interpret appropriate, accurate, and problem-focused history and physical examinations.
3. Perform lower extremity exams required for the diagnosis and management of disorders and conditions.
4. Formulate a prioritized differential diagnosis based on examination and clinical assessments.
5. Perform and/or Interpret appropriate diagnostic studies, and tests required for management and treatment.
6. Participate actively in the performance of treatment techniques using medical and surgical means.
7. Recommend appropriate referrals of patients ensuring continuity of care through transitions between providers or settings, and determining patient progress.
8. Recognize evidence of mental or physical impairment of oneself or other in order to protect patients from harm.
9. Develop and implement patient specific management plans and prevention strategies.
10. Demonstrate awareness of issues related to culture, religion, age, gender, sexual orientation, and mental and physical disabilities.
11. Engage patients and their families in shared decision-making through counseling and education.
12. Use information technology to access online medical information, manage information and assimilate evidence from scientific studies to patient care.

DOMAIN III: RESEARCH AND SCHOLARSHIP

Competency Statement: Apply concepts of research to further one's understanding of contemporary podiatric medicine and its application to appropriate care for patients.

1. Identify responsible practices and ethical behaviors used in research.
2. Demonstrate the acquisition and interpretation of medical and scientific literature.
3. Apply knowledge of the principles of research methodology and its relevance for clinical decision making.
4. Investigate opportunities that enhance life-long learning and contribute to the body of knowledge in podiatric research and scholarship.

DOMAIN IV: INTERPERSONAL AND INTERPROFESSIONAL COMMUNICATIONS

Competency Statement: Demonstrate communication and interpersonal skills that result in relevant information exchanges and decision-making with patients, their families, and members of the healthcare team.

1. Effectively communicate by utilizing oral, digital and written communication formats.
2. Communicate effectively (including non-verbal cues) with patients, families, and other healthcare professionals, especially when special barriers to communication exist.
3. Interact appropriately with peers, faculty, staff, and healthcare professionals in academic, research and healthcare settings.
4. Exhibit behavior that demonstrates the capacity to establish a doctor/patient relationship.

DOMAIN V: PROFESSIONALISM

Competency Statement: Exhibit the highest standards of competence, ethics, integrity, and accountability to patients. Place the patient's interest above oneself.

1. Apply theories and principles that govern ethical decision-making to the practice of medicine and research.
2. Recognize potential conflicts of interest inherent in various financial and organizational arrangements for the practice of medicine, in medical education and research.
3. Practice the standards that ensure patient privacy and confidentiality.
4. Demonstrate dependability, commitment and reliability in interactions with patients and their families and other health professionals.
5. Recognize and address in a constructive manner, unprofessional behaviors in oneself and others with whom one interacts.
6. Demonstrate personal behaviors that promote patient safety.
7. Identify personal deficiencies in knowledge and skills, and address them by implementing methods for improvement.
8. Employ strategies for seeking and incorporating feedback from patients, peers, and other health professionals to improve personal and patient outcomes.

DOMAIN VI: INTERPROFESSIONAL COLLABORATIVE PRACTICE

Competency Statement: Demonstrate the ability to work as an effective member of a healthcare team.

1. Demonstrate an understanding of and respect for other health care professionals and to work collaboratively with them in caring for patients.
2. Perform effectively in diverse health care delivery settings and diverse health care systems.
3. Describe the structure and function of health care delivery and payer systems used in the United States.
4. Identify resources for patients in situations in which social and economic barriers limit access to health care.

Domain VII: Social Awareness/Pain and Addiction

Competency Statement: Demonstrate an understanding of common societal problems including issues of addiction or abuse and their impact on patients and their families.

1. Use a socio-psycho-biological model to develop individualized prevention strategies for persons with pain and/or opioid use disorder.
2. Employ an integrated, team-based approach to the patient.
3. Engage family and social support in the care to the patient.

PROFESSIONALISM AND CULTURAL COMPETENCE

LEARNING OBJECTIVES

Cultural Competence

Ethics Competence

Professionalism

I. Cultural Competence

1. Define race, ethnicity, culture and their implications in healthcare. **4.0**
2. Define and understand the difference between cultural awareness, cultural competency and cultural humility. **4.0**
3. Define and describe how social determinants impact health and health care. **4.0**
4. Describe the inherent power imbalance between physician and patient and how it affects the clinical encounter. **4.0**
5. Explain and summarize the various dimensions of patient identities (race, ethnicity, sexual orientation, gender expression, disabilities, etc.) as they relate to healthcare disparities and quality of health care. **4.0**
6. Define and describe how historical, political, environmental, and institutional factors impact health care disparities. **3.0**
7. Recognize the historical impact of bias on health and health care. **4.0**
8. Recognize, understand and discuss the dangers of forming stereotypes and bias, and how they affect communication, judgment, relationships, and patient care. **4.0**
9. Discuss and demonstrate the ability to elicit patient preferences and respond appropriately to patient feedback about key cross-cultural issues. **4.0**
10. Recognize and acknowledge patient and family healing traditions and beliefs, including ethno-medical beliefs **4.0**
11. Show a commitment to provide compassionate care to all patients regardless of the patient's disease, prognosis, age, sex, race, sexual orientation, ethnicity, religion, spiritual beliefs, cultural health-related beliefs, socioeconomic class, and/or citizenship status. **4.0**
12. Identify the challenges and implications of demographics in the US for healthcare providers. **4.0**
13. Describe methods to identify key community mediators in order to address community needs. **4.0**

II. Ethics Competence

1. Identify and demonstrate knowledge of the principles of bioethics. **4.0**
2. Discuss the historical background and basic principles of ethics including cultural and religious differences between healthcare practitioners and patients, beginning of life issues and end of life issues. **4.0**
3. Discuss the role that ethical decision making plays in society, and appropriate healthcare practitioner-patient relationships. **4.0**
4. Recognize and avoid conflicts of interest including customary and accepted ethical standards of professional practice. **4.0**
5. Perform patient centered care, governed by ethical principles, integrity, honesty and compassion. **4.0**
6. Describe and model ethical clinical practice, such as informed consent, confidentiality, respect for human dignity and autonomy, and how these influence the ethical standards in clinical practice. **4.0**

III. Professionalism

1. Define medical professionalism. **4.0**
2. Recognize the importance of life-long learning and commit to maintaining competence throughout their medical career. **4.0**
3. Demonstrate professional responsibility, including being punctual, present and engaged in the classroom, patient encounters, meetings and other professional activities. **4.0**
4. Recognize personal limitations and seek help when the expertise, knowledge, or level of experience is inadequate to handle a situation in the classroom, hospital, or research setting. **4.0**
5. Demonstrate the ability to seek and accept feedback and constructive criticism from peers, faculty members, residents and clinicians in order to continually improve their educational experience, knowledge, and clinical skills. **4.0**
6. Provide respectful feedback to peers and respectful evaluation to faculty members, residents and clinicians in order to continually improve their educational experience, knowledge, and clinical skills. **4.0**
7. Practice honesty and integrity in all interactions, including: **4.0**
 - a. Accurately attribute sources in all written and oral presentations
 - b. Accurately represent clinical actions and findings
 - c. Demonstrate proper care and use of institutional property and personal property of others
 - d. Admit mistakes and errors
8. Demonstrate the ability to refrain from discussing patient care and/or unprofessional depiction of themselves and others on social media and networking sites. **4.0**
9. Demonstrate and model professional demeanor in their interactions with teachers, fellow students, patients and all members of the health-care team at all times. These qualities should be evident in appearance, communication, exemplary behavior and attitudes toward others and toward the profession. **4.0**
10. Exhibit respect, honesty and integrity in the collection, synthesis, analysis, and presentation of scientific and clinical data. **4.0**
11. Demonstrate the ability to communicate and work collaboratively with others and to function in a professional manner in an interprofessional setting. **4.0**
12. Develop personal habits that promote social, physical and mental health and well-being; and recognize signs of impairment in yourself and others and take appropriate action. **4.0**
13. Demonstrate respect for knowledge, skills and expertise of other team members. **4.0**
14. Demonstrate knowledge of and model the ethical, physical, and legal boundaries of the doctor-patient relationship. **4.0**
15. Demonstrate the ability to appropriately place the patient's interest above their own. **4.0**
16. Show respect for each patient's confidentiality. **4.0**
17. Communicate professional medical information in a clear and humanistic manner with patients and their relatives, other professionals and the public. **4.0**
18. Recognize and explain models of patient advocacy, practice and manage patient care in variety of communities. **3.0**

BIOCHEMISTRY LEARNING OBJECTIVES

Biological Acids, Bases and Buffers

Amino Acids and Protein Structure

Enzymes

Molecular Biology

Lipids and Biological Membranes

Hormones, Second messengers, Signal Transduction

Bioenergetics and Energy Metabolism

Carbohydrate Metabolism

Lipid Metabolism

Protein and Amino Acid Metabolism

Nucleotide Metabolism

Heme Metabolism

Hemostasis and Blood Coagulation

Diabetes

Free Radicals and Antioxidants

Metabolism of Ethanol

Nutrition

Integration of Metabolism

I. Biological Acids, Bases and Buffers

1. Define *pH*. 4.0
2. Differentiate between strong acid, weak acid, strong base, weak base, and buffer. 3.0
3. Describe how the Henderson-Hasselbach equation relates pH and pKa. 3.0
4. List the buffer systems that predominate in intracellular and extracellular fluid, distinguishing between blood and interstitial fluid. 3.0
5. Define *acidosis* and *alkalosis*. 4.0
6. Explain the physiological significance of carbonic anhydrase. 3.0
7. Explain the classification of the bicarbonate buffer as an open system. 1.0
8. Relate plasma CO₂ concentration and pH. 2.0
9. Explain the effects of hyperventilation and hypoventilation on blood pH. 2.0
10. Identify common disorders that lead to an acid-base imbalance. 2.0
11. Explain the role of the kidney in maintaining acid-base balance. 2.0

II. Amino Acids and Protein Structure

A. Amino Acids and General Concepts of Protein Structure

1. Identify the basic structure of alpha amino acids. 3.0
2. Describe the stereochemistry of amino acids. 2.0
3. Classify amino acids as polar, nonpolar, acidic, basic, aromatic, or sulfur-containing. 3.0
4. Describe acid-base properties of amino acids in terms of pK_a, isoelectric point and buffering capacity. 2.0
5. Describe the properties of the peptide bond. 2.0
6. Define primary, secondary, tertiary and quaternary structures of protein. 4.0
7. Explain protein domains. 3.0
8. Describe stabilizing factors of protein structures. 3.0
9. Describe protein denaturation and conditions that can contribute to this process. 3.0
10. Explain the role of chaperones in the protein folding process. 2.0
11. Explain protein folding diseases. 2.0

B. Relationship of Protein Structure and Function

1. Describe the relationship between protein conformational dynamics and function. 3.0
2. Describe structural and functional differences between hemoglobin and myoglobin. 4.0
3. Explain the role of heme in both hemoglobin and myoglobin. 4.0
4. Explain the oxygen dissociation curve of hemoglobin and myoglobin. 4.0
5. Summarize the effects of H⁺, CO, CO₂ and 2,3-bisphosphoglycerate (2,3-BPG) on the affinity of hemoglobin for oxygen. 4.0
6. Relate the unique amino acid composition of collagen to its molecular structure and function. 4.0
7. Explain the role of ascorbic acid and copper in collagen synthesis. 3.0
8. Correlate altered protein structures to sickle cell anemia, thalassemias, Osteogenesis imperfecta, Ehlers Danlos syndrome, and Scurvy. 3.0
9. Distinguish between the oxygen binding capacities of HbA and HbF. 2.0

III. Enzymes

1. Explain the reactions catalyzed by oxidoreductases, transferases, hydrolases, lyases, isomerases, and ligases. 4.0
2. Define *co-factor*, *coenzyme*, *prosthetic group*, *holoenzyme*, and *apoenzyme*. 4.0
3. Explain the active site and its significance to enzymatic function. 4.0
4. Describe the effect of enzymes on the energy of activation for the forward and reverse reaction, and the equilibrium constant of a reaction. 4.0
5. Explain how temperature alters enzyme-catalyzed reactions. 3.0
6. Relate the importance of pH to enzyme function. 3.0
7. Define V_{max} and K_m . 4.0
8. Describe Michaelis-Menten enzyme kinetics in terms of V_{max} and K_m . 4.0
9. Recognize competitive inhibition and noncompetitive inhibition from the Michaelis-Menten and Lineweaver-Burk double-reciprocal plots. 3.0
10. Explain irreversible inhibition. 3.0
11. Explain allosteric enzymes. 4.0
12. Contrast allosteric kinetics and Michaelis-Menten kinetics. 3.0
13. Define *isoenzyme*. 4.0
14. Define *zymogen*. 4.0
15. Describe and provide specific examples for mechanisms of enzyme regulation, including:
 - a. product inhibition, feedback inhibition and forward activation; 4.0
 - b. phosphorylation/dephosphorylation; 4.0
 - c. calcium-binding proteins; 4.0
 - d. proteolytic activation/deactivation; 4.0
 - e. allosteric regulation; 4.0
 - f. induction/repression; 4.0
 - g. substrate availability; and 4.0
 - h. compartmentalization. 4.0
16. Define the turn-over number and catalytic efficiency of enzymes. 2.0

IV. Molecular Biology

A. Structure and Organization of Nucleic Acids

1. Describe the basic structural unit of DNA and RNA molecules. 4.0
2. Distinguish between the primary and secondary structure of DNA and RNA. 3.0
3. Differentiate between euchromatin and heterochromatin. 3.0
4. Explain base pair complementarity. 4.0
5. Explain the denaturation and renaturation of the DNA molecule. 4.0
6. Explain nucleosome complex. 3.0
7. Define *gene* and *pseudogene*. 3.0
8. Contrast the organization of genes in prokaryotes and eukaryotes. 3.0
9. Define *introns* and *exons*. 4.0
10. Describe the structure and function of each type of RNA (mRNA, rRNA, tRNA, and iRNA). 4.0
11. Compare mitochondrial and bacterial DNA 1.0
12. Explain the significance of repetitive DNA sequences 2.0

B. DNA Replication

1. Describe semi-conservative DNA replication. 3.0
2. Define *origin of replication*, *replication fork*, *primer*, and *template*. 4.0
3. Outline the major functions and properties of bacterial DNA polymerases I and III and mammalian DNA polymerases alpha, delta and epsilon. 2.0
4. Discuss the functions of helicase and topoisomerases I and II. 3.0
5. Describe the role of single-strand DNA-binding proteins. 2.0
6. Distinguish between the leading and lagging strands of DNA. 3.0
7. Describe Okazaki fragments. 3.0
8. Explain telomeres in relationship to DNA replication. 4.0
9. Rationalize DNA replication as a point of attack in chemotherapy. 3.0

C. Mutations

1. Define the following types of mutations:
 - a. silent mutation 4.0
 - b. nonsense mutation 4.0
 - c. missense mutation 4.0
 - d. read-through mutation 4.0
 - e. insertion and deletion 4.0
 - f. frame-shift mutation 4.0
2. Describe mutations caused by UV light and X-rays. 3.0
3. Define *mutagen*. 3.0
4. Describe the following DNA damage repair:
 - a. base excision repair 3.0
 - b. mismatch repair 3.0
 - c. repair of double stranded breaks (DSBs) 3.0

D. Transcription and RNA processing

1. Define *transcription*. 4.0
2. Differentiate between coding and non-coding (template) strand of a gene. 4.0
3. Describe post-transcriptional processing of mRNA, rRNA, and tRNA in eukaryotes. 3.0
4. Compare and contrast the regulation of transcription in eukaryotes and prokaryotes. 3.0
5. Explain the general role of basal transcription factors in the function of eukaryotic RNA polymerases 3.0
6. Describe the relationship between mRNA and coding strand of DNA. 1.0
7. Explain how errors in RNA modifications can lead to β -thalassemia and phenylketonuria. 1.0
8. Identify the target of alpha-amanitin. 1.0

E. Translation and Protein Processing

1. Explain the translation process (initiation, elongation, and termination). 4.0
2. Outline how the ribosome, mRNA and tRNA assemble for protein synthesis and explain their roles. 4.0
3. Identify properties of genetic code, codons and anticodons. 4.0
4. Explain the "Wobble Hypothesis." 3.0
5. Explain the role of tRNA in translation. 4.0
6. Explain the "proofreading" function of amino acyl-tRNA synthetases. 2.0

- | | |
|---|-----|
| 7. List post-translational modifications of proteins. | 3.0 |
| 8. Describe the role of the signal peptide in protein translocation and secretion. | 3.0 |
| 9. Discuss protein turnover with reference to the role of ubiquitin and the proteasome. | 4.0 |
| 10. Describe the effects of antibiotics on translation in prokaryotes. | 3.0 |

F. Regulation of Gene Expression

- | | |
|--|-----|
| 1. Define: | |
| a. chromatin remodeling | 3.0 |
| b. acetylation/deacetylation of histone | 4.0 |
| c. methylation/demethylation of DNA | 4.0 |
| d. epigenetics | 4.0 |
| e. gene rearrangement | 2.0 |
| f. gene amplification | 2.0 |
| g. gene expression | 4.0 |
| h. operon | 3.0 |
| i. promoter | 4.0 |
| j. operator | 3.0 |
| k. inducers | 3.0 |
| l. response elements | 3.0 |
| m. gene-specific transcription factors | 2.0 |
| 2. Describe the regulation of <i>lac</i> operon. | 2.0 |
| 3. Explain the regulation of eukaryotic gene expression at multiple levels. | 4.0 |
| 4. Describe the gene regulatory functions of the steroid/thyroid hormone receptor superfamily. | 4.0 |
| 5. Describe the basic functional motifs/domains of DNA-binding proteins. | 1.0 |
| 6. Characterize mRNA transport and stability as important to the regulation of gene expression. | 2.0 |
| 7. Characterize the initiation of translation as important to the regulation of gene expression in eukaryotes. | 2.0 |
| 8. Describe the regulation of <i>Trp</i> operon. | 1.0 |
| 9. Explain stringent response in bacteria. | 1.0 |
| 10. Explain the regulation of gene expression by extracellular factors. | 1.0 |
| 11. Describe RNA editing using the expression of ApoB-48 as an example. | 1.0 |
| 12. Define <i>microRNA</i> (miRNA). | 2.0 |
| 13. Explain small interference RNA (siRNA). | 2.0 |
| 14. Explain RNA interference (RNAi). | 2.0 |
| 15. Describe the effect of miRNA and siRNA on gene expression. | 2.0 |

G. Biotechnology

- | | |
|---|-----|
| 1. Explain gel electrophoresis. | 4.0 |
| 2. Explain the significance of using dideoxynucleotides in DNA sequencing technique. | 3.0 |
| 3. Explain the method of DNA sequencing by synthesis, including the Sanger method. | 1.0 |
| 4. Describe how restriction enzyme digests of a given DNA sequence are used in recombinant DNA molecule generation. | 3.0 |
| 5. Explain the use of plasmids as cloning vectors. | 2.0 |
| 6. Describe how to produce a genomic library. | 2.0 |
| 7. Describe how to produce a cDNA library. | 2.0 |

8. Explain the production of recombinant proteins. 3.0
9. Describe the following techniques:
 - a. Southern blotting analysis 2.0
 - b. Northern blotting analysis 2.0
 - c. Western blotting analysis 4.0
 - d. Enzyme-linked immunosorbent assay (ELISA) 3.0
 - e. Immunohistochemistry 3.0
10. Explain the polymerase chain reaction (PCR). 4.0
11. Explain reverse transcription (RT)-PCR. 4.0
12. Explain restriction fragment length polymorphism (RFLP) analysis. 2.0
13. Explain the usefulness of allele-specific oligonucleotide (ASO) probes. 3.0
14. Explain GeneArrays (or Microarrays). 3.0
15. Explain gene targeting and transgenic animals. 1.0
16. Explain the use of RNA sequencing for analysis of gene expression. 2.0

H. Cancer

1. Define *proto-oncogenes* and *oncogenes*. 4.0
2. List classes of proteins coded for by proto-oncogenes. 3.0
3. Summarize the mechanisms through which proto-oncogenes become oncogenes. 3.0
4. Identify a tumor suppressor gene. 4.0
5. Outline the process of carcinogenesis (using colorectal cancer as an example). 3.0
6. Describe the role of telomerase in cancer etiology. 2.0

V. Lipids and Biological Membranes

1. Define:
 - a. amphipathic 4.0
 - b. emulsification 4.0
 - c. liposome 4.0
 - d. micelle 4.0
 - e. membrane fluidity 3.0
 - f. fatty acid nomenclature 3.0
2. Describe the structural features of fatty acids, phospholipids, sphingolipids, triglycerides, and cholesterol. 4.0
3. Describe the role of cholesterol, glycoproteins and glycolipids in biological membranes. 4.0
4. Describe the organization and function of biological membranes. 4.0
5. Distinguish between integral and peripheral membrane proteins and describe the structural properties of each. 4.0
6. Compare active transport, secondary active transport, symport, and antiport. 3.0
7. Distinguish between facilitated diffusion and simple passive diffusion. 4.0
8. Identify the defective ion channels in cystic fibrosis. 2.0

VI. Hormones, Second Messengers, Signal Transduction

1. Define *hormone* and distinguish between endocrine, paracrine, and autocrine signaling. 4.0
2. Differentiate between the properties and mode of action of the hydrophilic and hydrophobic hormones. 4.0
3. Define *second messenger*. 4.0
4. Describe the structure and function of monomeric and trimeric G-proteins. 4.0
5. Describe how cAMP mediates signal transduction between the plasma membrane and the cytosol. 4.0
6. Describe the IP₃/DAG/Ca²⁺ signal transduction system. 4.0
7. Outline the mode of action of growth factors and the role of receptors with endogenous enzyme activity. 4.0
8. Distinguish between the modes of action of insulin and glucagon. 4.0
9. Describe the role of calcium in signal transduction. 4.0
10. Explain the mode of action of cholera and pertussis toxin. 2.0

VII. Bioenergetics and Energy Metabolism

A. Introduction to Metabolism and Free Energy

1. Contrast the roles of anabolic and catabolic pathways. 4.0
2. Explain the functions of NAD⁺, NADP⁺, FAD, and FMN in enzymatic reactions. 4.0
3. Explain the central roles of glucose 6-phosphate, acetyl-CoA, and pyruvate in the integration of metabolic pathways. 4.0
4. Differentiate between substrate-level phosphorylation and oxidative phosphorylation. 4.0
5. Describe the regulation of anabolic and catabolic pathways by insulin, glucagon, epinephrine and cortisol. 4.0
6. Describe the concept of free energy change of the reaction. 3.0
7. Explain the relationship between the free energy change (ΔG) of the reaction and standard free energy change (ΔG^0) of the reaction. 3.0
8. Explain reaction coupling. 3.0
9. Describe "high-energy" bonds in terms of thermodynamic principles. 3.0
10. Differentiate exergonic and endergonic reactions. 3.0
11. Explain oxidation and reduction. 4.0

B. Pyruvate Dehydrogenase Complex (PDH)

1. Explain how pyruvate enters the mitochondrial matrix from the cytoplasm. 2.0
2. Describe the pyruvate dehydrogenase complex as an alpha-ketoacid dehydrogenase which is a highly organized assembly of 5 cofactors and 3 enzymes. 3.0
3. Describe the reaction catalyzed by the pyruvate dehydrogenase enzyme in terms of the origin of the substrate, the products, and its cellular location. 3.0

- | | |
|---|-----|
| 4. Explain how pyruvate enters the mitochondrial matrix from the cytoplasm. | 2.0 |
| 5. Describe the pyruvate dehydrogenase complex as an alpha-ketoacid dehydrogenase which is a highly organized assembly of 5 cofactors and 3 enzymes. | 3.0 |
| 6. Describe the reaction catalyzed by the pyruvate dehydrogenase enzyme in terms of the origin of the substrate, the products, and its cellular location. | 3.0 |
| 7. Evaluate how covalent modification and allosteric effectors can control the activity of the pyruvate dehydrogenase complex. | 2.0 |
| 8. Describe the central role of acetyl-SCoA (Acetyl-CoA) as a crossroads in metabolism. | 4.0 |
| 9. Explain how pyruvate enters the mitochondrial matrix from the cytoplasm. | 2.0 |
| 10. Describe the pyruvate dehydrogenase complex as an alpha-ketoacid dehydrogenase which is a highly organized assembly of 5 cofactors and 3 enzymes. | 3.0 |
| 11. Describe the reaction catalyzed by the pyruvate dehydrogenase enzyme in terms of the origin of the substrate, the products, and its cellular location. | 3.0 |
| 12. Evaluate how covalent modification and allosteric effectors can control the activity of the pyruvate dehydrogenase complex. | 2.0 |
| 13. Describe the central role of acetyl-SCoA (Acetyl-CoA) as a crossroads in metabolism. | 4.0 |
| 14. Explain how pyruvate enters the mitochondrial matrix from the cytoplasm. | 2.0 |
| 15. Describe the pyruvate dehydrogenase complex as an alpha-ketoacid dehydrogenase which is a highly organized assembly of 5 cofactors and 3 enzymes. | 3.0 |
| 16. Describe the reaction catalyzed by the pyruvate dehydrogenase enzyme in terms of the origin of the substrate, the products, and its cellular location. | 3.0 |
| 17. Evaluate how covalent modification and allosteric effectors can control the activity of the pyruvate dehydrogenase complex. | 2.0 |
| 18. Describe the central role of acetyl-SCoA (Acetyl-CoA) as a crossroads in metabolism. | 4.0 |
|
 | |
| C. <u>Citric Acid Cycle (CAC) / Tricarboxylic Acid (TCA) Cycle / Krebs Cycle</u> | |
| 1. Describe key reactions of the citric acid cycle including; the reversible and irreversible steps, the two decarboxylation steps, the oxidative steps and the substrate level phosphorylation step. | 2.0 |
| 2. Calculate the amount of ATP that is produced per one turn of the citric acid cycle. | 2.0 |
| 3. Distinguish between substrate level phosphorylation and oxidative phosphorylation. | 3.0 |
| 4. Calculate the total amount of ATP produced from the complete oxidation of glucose to carbon dioxide and water. | 2.0 |
| 5. List the regulatory enzymes in the citric acid cycle and describe how each is controlled. | 3.0 |
| 6. Define anapleurotic reactions. | 3.0 |
| 7. Describe the coordinated regulation between the CAC and Oxidative Phosphorylation by oxygen and ADP levels. | 3.0 |
|
 | |
| D. <u>The Electron Transport Chain (ETC)</u> | |
| 1. Describe the structure and function of mitochondrion and its various compartments. | 3.0 |
| 2. Determine the localization and function of the components of the mitochondrial electron transport chain (ETC). | 3.0 |
| 3. Identify common inhibitors of ETC. | 3.0 |
| 4. Explain the concept of transporting reducing equivalents across mitochondrial membranes. | 4.0 |

- | | |
|--|-----|
| 5. Explain chemiosmotic potential (or proton motive force) and its relation to mitochondrial ATP production. | 4.0 |
| 6. Describe mitochondrial ATP synthase. | 3.0 |
| 7. Explain oxidative phosphorylation. | 4.0 |
| 8. Explain uncoupling proteins and other uncoupling agents. | 3.0 |
| 9. Explain P/O ratio. | 2.0 |
| 10. Explain OXPHOS diseases. | 2.0 |
| 11. Explain standard oxidation reduction potential (E_0). | 1.0 |
| 12. Explain how oligomycin inhibits ATP synthase and ultimately inhibits the activity of ETC. | 1.0 |

IX. Carbohydrate Metabolism

- | | |
|--|-----|
| 1. Differentiate between mono-, di-, oligo-, and polysaccharides. | 4.0 |
| 2. Define <i>aldose</i> and <i>ketose</i> . | 3.0 |
| 3. Explain the breakdown of carbohydrates in the digestive system. | 4.0 |
| 4. Describe carbohydrate uptake by the cells of the intestinal epithelium. | 4.0 |
| 5. Identify disorders related to carbohydrate absorption. | 2.0 |
| 6. Describe phosphorylation-coupled trapping of carbohydrates. | 4.0 |
| 7. Describe the glycolytic degradation of glucose, galactose, and fructose. | 4.0 |
| 8. Outline regulated steps in glycolysis and identify the regulatory factors. | 4.0 |
| 9. Identify the glycolytic reactions that consume or generate ATP. | 3.0 |
| 10. Explain the significance of oxidation of NADH in anaerobic glycolysis. | 4.0 |
| 11. Describe the Cori cycle. | 4.0 |
| 12. Explain the consequences of the following | |
| a. Pyruvate kinase deficiency | 3.0 |
| b. Fructose intolerance | 3.0 |
| c. Classic galactosemia | 3.0 |
| d. Arsenic poisoning | 3.0 |
| e. Lactose intolerance | 3.0 |
| 13. Describe gluconeogenesis. | 4.0 |
| 14. Explain the regulation of gluconeogenesis. | 4.0 |
| 15. Explain the regulation of pyruvate carboxylase. | 3.0 |
| 16. Describe the pyruvate carboxylase reaction and its role in gluconeogenesis. | 2.0 |
| 17. Describe how deficiency of pyruvate carboxylase can lead to lactic acidosis. | 2.0 |
| 18. Explain how impaired gluconeogenesis causes lactic acidosis and fasting hypoglycemia. | 4.0 |
| 19. Characterize the importance of insulin- and glucagon-dependent regulation of glycolysis and gluconeogenesis. | 4.0 |
| 20. Describe the pentose phosphate pathway (HMP). | 4.0 |
| 21. Describe the consequences of glucose-6-phosphate dehydrogenase deficiency. | 4.0 |
| 22. Explain how insulin, glucagon, epinephrine and cortisol influence carbohydrate metabolism to maintain blood glucose level. | 4.0 |
| 23. Compare the physiological functions of liver and muscle glycogen stores. | 4.0 |
| 24. Differentiate between glycogenesis and glycogenolysis. | 4.0 |
| 25. Identify and describe glycogen storage diseases (von Gierke and McArdle diseases). | 3.0 |
| 26. Describe the influence of alcohol on carbohydrate metabolism. | 3.0 |
| 27. Describe the structures and functions of GAGs and proteoglycans. | 4.0 |
| 28. Define <i>mucopolysaccharidoses</i> . | 1.0 |
| 29. Describe the synthesis of lactose. | 1.0 |

X. Lipid Metabolism

A. Fatty Acid Oxidation (Beta-oxidation) and Ketogenesis

1. Identify when and where lipolysis, fatty acid oxidation, and ketogenesis occur. 4.0
2. Describe the function and regulation of hormone-sensitive lipase in lipolysis. 4.0
3. Explain fatty acid activation. 3.0
4. Explain the function and regulation of carnitine shuttle. 4.0
5. Describe β -oxidation of various types of fatty acids (saturated, unsaturated, and branched-chain). 3.0
6. Describe the metabolic fate of the products of fatty acid oxidation. 4.0
7. Describe the role of fatty acid oxidation in peroxisomes. 2.0
8. Identify the ketone bodies produced in the liver and explain their metabolic fates. 4.0
9. Explain the decreased rate of gluconeogenesis from ketone body oxidation. 4.0
10. Characterize fatty acids as unusable precursors for the net synthesis of glucose. 4.0
11. Explain why limited food intake can trigger disease conditions in individuals with the medium-chain fatty acyl CoA dehydrogenase deficiency. 2.0
12. Characterize dietary intake of medium-chain and short-chain fatty acids and its benefits to individuals with carnitine shuttle defects. 2.0

B. Fatty Acid Biosynthesis

1. Identify when and where fatty acid synthesis occurs. 4.0
2. List enzymes involved in the pathway from citrate to fatty acyl-CoA and identify the first-committed step. 4.0
3. Explain the significance of NADPH as substrate and palmate, and CO_2 as products in this pathway. 4.0
4. Describe the reactions catalyzed by ATP-citrate lyase and acetyl CoA carboxylase and their regulations. 4.0
5. Describe the reaction carried out by FA synthase and explain the structural properties of this enzyme. 3.0
6. Explain how fatty acids are elongated and desaturated. 3.0
7. Explain why essential fatty acids are required in the human diet. 4.0

C. TAG, Membrane Lipid and Eicosanoid Biosynthesis

1. Describe TAG synthesis. 4.0
2. Describe membrane lipid synthesis. 2.0
3. Describe the biosynthesis of eicosanoids. 4.0
4. Describe the principal regulatory enzymes, such as phospholipase A_2 and the cyclooxygenases (COX-1 and COX-2). 4.0
5. Describe the mechanism of action of anti-inflammatory steroids and non-steroidal anti-inflammatory drugs (NSAIDs) in modulating the biosynthesis of the eicosanoids. 4.0
6. Describe the functions of leukotrienes, prostaglandins, and thromboxanes. 2.0
7. Compare the biological potency of the prostaglandins and thromboxanes made from omega-6 and omega-3 fatty acids. 2.0
8. Explain biochemical defects associated with sphingolipidoses, such as Tay-Sachs, Gaucher, and Niemann-Pick diseases. 1.0

D. Cholesterol Metabolism

1. Describe the general structure of cholesterol. **4.0**
2. Compare and contrast cholesterol and cholesterol ester in terms of chemical characteristics and cellular significance. **4.0**
3. Identify when and where cholesterol synthesis occurs. **4.0**
4. Describe the pathway of cholesterol synthesis in three phases: synthesis of HMG-CoA, synthesis of mevalonic acid, and synthesis of cholesterol. **4.0**
5. Explain the regulation of the cytosolic HMG-CoA reductase. **4.0**
6. Explain the biochemical basis of how the statin drugs lower serum cholesterol. **4.0**
7. Explain the occurrence of rhabdomyolysis in some patients on statin drugs. **1.0**

E. Cholesterol Derivatives

1. Describe the function and physiological significance of bile acid/bile salt synthesis and excretion. **4.0**
2. Identify and describe the two-phase reactions that convert cholesterol into bile acids and bile salts. **3.0**
3. Explain how bile salt is recycled. **3.0**
4. Explain the regulation of bile acid synthesis via cholesterol 7- α -hydroxylase. **3.0**
5. Describe the mechanisms and cellular locations of the synthesis of cholecalciferol, 25-hydroxycholecalciferol, and 1,25-dihydroxycholecalciferol. **3.0**
6. Describe the mechanism of action of cholestyramine, HMG-CoA reductase inhibitors (statins), niacin, and weight loss in managing hypercholesterolemia. **2.0**
7. Explain the etiology of cholelithiasis. **1.0**

F. Plasma Lipoproteins and Lipid Transport

1. Compare and contrast chylomicron (CM), chylomicron remnant, VLDL, LDL, and HDL in terms of composition, function, location of synthesis, and delivery of lipid contents. **4.0**
2. Describe the reactions catalyzed by the following enzymes: lipoprotein lipase (LPL); phosphatidylcholine: cholesterol acyltransferase (PCAT, also known as LCAT, in which "L" stands for lecithin); acyl-CoA: cholesterol acyltransferase (ACAT); and hepatic lipase. **3.0**
3. Describe the role of cholesterol ester transfer protein (CETP) and PCAT in reverse transport of cholesterol by HDL. **3.0**
4. Explain the etiology of familial hypercholesterolemia. **3.0**
5. Describe the process of atherosclerosis and the roles played by LDL and HDL. **3.0**
6. Relate apoE to Alzheimer's disease. **1.0**

XI. Protein and Amino Acid Metabolism

A. Protein Digestion

1. Describe the process of dietary protein digestion. **4.0**
2. Describe the transport systems involved in the uptake of amino acids, dipeptides, and tripeptides. **2.0**
3. Explain the disorders of amino acid absorption/reabsorption (hartnup, cysteinuria). **2.0**

B. Transamination and the Urea Cycle

1. Describe the basic function of transaminases and the role of pyridoxal phosphate in transamination reactions. 4.0
2. Describe the metabolic processes that produce ammonia. 4.0
3. Explain the role of the urea cycle in ammonia detoxification. 4.0
4. Identify the enzymes and their respective locations of the urea cycle. 3.0
5. List the sources of nitrogen incorporated into urea. 3.0
6. Describe the regulation of the urea cycle. 4.0
7. Describe the disorders of the urea cycle (OTC deficiency, arginase deficiency). 2.0

C. Metabolism of Individual Amino Acids

1. Describe the metabolic significance of branched-chain amino acids in skeletal muscle. 3.0
2. Describe the common biochemical defect involved in Maple Syrup Urine disease. 2.0
3. Describe the significance of creatine and its metabolites. 3.0
4. Explain the relationship between hyperhomocysteinemia, vitamin B₁₂ deficiency and cardiovascular disease. 3.0
5. Identify glucogenic and ketogenic amino acids. 2.0
6. Explain the role of SAM, tetrahydrofolate (FH₄) and vitamin B₁₂ in one carbon metabolism. 4.0
7. Describe how vitamin B₁₂ deficiency results in "folate (methyl) trap." 3.0
8. Explain the cause and symptoms of Phenylketonuria (PKU). 4.0
9. Identify the amino acids that are precursors for the synthesis of dopamine, norepinephrine, acetylcholine, histamine, GABA, glutathione, and creatine. 3.0
10. Describe the major pathway of serine biosynthesis. 1.0
11. Describe the major pathway of glycine formation. 1.0
12. Explain the role of folic acid in glycine metabolism. 1.0
13. Describe the function of tetrahydrobiopterin and dihydrobiopterin reductase in the metabolism of aromatic amino acids. 2.0
14. Relate tryptophan and niacin. 1.0

D. Amino Acid Metabolism in Tissues

1. Describe the metabolic fates of amino acids released from muscle in the fasting state. 4.0
2. Describe the pathways of amino acid oxidation in muscle in the fasting state. 4.0
3. Describe the Alanine-Glucose cycle and explain its function. 4.0
4. Describe the role of the purine-nucleotide cycle in muscle. 2.0

XII. Nucleotide Metabolism

A. General Concepts

1. Differentiate between nucleoside, nucleotide, deoxynucleosides and deoxynucleotides. 3.0
2. Contrast the functions of ribonucleotides and deoxyribonucleotides. 3.0
3. Describe the importance of Pentose Phosphate Pathway (also called Hexose Monophosphate Shunt) for biosynthesis of nucleotides. 4.0
4. Describe the importance PRPP synthetase and its regulation in relationship to purine and pyrimidine nucleotide synthesis. 3.0
5. Identify structures of purines (adenine and guanine) and pyrimidines (cytosine, uracil, and thymine). 2.0

6. Explain the usage of purine and pyrimidine analogs in cancer treatment, viral infections, and gout. **1.0**

B. Metabolism of Purine Nucleotides

1. Outline the regulatory steps of *de novo* and salvage pathways of purine nucleotide synthesis. **3.0**
2. Describe the importance of folate in purine nucleotide biosynthesis. **3.0**
3. Describe salvage pathways of purine nucleotides. **4.0**
4. Explain the conversion of ribonucleotides into deoxyribonucleotides. **3.0**
5. Describe degradation of purine nucleotides. **4.0**
6. Relate hyperuricemia and gout disease. **4.0**
7. Compare the chemotherapies available for the management of gout. **3.0**
8. Describe Lesch-Nyhan syndrome. **3.0**
9. Explain severe combined immunodeficiency (SCID) due to adenosine deaminase deficiency. **2.0**
10. Explain the classification of certain sulfanomides (also called PABA analogs) as antibiotics. **1.0**
11. Explain positive and negative regulations of ribonucleotide reductase. **1.0**
12. Explain the effect of hydroxyurea on ribonucleotide reductase. **1.0**
13. Explain why deficiency of glucose-6-phosphatase may lead to gout. **1.0**

C. Metabolism of Pyrimidine Nucleotides

1. Describe the *de novo* synthesis pathway of pyrimidine. **3.0**
2. Identify and describe the key regulatory step of *de novo* synthesis pathway of pyrimidine. **3.0**
3. Explain the importance of carbamoyl phosphate synthetase II. **4.0**
4. Differentiate between carbamoyl phosphate synthetase II and carbamoyl phosphate synthetase I. **3.0**
5. Describe thymidylate synthase and the reaction it catalyzes. **4.0**
6. Explain the effect of folate deficiency on the activity of thymidylate synthase. **4.0**
7. Explain the use of 5-fluorouracil (5-FU) as an anti-cancer drug. **3.0**
8. Explain the use of methotrexate as an anti-cancer drug. **4.0**
9. Describe orotic aciduria and its treatment. **1.0**
10. Describe the conversion of UMP to CTP. **1.0**

XIII. Heme Metabolism

1. Describe the regulatory steps in heme synthesis. **4.0**
2. Describe heme catabolism. **3.0**
3. Describe the metabolism of bilirubin in the liver and in the gut. **3.0**
4. Distinguish between hemolytic, cholestatic and hepatocellular jaundice. **4.0**
5. Explain delta-aminolevulinic acid (ALA) synthase inhibition from hemin. **2.0**
6. Explain porphyrias. **2.0**
7. Relate photosensitivity to porphyrias. **2.0**
8. Explain the effect of lead poisoning on heme synthesis. **2.0**
9. Describe the formation of urobilinogen, urobilin, and stercobilin. **1.0**

XIV. Hemostasis and Blood Coagulation

1. Define:
 - a. hemostasis 4.0
 - b. coagulation 4.0
2. Describe the role of platelets in wound healing. 4.0
3. Describe the roles of the following factors in platelet activation and aggregation:
 - a. ADP 4.0
 - b. Platelet activating factor (PAF) 4.0
 - c. Prostacyclin (PGI₂) 4.0
 - d. Thrombin 4.0
 - e. Thromboxane A₂ (TXA₂) 4.0
4. Explain the anti-platelet effect aspirin in low dosages. 4.0
5. Describe the role of von Willebrand factor in coagulation. 4.0
6. Describe the following pathways of coagulation:
 - a. Tissue factor pathway (extrinsic) 4.0
 - b. Contact activation pathway (intrinsic) 4.0
 - c. Final common pathway 4.0
7. Explain the importance of vitamin K-dependent γ -carboxylation of certain glutamate residues of factors VII, IX, X, II and proteins C and S. 3.0
8. Explain the importance of vitamin K epoxide reductase (VKOR or VKORC). 3.0
9. Describe the action mechanisms of the following anticoagulants:
 - a. Antithrombin 4.0
 - b. Heparin 4.0
 - c. Tissue factor pathway inhibitor (TFPI) 4.0
 - d. Proteins C and S 4.0
10. Explain the anti-coagulation action of warfarin and related coumarins. 4.0
11. Define *fibrinolysis*. 4.0
12. Explain the action of plasmin. 4.0
13. Explain the roles of the following factors in fibrinolysis:
 - a. Tissue plasminogen activator (tPA) 4.0
 - b. Urokinase 4.0
 - c. Plasminogen 4.0
 - d. Plasminogen activator inhibitor (PAI) 4.0
 - e. α 2-antiplasmin and α 2-macroglobulin 2.0
 - f. Thrombin-activatable fibrinolysis inhibitor (TAFI) 2.0

XV. Diabetes Mellitus

1. Define diabetes mellitus. 4.0
2. Differentiate between type 1 and type 2 diabetes, including treatment of each. 4.0
3. Explain a glucose tolerance test. 4.0
4. Discuss metabolic syndromes of type I and type II diabetes. 4.0
5. Explain non-enzymatic glycation of proteins. 4.0
6. Explain the clinical significance of HbA_{1c} levels. 4.0
7. Describe the polyol pathway and its role in diabetic retinopathy and neuropathy. 4.0

8. Describe ketoacidotic, hyperosmolar, and hypoglycemic diabetic comas, including the treatments for each. 4.0
9. Explain insulin synthesis. 4.0
10. Explain the regulation of insulin secretion. 4.0
11. Explain the significance of the postprandial level of plasma C-peptide. 3.0
12. Contextualize insulin action within blood glucose regulation. 4.0
13. Identify the risk factors associated with type II diabetes. 3.0
14. Explain gestational diabetes. 2.0

XVI. Free Radicals and Antioxidants

1. Define *free radicals* and reactive oxygen species (ROS). 4.0
2. Define *antioxidant*. 4.0
3. Explain how mitochondrial metabolism leads to the generation of ROS. 4.0
4. Describe the synthesis of nitric oxide by nitric oxide synthase (NOS). 4.0
5. Define *oxidative stress*. 4.0
6. List the types of ROS-induced damages in the cell. 4.0
7. Describe the production of free radicals during ischemic reperfusion. 2.0
8. Describe the functions of superoxide dismutase, catalase, and glutathione peroxidase. 4.0
9. Characterize the biological importance of glutathione. 4.0
10. Describe glutathione reductase and its importance. 4.0
11. Relate hemolytic anemia to G6PD deficiency. 4.0
12. Explain the oxygen-dependent pathway of microbial killing in neutrophils. 4.0

XVII. Metabolism of Ethanol

1. Describe the enzymatic reaction for the following enzymes:
 - a. Alcohol dehydrogenase 3.0
 - b. Acetaldehyde dehydrogenase 3.0
 - c. CYP2E1 3.0
2. Contrast the actions of alcohol dehydrogenase versus CYP2E1 3.0
3. Describe the fates of acetaldehyde and acetate 2.0
4. Explain polymorphisms in the patterns of ethanol metabolism 1.0
5. Describe how ethanol metabolism can result in
 - a. Increased NADH/NAD⁺ ratio 4.0
 - b. Acetaldehyde toxicity (adduct formation) 2.0
 - c. Free radical formation 2.0
 - d. Fatty liver 3.0

XVIII. Nutrition

A. Metabolic Fuels and Dietary Components

1. Explain resting metabolic rate (RMR), body mass index (BMI), dietary reference intakes (DRI), and daily energy expenditure (DEE). 4.0
2. List the energy content (calories per gram) of carbohydrates, alcohol, fat, and protein. 4.0
3. Explain the glycemic index of foods. 4.0
4. Compare and contrast proteins from wheat, corn, rice and beans against animal proteins in terms of quality. 2.0

5. Explain the protein-sparing effect of carbohydrate.	3.0
6. Differentiate between Kwashiorkor and Marasmus.	3.0
7. Discuss methods used for nutritional assessment.	2.0
8. List the water and fat-soluble vitamins and the function of each.	4.0
9. Describe the symptoms of the following vitamin deficiencies:	
a. Vitamin B ₃ (niacin) deficiency and Pellagra	3.0
b. Vitamin B ₁ (thiamine) deficiency and Beri-Beri and Wernicke-Korsakoff syndromes	3.0
c. Vitamin C (ascorbic acid) deficiency and Scurvy	4.0
d. Vitamin D deficiency and Rickets and Osteomalacia	4.0
e. Vitamin A deficiency and night blindness and retardation of growth	4.0
f. Vitamin K deficiency and hemorrhage	4.0
g. Folic acid (vitamin B ₉) deficiency and megaloblastic anemia and birth defects	3.0
h. Vitamin B ₁₂ (cobalamin) deficiency and megaloblastic anemia and neuropathy	3.0
i. Vitamin B ₂ (riboflavin) deficiency and dermatitis	3.0
10. Describe the functions of the following minerals and the symptoms of associated deficiencies/toxicities:	
a. Iodine	2.0
b. Iron	4.0
c. Zinc	2.0
11. Identify and define the essential nutrients.	2.0
12. Define the tissues important for calcium metabolism.	2.0
13. Describe the trans organ events that lead to the activation of vitamin D.	3.0
14. Define the hormones (PTH, Vit D and calcitonin) and their effects on the various tissues in calcium and phosphorus maintenance.	3.0
B. <u>The Fed or Absorptive State</u>	
1. Define <i>fed/absorptive state</i> .	4.0
2. Describe the digestion and absorption of dietary carbohydrates, proteins, and fats.	4.0
3. Describe the changes in hormone levels after a meal.	4.0
4. Identify and compare glucose metabolism during the fed and fasting states in the following tissues:	
a. liver	4.0
b. brain and other neural tissues	4.0
c. red blood cells	4.0
d. muscle	4.0
e. adipose tissue	4.0
5. Describe the functions of lipoproteins in the fed state.	4.0
6. Describe metabolic fate of dietary amino acids in the fed state.	4.0
C. <u>Fasting and Starvation</u>	
1. Define <i>fasting state</i> .	4.0
2. Explain the metabolism of the liver during fasting.	4.0
3. Explain the metabolism of adipose tissue during fasting.	4.0
4. Explain the effects of prolonged fasting on the body.	4.0
5. Define <i>prolonged fasting/starvation</i> .	4.0
6. Describe the metabolic changes in various tissues during prolonged fasting.	4.0

XVIII. Integration of Metabolism

1. Identify the major metabolic pathways operating in the liver, brain, red blood cell, heart and skeletal muscle, adipose tissue, and the metabolic fuels used by them. **4.0**
2. Analyze the necessity of organs to work together to ensure availability of fuels in the bloodstream. **4.0**
3. Describe how insulin, glucagon, and epinephrine regulate metabolic pathways via the regulation of key enzymes in various tissues. **4.0**
4. Describe the alterations in metabolism that occur in the obese state and the biochemical signals regulating obesity. **4.0**
5. Explain the metabolic changes that occur during acute and chronic ethanol consumption. **3.0**

COMPOSITE HISTOLOGY LEARNING OBJECTIVES

Tissue Preparation and Microscopy

The Cell

Tissue and Basic Tissue Types

Epithelium and Glands

Connective Tissues

Muscle Tissue

Nervous Tissue

Circulatory System

Lymphatic System

Integument

Endocrine System

Respiratory System

Urinary System

Digestive System

Male Reproductive System

Female Reproductive System

I. TISSUE PREPARATION AND MICROSCOPY

1. Describe tissue preparation for microscopy. **1.0**
2. Compare the appearance of cells in light microscopy (LM), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). **1.0**
3. Recognize basic staining and patterns, including immunohistochemical markers. **2.0**

II. THE CELL (EUKARYOTE)

1. Describe the phospholipid bilayer structure of the cell membrane, its permeability properties, and the roles of its associated membrane proteins (receptors, channels, and glycocalyx). **4.0**
2. Describe the cell membrane and define membrane trafficking including endocytoses and exocytosis. **3.0**
3. Identify (EM, LM) the cytoplasmic organelles and describe their basic structures and functions including the ribosomes, polysomes, smooth ER, rough ER, lysosomes, mitochondria, Golgi Complex, peroxisomes, and proteasomes. **3.0**
4. Define and describe the cytoskeletal elements including microtubules and motor proteins (kinesin and dynein), microfilaments, intermediate filaments and thick filaments (myosin). **4.0**
5. Differentiate between the inclusions and organelles. **1.0**
6. Identify (LM, EM) the cell's nucleus, its membrane structure and specializations as well as associated fibers and organelles. **3.0**
7. Identify (LM, EM) and define euchromatin and heterochromatin, Barr body. **3.0**
8. Identify (LM, EM) and describe the structure and function of the nucleolus. **3.0**
9. Define and describe the stages of mitosis, meiosis and the cell cycle and identify mitotic figures. **2.0**
10. Describe necrosis and apoptosis. **4.0**

III. TISSUE AND BASIC TISSUE TYPES

1. Define *tissue*. **4.0**
2. Describe the characteristics of each of the primary histological tissue types and discuss their function. **4.0**

IV. EPITHELIUM AND GLANDS

1. Define *epithelium* and describe its functions. **4.0**
2. Describe the major features that must be present to classify epithelial tissue (free surface, basement membrane, polarity, avascular). **4.0**
3. Describe the classification of different types of epithelium and be able to identify each microscopically (LM) on the basis of number of cell layers and surface cell type. **4.0**
4. Identify (LM, EM) and discuss the structures and function of the surface specializations of the cell (cilia, microvilli, stereocilia, infoldings, brush border). **4.0**
5. Describe the basic structure and functions of the basement membrane. **4.0**
6. List where each type of epithelium is found in the body. **3.0**
7. Describe and identify (LM,EM) apical, lateral and basal domains including junctional complexes (tight, adhering and gap). **3.0**
8. Describe the origin of glands from epithelial tissue and distinguish between mucous and serous secreting glands. **3.0**

V. CONNECTIVE TISSUE PROPER

1. Identify (LM) and classify the major types of adult connective tissue and its components. 4.0
2. Describe the components and list the main components of the extracellular matrix, (glycosaminoglycans, proteoglycans, fibronectin, laminin and multi-adhesive proteins). 3.0
3. Describe how extracellular matrix is remodeled; know the significance of remodeling and the role of matrix metalloproteases (MMPs) in remodeling. Be able to name the three most common MMPs. 2.0
4. Identify collagen, elastic and reticular fibers (LM,EM). 3.0
5. Classify the major isoforms of collagen, with a focus on types I – IV; recognize how they differ in structure and function and where they are found in the body. 4.0
6. Distinguish between embryonic and adult connective tissues. 1.0
7. Identify cells in connective tissue (LM): fibroblasts, mast cells, plasma cells, macrophages neutrophils, eosinophils, basophils, lymphocytes, adipocytes. 4.0
8. Describe the function of the main cells in connective tissue 4.0
9. Classify cells in connective tissue as resident (fixed) or transient (wandering). 2.0
12. Describe the histological basis of connective tissue disorders including Ehlers Danlos and Marfan's syndromes. 2.0

VI. SPECIALIZED CONNECTIVE TISSUE

A. CARTILAGE

1. Describe the structure of the different types of cartilage. 4.0
2. List where each type of cartilage is found in the body. 4.0
3. Identify (LM) hyaline, elastic and fibrocartilage. 3.0
4. Identify (LM,EM) and describe the structure and function of the chondroblast and the Chondrocyte. 3.0
5. Describe the structure and function of the perichondrium and distinguish between the cellular and fibrous layers. 4.0
6. Describe and distinguish between interstitial and appositional growth of cartilage. 3.0
7. Describe and list the transcriptional factors that regulate chondroblast commitment and differentiation. 1.0

B. BONE

1. Describe the morphological appearance and structure of mature (lamellar) and immature (woven) bone and the function of each. 4.0
2. Distinguish between compact and spongy bone. 4.0
3. Identify (LM) mature vs. woven and compact vs. lamellar bone. 4.0
4. Identify (LM) the cells found in bone (osteoblasts, osteocytes, osteoclasts) and describe the morphological appearance and function of each. 4.0
5. Describe the matrix of bone and know its role in calcium homeostasis. 4.0
6. Describe intramembranous ossification and endochondral bone formation and where each occurs. 3.0
7. Describe the processes involved in fracture repair. 4.0
8. Describe the roles of Vitamins C and D in bone formation. 3.0
9. Know the roles of parathyroid hormone and calcitonin in calcium metabolism. 3.0
10. Describe the roles of thyroid hormone, growth hormone and estrogen in maintenance of normal bone tissue and consequences resulting from abnormal levels of these hormones. 2.0

C. BLOOD

1. Distinguish between plasma and serum. **4.0**
2. Define hematocrit. **4.0**
3. Describe the morphological structure of the erythrocyte and recognize the basis for red cell transport of blood gases. **3.0**
4. Identify (LM) red blood cells in a blood smear. **3.0**
5. Describe the functions of the proteins ankyrin and spectrin in maintaining morphology of the red blood cell. **2.0**
6. Describe the morphological foundations for sickle cell. **2.0**
7. Describe the components of the “buffy coat”. **3.0**
8. Identify (LM) white blood cells in a blood smear. **4.0**
9. Describe the functions of each white blood cell in peripheral blood. **4.0**
10. Describe the fate of peripheral blood monocytes and lymphocytes in connective tissue and the function of each. **3.0**
11. Recognize (LM) the appearance of leukemia in bone marrow and blood smears. **2.0**
12. Identify (LM) and describe platelets in peripheral blood smear and describe their role in clot formation. **4.0**

D. HEMATOPOIESIS

1. Describe “pluripotent” stem cell in terms of origin and function. **3.0**
2. Describe bone marrow in terms of blood precursor cells and know where red and yellow bone marrow are found in the adult. **3.0**
3. Name the stages of development of each blood cell type and be able to identify the major features that characterize each stage. **2.0**
4. Describe megakaryocytes and how platelets are formed **3.0**
5. List growth factors regulating hematopoiesis (erythropoietin, thrombopoietin, GM-CSF). **2.0**

VII. MUSCLE TISSUE

1. Identify (LM & EM) the three muscle types in both cross section and longitudinal section **4.0**
2. Identify (EM) and describe myofibrils, sarcomeres, and myofilaments of striated muscle. **3.0**
3. Identify (EM and LM) the thick and thin filaments, A and I bands, H-zone and Z discs. **3.0**
4. Describe the organization of T-tubules and sarcoplasmic reticulum and their roles in excitation contraction coupling. **2.0**
5. Describe the structure and function of gap junctions in cardiac and smooth muscle, and of intercalated discs in cardiac muscle. **3.0**
6. Identify (LM and EM) intercalated discs. **3.0**
7. Describe the organization of muscle fibers into a tissue, including the location of epimysium, perimysium and endomysium. **3.0**
8. Describe the basic morphology, location and function of a neuromuscular junction (motor end plate) in skeletal muscle. **4.0**
9. Describe the basic morphology, location and function of a muscle spindle and a Golgi tendon organ. **3.0**
11. Describe the role of the dystrophin molecules in anchoring myofibrils to the sarcolemma. **3.0**
12. Distinguish between the regenerative potentials of cardiac, smooth and skeletal muscle. **4.0**

VIII. NERVOUS TISSUE

1. Distinguish multipolar, pseudo-unipolar and bipolar neurons **3.0**
2. Describe the structure of the axon including the terminal bouton. **4.0**
3. Distinguish between the central and peripheral nervous systems. **4.0**
4. Identify (LM) components of ganglia, including satellite cells and ganglion cells. **4.0**
5. Identify (LM & EM) the individual components of neuron soma, dendrites, and axons. **4.0**
6. Describe and identify (EM) the pre and post synaptic elements of the chemical synapse. **4.0**
7. Identify (LM) gray matter (cells) and white matter (fibers) in the spinal cord. **3.0**
8. Describe the functions of astrocytes, microglial cells and ependymal cells. **4.0**
9. Describe the location of pre-ganglionic neurons of the sympathetic and parasympathetic nervous system. **3.0**
10. Describe the organization of a peripheral nerve including epineurium, perineurium, and endoneurium. **3.0**
11. Describe the process of myelin formation in the peripheral and central nervous systems, including the function of the Schwann cell and oligodendrocyte in each. **3.0**
12. Describe the Nodes of Ranvier and saltatory conduction. **3.0**
13. Describe the elements of the blood brain and blood nerve barriers. **3.0**

IX. CIRCULATORY SYSTEM

1. Describe the three general basic layers (tunics) common to all structures of the cardiovascular system (heart, arteries and veins). **4.0**
2. Identify (LM) and compare the three layers of the heart: epicardium, myocardium, endocardium. **3.0**
3. Identify (LM) Purkinje fibers and describe their function in the conduction system of the heart. **3.0**
4. Identify (LM) elastic arteries, muscular arteries, small arteries, and arterioles. **3.0**
5. Identify (LM) large veins, medium veins, small veins and venules. **3.0**
6. Describe the different types of capillaries, and correlate structure with function. **3.0**
7. Identify capillaries (LM and EM) and distinguish the three types of capillaries (EM) ; correlate structure with function. **3.0**
8. Describe the function(s) of the endothelial cells in the circulatory system. **2.0**
9. Identify (LM) lymphatic capillaries and vessels. **2.0**

X. LYMPHATIC SYSTEM

1. Describe the different mechanisms the body uses to fight off pathogens. **2.0**
2. Distinguish between innate and adaptive immune responses based on the cell types present in the tissue. **3.0**
3. Compare and contrast the roles different cell types that are involved in innate and adaptive immune responses. **2.0**
4. Distinguish primary and secondary lymphatic organs. **3.0**
5. Describe the organizations of each lymphoid organ, the various types of diffuse and aggregated lymphatic tissue, the regions rich in B & T lymphocytes, and explain the cellular processes relevant to immune functions that are taking place in these regions for each organ. **3.0**

6. Describe the organization of primary and secondary lymphatic nodules, and germinal centers. **3.0**
7. Identify (LM) mucosa associated lymphoid tissue (MALT) including lymphocyte aggregates and nodules. **3.0**
8. Identify the tonsils (LM) including primary and secondary lymphatic nodules, germinal centers, crypts and epithelium. **3.0**
9. Identify lymph nodes (LM) including the capsule, subcapsular space, cortex, paracortex, medulla, medullary sinus, and medullary cords. **3.0**
10. Describe the recirculation of lymphocytes. **3.0**
11. Identify the thymus (LM) including the capsule, cortex and medulla, thymocytes, Hassell's corpuscles, and epithelial reticular cells. **3.0**
12. Identify the spleen (LM) including the capsule, red pulp, white pulp, periarteriolar lymphatic sheaths, and nodules and describe its organization including vasculature. **3.0**
13. Identify structures (LM) within the white pulp, periarteriolar lymphatic sheaths and splenic nodules) and explain the cellular processes relevant to immune functions that are taking place in these regions. **3.0**

XI. INTEGUMENT

1. Identify (LM) the layers of the epidermis of thick and thin skin. **4.0**
2. Compare characteristic features of thick and thin skin. **4.0**
3. Distinguish between the roles of keratin, keratohyaline granules and melanin granules in epidermis. **4.0**
4. Describe the maturation of keratinocytes as they migrate through each epidermal layer. **4.0**
5. Describe the structure, location and function of cells within each layer of the epidermis including Langerhans cells, Merkel cells and melanocytes. **4.0**
6. Identify (LM) the layers of the dermis and hypodermis and distinguish them with respect to structure and function. **4.0**
7. Describe the basic structure and function of the nail. **4.0**
8. Identify (LM) the nail matrix, nail plate, nail bed, hyponychium, eponychium and cuticle. **4.0**
9. Identify (LM) eccrine and apocrine sweat glands. **2.0**
10. Identify (LM) hair follicles, hair shaft, arrector pili muscles and sebaceous glands. **3.0**
11. Describe the mechanism of secretion of sebaceous and sweat glands. **2.0**
12. Identify (LM) Paccinian and Meissner's corpuscles and describe the function of each. **3.0**
13. Describe the vascular supply of the skin. **2.0**

XII. ENDOCRINE SYSTEM

1. Describe the organization of the pituitary into anterior and posterior pituitary. **3.0**
2. List the endocrine secretory cells of the anterior pituitary, the hormones secreted by each, and their classification as acidophils or basophils. **3.0**
3. Describe the function of pituicytes and Herring bodies of the posterior pituitary. **3.0**
4. Identify (LM) the anterior and posterior pituitary, acidophils, basophils, chromophobes, sinusoids, pituicytes and Herring bodies. **3.0**
5. List the endocrine secretory cells of the thyroid gland, the hormones secreted by each, and briefly describe the role of thyroglobulin in the synthesis and subsequent release of thyroid hormone by follicular cells. **3.0**
6. Identify (LM) the thyroid gland, follicular and parafollicular cells and colloid in light microscopy. **3.0**

7. Identify (LM) the parathyroid gland and describe the function of chief cells and oxyphil cells. **3.0**
8. Distinguish between the zona glomerulosa, zona fasciculata and zona reticularis of the adrenal cortex based on their cellular and vascular organization, and list the major endocrine secretions for each zone. **4.0**
9. Identify (LM) the adrenal cortex, the zona glomerulosa, zona fasciculata, zona reticularis and sinusoids. **4.0**
10. Identify the adrenal medulla (LM) and chromaffin cells and describe their function/secretion. **4.0**
11. List the endocrine secretory cells of the islets of Langerhans (alpha, beta & delta) and give the secretory product of each. **4.0**
12. Identify (LM) the pancreatic islets of Langerhans. **4.0**

XIII. RESPIRATORY SYSTEM

1. Identify olfactory and respiratory epithelium and describe their function in conditioning inhaled air. **2.0**
2. Identify (LM) laryngeal structures, vocal cords and vocalis muscle. **1.0**
3. Identify (LM) the trachea and bronchi including epithelium, submucosa, arrangement of cartilage and smooth muscle. **3.0**
4. Describe the histological differences between bronchi and bronchioles. **2.0**
5. Identify (LM) bronchioles and respiratory bronchioles. **3.0**
6. Identify (LM) and describe the structural organization of the alveolar duct, alveolar sac and alveoli. **3.0**
7. List the components of the air-blood barrier. **3.0**
8. Identify (LM) and describe structure and function of Club cells, Type 1 and Type 2 alveolar cells (pneumocytes), endothelial cells, and dust cells. **3.0**
9. Describe and compare the pulmonary and bronchial circulations. **3.0**
10. Describe the lymphatic drainage of the lung. **3.0**

XIV. URINARY SYSTEM

1. Describe and identify the kidney (LM) including the capsule, cortex, medulla, renal columns, major and minor calyces, renal pyramids and renal pelvis. **3.0**
2. Identify (LM) the circulatory system of the kidney including the interlobular and arcuate vessels, afferent and efferent arterioles, the glomerulus, and peritubular and vasa recta capillary networks; and describe the portal system. **4.0**
3. Identify (LM) the structures of the renal corpuscle including: Bowman's capsule, Bowman's space, the parietal layer, urinary and vascular poles, and the associated macula densa. **4.0**
4. Identify (SEM) the components of the glomerular filtration barrier, podocytes, basement membrane and endothelial cells and describe their functions. **3.0**
5. Identify (LM) and describe the specific regions of the renal tubules: proximal and distal convoluted tubules, thick and thin segments of the Loop of Henle and collecting ducts. **4.0**
6. Describe the structures and functions of the components of the juxtaglomerular (JG) apparatus (JG cells and macula densa). **3.0**
7. Identify (LM) the ureter and urinary bladder including the mucosal epithelial lining. **3.0**
8. Distinguish between the structures of the female and male urethrae. **2.0**

XV. DIGESTIVE SYSTEM

A. Alimentary Canal

1. Describe the histological structure of the oral cavity, salivary glands, lips, tongue, (papillae, taste buds) and oropharynx. **2.0**
2. Identify (LM) and describe the histological structures of the four basic layers of the alimentary canal: mucosa, submucosa, muscularis externa and serosa or adventitia from the esophagus to the anal canal including the enteric nervous system. **3.0**
3. Identify (LM) the esophagus including the esophageal glands and the location of skeletal and smooth muscle in the esophagus. **3.0**
4. Distinguish among the three classes of mucosal glands of the stomach by location, cell population and secretory products, including mucus, chief, parietal and enteroendocrine cells. **4.0**
5. Identify (LM) the stomach, fundic glands and mucus, chief, parietal and enteroendocrine cells.
6. Identify (LM) the small intestine and identify (LM) and describe the location and function of the cells within the small intestine: enterocytes, goblet cells, Paneth cells and enteroendocrine cells. **3.0**
7. Identify (LM) and describe the three regions of the small intestine including villi, central lacteals, crypts of Lieberkuhn, Brunner's glands, Peyer's patches and plicae circularis. **3.0**
8. List three structures of the small intestine that increase its absorptive surface area. **3.0**
9. Identify (LM) and describe the function of the large intestine. **3.0**

B. Digestive Glands

1. Distinguish between the structure of the salivary glands and the exocrine pancreas.
2. Identify (LM) parotid, sublingual, and submandibular salivary glands, mucous and serous acini and tubules, serous demilunes, and striated ducts. **2.0**
3. Identify the pancreas (LM), acini, ducts, centro acinar cells, and Islets of Langerhans. **3.0**
4. Identify (LM) the liver and describe the function of the classic lobule, portal triads, hepatic plates, sinusoids, Space of Disse, bile canaliculi and central veins. **3.0**
5. Distinguish the functional significance of a classic liver lobule, a portal liver lobule and an hepatic acinus. **3.0**
6. Identify the liver (LM) and identify (LM) and describe the function of endothelial cells, hepatocytes, Kupffer cells and Ito (stellate) cells. **3.0**
7. Trace the paths of bile and blood through a classic liver lobule. **3.0**
8. Identify (LM) and describe the function of the gall bladder. **2.0**
9. Describe the histological structure of the gastrointestinal-associated glands, including the liver, gall bladder, and exocrine pancreas. **3.0**

XVI. MALE REPRODUCTIVE SYSTEM

1. Describe the general structure and function of the testis. **3.0**
2. Describe the structure and histological appearance of the cells of the seminiferous tubules and peritubular tissue. **2.0**
3. Describe the stages of spermatogenesis and spermeiogenesis. **2.0**

- | | |
|---|------------|
| 4. Describe the histological structure and function of the excurrent duct system and associated glands. | 2.0 |
| 5. Identify (LM) and describe the function of Sertoli and Leydig cells. | 3.0 |
| 6. Describe the histological structure and function of the excurrent duct system. | 2.0 |
| 7. Identify (LM) the prostate gland and seminal vesicles. | 3.0 |

XVI. FEMALE REPRODUCTIVE SYSTEM

- | | |
|--|------------|
| 1. Describe and identify (LM) the ovary | 2.0 |
| 2. Describe the histological appearance of the cells of the ovarian follicles and the corpus luteum. | 2.0 |
| 3. Explain oogenesis and follicular development. | 2.0 |
| 4. Identify (LM) and describe the structure and function of granulosa, theca and luteal cells. | 2.0 |
| 5. Describe the histological structure and function of the uterine tube, uterus, vagina. | 2.0 |
| 6. Describe the histological appearance and physiological changes of the endometrium over the course of one menstrual cycle. | 3.0 |
| 7. Distinguish the histological features of lactating from non-lactating breast tissue. | 2.0 |

EMBRYOLOGY LEARNING OBJECTIVES

Fertilization, Implantation, and Early Development

Development of the Gastrointestinal System

Development of the Respiratory System

Development of the Cardiovascular System

Development of the Urogenital System

Development of the Pharyngeal Apparatus and the Head and Neck

Development of the Nervous System

Development of the Musculoskeletal System

Development of the Limbs

Development of the Integumentary System

I. Fertilization, Implantation, and Early Development

1. Define:
 - a. *blastomere* 3.0
 - b. *morula* 3.0
2. Describe the process of fertilization. 2.0
3. Explain the process of cleavage of the zygote. 2.0
4. Discuss the formation of the blastocyst, including components and the products of their formation. 3.0
5. Describe the process of implantation, including the formation of the bilaminar disc. 3.0
6. Describe the process of chorionic villi formation. 2.0
7. Describe the process of gastrulation and the formation of the germ layers. 3.0
8. Identify germ layers and their derivatives. 3.0
9. Discuss the reorganization of the intraembryonic mesoderm. 3.0
10. Describe the processes and significance of notochordal development. 3.0
11. Describe the process of embryonic folding and the formation of the intraembryonic coelom. 3.0
12. Explain the critical nature of the fourth through eighth weeks of human development. 3.0
13. Compare and contrast the major features of the embryonic and fetal periods of development. 2.0

II. Development of the Gastrointestinal System

1. List the derivatives and major developmental events, including common anomalies, of the foregut, the midgut, and the hindgut. 3.0
2. Discuss the rotations, malrotations, and repositioning of the embryonic gut and gut-derivative organs. 3.0
3. Describe the process and anomalies of recanalization of the gut tube. 2.0

III. Development of the Respiratory System

1. Describe the development of the respiratory system, including stages of lung development. 2.0
2. Describe the formation of the diaphragm, including development of congenital diaphragmatic hernia (CDH). 2.0
3. Describe the embryogenesis of tracheoesophageal atresias, stenoses, and fistulas. 2.0

IV. Development of the Cardiovascular System

1. Describe the development of the primitive cardiovascular system and blood cells. 3.0
2. Describe the formation of the embryonic heart tube. 3.0
3. Describe the development of the fetal heart from the embryonic heart tube. 3.0
4. Explain septation of the atria and ventricles, and discuss commonly associated defects. 3.0
5. Describe the development and derivatives of the aortic arches. 2.0
6. Discuss changes in the cardiovascular system following birth. 2.0

V. Development of the Urogenital System

1. Describe the formation and derivatives of the pronephros, mesonephros, and metanephros. **3.0**
2. Discuss the development of the kidneys and ureters, including repositioning and anomalies. **2.0**
3. Describe the development of the urinary bladder and urethra. **2.0**
4. Describe the development, including anomalies, of the male and female gonads, ducts, and external genitalia. **2.0**

VI. Development of the Pharyngeal Apparatus and the Head and Neck

1. Describe the development and derivatives of the pharyngeal (brachial) apparatus and common anomalies. **2.0**
2. Describe the development, including common anomalies, of the face, palate, and nasal cavities. **2.0**
3. Discuss the development of the eye and ear. **1.0**

VII. Development of the Nervous System

1. Explain the process of neurulation and neural crest formation, including neural tube defects. **4.0**
2. List the derivatives of the neural crest. **3.0**
3. Describe cell differentiation within the neural tube. **3.0**
4. Describe the development, including anomalies, of the brain vesicles and their derivatives. **3.0**
5. Describe the development, including anomalies, of the spinal cord. **4.0**
6. Discuss the formation of the peripheral nervous system and cranial nerves. **4.0**

VIII. Development of the Musculoskeletal System

1. Discuss the three groups of cells derived from somites, including their migration and the structures derived from each group. **3.0**
2. Identify the role of somatic mesoderm in muscular system development. **4.0**
3. Describe the development and derivatives of hypaxial and epaxial musculature. **3.0**
4. Describe the role of intramembranous and endochondral ossification in development of the axial and appendicular skeletal systems, including common anomalies. **4.0**

IX. Development of the Limbs

1. Describe the role of the apical ectodermal ridge (AER) in lower limb development. **4.0**
2. Describe and compare hand and foot plates, and digital rays in upper and lower limb development. **4.0**
3. Discuss the importance of limb axes and limb rotation. **4.0**
4. Discuss the importance of myotome and dermatome formation in limb development. **3.0**
5. Describe the development of the nerve distribution of the limbs. **4.0**
6. Describe the anomalies in limb development (eg, amelia and meromelia, cleft foot/hand, talipes equinovarus, polydactyly, and syndactyly). **4.0**

X. Development of the Integumentary System

1. Describe the development of epidermis and dermis. **3.0**
2. Describe the development of skin appendages (eg, hair, nails, sebaceous glands and sweat glands). **3.0**
3. Explain the basis of dermatome distribution of sensory nerves. **4.0**

GENERAL ANATOMY LEARNING OBJECTIVES

Basic Anatomy of the Back

Clinical Anatomy of the Back

Basic Anatomy of the Upper Limb

Clinical Anatomy of the Upper Limb

Basic Anatomy of Pelvis and Perineum

Clinical Anatomy of Pelvis and Perineum

Basic Anatomy of Thorax

Clinical Anatomy of Thorax

Basic Anatomy of Abdomen

Clinical Anatomy of Abdomen

Basic Anatomy of Head and Neck

Clinical Anatomy of Head and Neck

I. Basic Anatomy of the Back

1. Identify the major surface features and anatomical landmarks of the back. 4.0
2. List the functions of the vertebral column. 4.0
3. Differentiate between the primary and secondary curvatures of the spine. 3.0
4. Describe the osteological features of vertebrae. 4.0
5. Describe the osteological features of the atlas and axis. 3.0
6. Describe the osteological features of the sacrum and coccyx 4.0
7. Explain the structure and function of an intervertebral disc. 4.0
8. Describe the attachments and locations of the ligaments of the vertebral column. 4.0
9. Describe the intervertebral joints. 4.0
10. Explain the structure and function of the facet (zygapophyseal) joints and compare them in the cervical, thoracic, and lumbar regions. 3.0
11. Describe the boundaries of the intervertebral foramen and its contents. 4.0
12. Describe the atlanto-occipital and atlanto-axial joints with emphasis on their movements. 3.0
13. Describe the features of the vertebral column that control its mobility. 4.0
14. Contrast the movements found in the cervical, thoracic, and lumbar regions of the spine. 3.0
15. Describe the fascia of the back, including the thoracolumbar fascia. 2.0
16. Define dermatome and myotome. 4.0
17. Describe the cutaneous innervation of the back. 4.0
18. Differentiate between the extrinsic and intrinsic back muscles. 4.0
19. Describe the intrinsic muscles of the back in terms of their innervations and major actions. 3.0
20. Describe the origins and insertions of the intrinsic back muscles. 2.0
21. Describe the osteological features and boundaries of the suboccipital triangle and its contents. 2.0
22. Describe the origin, course, and termination of the vertebral artery. 3.0
23. Differentiate between the CNS and PNS. 4.0
24. Describe the relationship between the vertebral levels and spinal cord levels in the adult and child. 4.0
25. Describe the major features of the spinal cord and meninges. 4.0
26. Diagram a transverse section through the vertebral canal demonstrating the meninges and the meningeal spaces. 4.0
27. Draw the structure of a typical spinal nerve. 4.0
28. Identify the spinal nerves in relation to the adjacent vertebrae above and below. 4.0
29. Describe the vascular supply and venous and lymphatic drainage of the back, vertebral column, and spinal cord. 3.0

II. Clinical Anatomy of the Back

1. Identify the osteological features of the back as demonstrated on diagnostic imaging. 4.0
2. Identify soft-tissue structures of the back on sagittal and transverse CTs and MRIs. 3.0
3. Define *pars interarticularis* and identify the features of the "Scotty dog" as seen on oblique radiographs of the lumbar spine. 4.0

4. Explain lumbarization and sacralization. 4.0
5. Integrate basic anatomy with the following clinical correlates: 4.0
 - a. low back pain 4.0
 - b. spina bifida 4.0
 - c. laminectomy 4.0
 - d. lumbar puncture 4.0
 - e. herniated nucleus pulposus 4.0
 - f. scoliosis 4.0
 - g. kyphosis 4.0
 - h. lordosis 4.0
 - i. spondylosis 4.0
 - j. spondylolysis 4.0
 - k. spondylolisthesis 4.0
 - l. spinal stenosis 4.0
6. Rationalize the choice of sites for lumbar puncture, rhizotomy and epidural anesthesia. 4.0
7. List, in order, the structures and spaces pierced in a lumbar puncture and epidural anesthesia. 4.0
8. Describe the venous anastomoses and lymphatic drainage associated with the back and the vertebral column and discuss their clinical significance. 4.0

III. Basic Anatomy of the Upper Limb

1. For each region, or compartments, of the upper limb describe structural relationships within the context of sectional anatomy. 4.0
2. Identify the surface anatomy and palpable bony landmarks of the upper extremity. 4.0
3. Describe the innervation of the upper extremity in terms of dermatomes and cutaneous domains. 4.0
4. Describe the superficial and deep venous drainage of the upper extremity. 4.0
5. Describe the superficial and deep lymphatic drainage of the upper extremity. 4.0
6. Describe the structure and function of the joints of the upper extremity including associated bursae. 4.0
7. Describe the superficial and deep fascia of the upper extremity in terms of myofascial compartments and their contents. 4.0
8. Describe the arterial anastomoses occurring at the shoulder, elbow, wrist and hand. 4.0
9. Describe the osteological features of the scapula, humerus, and clavicle. 4.0
10. Describe the extrinsic (superficial) muscles of the back in terms of their origins, insertions, innervations, and major actions. 4.0
11. Describe the muscles of the pectoral region in terms of origins, insertions, actions, innervations, and blood supply. 4.0
12. Describe the muscles of the anterior and posterior compartments of the arm in terms of origins, insertions, actions, innervations, and blood supply. 4.0
13. Describe the structure and function of the rotator cuff. 4.0
14. Describe the boundaries and contents of the axilla. 4.0
15. Describe the axillary artery and its branches. 4.0
16. Describe the brachial artery and its branches. 4.0
17. Describe the axillary lymph nodes. 4.0
18. Describe the brachial plexus, including roots, trunks, divisions, cords, and branches. 4.0

19. Describe the boundaries and contents of the quadrangular space, triangular space, and triangular interval. 4.0
20. Describe the osteological features of the ulna and radius. 4.0
21. Describe the osteological features of the carpal, metacarpal and phalangeal bones. 4.0
22. Describe the structure and function of the interosseous membrane. 4.0
23. Describe the structure and function of the flexor and extensor retinacula. 4.0
24. Describe the structure and function of synovial tendon sheaths. 4.0
25. Describe the muscles of the anterior and posterior compartments of the forearm in terms of origins, insertions, actions, innervations, and blood supply. 4.0
26. Describe the boundaries and contents of the cubital fossa. 4.0
27. Describe the branches of the radial and ulnar arteries in the forearm. 4.0
28. Describe the boundaries and contents the anatomical snuffbox. 4.0
29. Describe the structure of the carpal tunnel and its contents. 4.0
30. Describe the intrinsic muscles of the hand in terms of origins, insertions, actions, innervations, and blood supply. 4.0
31. Explain the structure and function of the extensor expansions (aponeuroses). 4.0
32. Describe the branches of the radial and ulnar arteries at the wrist and in the hand. 4.0

IV. Clinical Anatomy of the Upper Limb

1. Identify the osteological features of the upper extremity as demonstrated on diagnostic imaging. 4.0
2. Identify soft tissue structures of the shoulder, arm, elbow, forearm, wrist, and hand on CT and MRI images. 3.0
3. Explain winging of the scapula. 4.0
4. Compare and contrast a separated shoulder and a dislocated shoulder and resulting symptoms and complications. 4.0
5. Describe the clinical significance of rotator cuff injuries. 4.0
6. Explain “nurse maid’s elbow” (dislocation of proximal radioulnar joint). 3.0
7. Define *Colles’ fractures*. 3.0
8. Explain the clinical significance of scaphoid fractures, including radiographic diagnosis. 4.0
9. Explain the clinical significance of lunate dislocation. 3.0
10. Explain Dupuytren’s contracture and its clinical significance. 2.0
11. Describe DeQuervain’s tenosynovitis. 3.0
12. Explain the mechanism of “trigger finger” (stenosing tenosynovitis). 3.0
13. Explain ganglion cyst formation. 3.0
14. Describe the functional deficits resulting from the most common brachial plexus injuries. 4.0
15. Describe the anatomical basis for wrist drop. 3.0
16. Diagnose probable lesion sites of the brachial plexus from motor and sensory deficits. 4.0
17. Explain cubital tunnel syndrome and its clinical significance. 3.0
18. Explain carpal tunnel syndrome and its clinical significance. 4.0
19. Identify sites where pulses are taken in the upper extremity. 4.0
20. Describe the clinical importance of the arterial anastomoses of the shoulder, elbow, and hand. 3.0
21. Identify common sites used for venipuncture. 4.0
22. Describe the clinical significance of lymphadenopathy. 4.0
23. Describe common routes for the spread of infection from the hand to the forearm 3.0

V. Basic Anatomy of Pelvis and Perineum

1. Describe the skeletal and ligamentous components of the pelvis, pelvic inlet, and pelvic outlet. **4.0**
2. Compare and contrast the male and the female pelvis (as related to mechanical differences and changes occurring during pregnancy). **3.0**
3. Explain the structure and function of the lumbosacral and sacroiliac joints and pubic symphysis. **4.0**
4. Describe the openings that permit passage of structures to and from the pelvis, perineum, and lower extremity and identify the structures that pass through them. **4.0**
5. Describe the anatomical walls and floor of the pelvic cavity. **3.0**
6. Describe the pelvic muscles (pelvic diaphragm) in terms of their origins, insertions, actions, innervations, and blood supply. **3.0**
7. Describe the pelvic (fascial) ligaments and the structures that they support and transmit. **2.0**
8. Describe the inferior boundaries of the peritoneum and peritoneal cavity/pouches within the male and in the female pelvis. **3.0**
9. Describe the organization and relationships of the pelvic viscera in sagittal, frontal, and transverse sections of the male and the female pelvis. **3.0**
10. Relate internal pelvic viscera to its continuity into the perineum. **3.0**
11. Describe the internal iliac artery and its branches. **4.0**
12. Describe the venous drainage of the pelvis and perineum. **3.0**
13. Describe the lymphatic drainage from the pelvis and perineum. **3.0**
14. Describe the sacral plexus and its branches. **4.0**
15. Describe the somatic and autonomic innervations of the pelvis and perineum and as pertains to sexual response and continence. **3.0**
16. Identify the boundaries of the perineum. **2.0**
17. Identify the boundaries and contents of the urogenital and anal triangles. **2.0**
18. Describe the pudendal nerve and its branches. **3.0**
19. Describe the internal pudendal artery and its branches. **3.0**
20. Describe the blood supply, lymphatic drainage, and innervation of the sigmoid colon and rectum with respect to embryonic origin. **2.0**
21. Compare and contrast the anal canal above the pectinate line and below the pectinate line in terms of arterial supply, venous drainage, and innervation. **3.0**
22. Compare and contrast the internal and external anal sphincters in terms of location, structure, and innervation. **3.0**
23. Describe the course, constrictions, and relationships of the ureters in the pelvis. **3.0**
24. Explain the structure and function of the urinary bladder. **3.0**
25. Describe the anatomy of the urethra in male and in female. **2.0**
26. Compare and contrast the external urethral sphincter in the male and female. **2.0**
27. Describe the testicular arteries. **2.0**
28. List, in order, the veins through which venous blood originating in the testes would be returned to the inferior vena cava (IVC) on both right and left sides of the body. **2.0**
29. Describe the path taken by spermatozoa from the testes to the penile urethra. **2.0**
30. Describe the anatomy of the scrotum, testes and epididymis including the arterial supply, venous, and lymphatic drainage. **2.0**
31. Describe the course and contents of the spermatic cord. **2.0**
32. Explain the structure and function of the seminal vesicles. **2.0**
33. Explain the structure and function of the prostate gland. **2.0**
34. Describe the general anatomy of the penis including blood supply of the erectile tissues. **2.0**
35. Describe the ovarian arteries. **2.0**
36. Describe the broad ligament. **2.0**
37. Describe the anatomy of the ovary and associated ligaments. **2.0**

- | | |
|---|-----|
| 38. Describe the uterine tubes. | 2.0 |
| 39. Describe the uterus including the cervix. | 2.0 |
| 40. Describe the uterine arteries, emphasizing their relationships to the transverse (cardinal) ligament and the ureters. | 2.0 |
| 41. Describe the vagina and the fornices. | 2.0 |
| 42. Describe the vulva. | 2.0 |
| 43. Describe the structure of the clitoris and vestibular bulbs, including blood supply to the erectile tissues. | 2.0 |
| 44. Identify the homologous structures of the male and female reproductive systems. | 2.0 |

VI. Clinical Anatomy of Pelvis and Perineum

- | | |
|---|-----|
| 1. Describe the common disorders of the scrotum, testes, and epididymis. | 2.0 |
| 2. Identify the osteological and soft tissue features of the pelvis and perineum in diagnostic imaging. | 4.0 |
| 3. Describe the palpable anatomical landmarks of the pelvis and perineum, and explain their clinical significance. | 4.0 |
| 4. Explain the clinical significance of an open female peritoneal cavity versus a closed male peritoneal cavity. | 3.0 |
| 5. Explain the changes in position of the urinary bladder and its overlying peritoneum during pregnancy. | 2.0 |
| 6. Explain the clinical significance of the vascular anastomosis between vessels in the pelvis and perineum. | 3.0 |
| 7. Describe the pudendal nerve in terms of clinically relevant sites for nerve block. | 4.0 |
| 8. Describe the clinical significance of the ischioanal fossae. | 2.0 |
| 9. Compare and contrast internal hemorrhoids from external hemorrhoids in terms of location, venous drainage, and possible causes. | 4.0 |
| 10. Compare and contrast the internal and external anal sphincters in terms of fecal continence. | 3.0 |
| 11. Explain the functional and clinical significance of the perineal body. | 3.0 |
| 12. Relate urinary stress incontinence or uterine prolapse to weakness of the pelvic diaphragm. | 3.0 |
| 13. Describe the basic patterns of sympathetic and parasympathetic innervation in the urinary bladder and internal urethral sphincter during bladder filling (urinary continence) and emptying (micturition). | 2.0 |

VII. Basic Anatomy of Thorax

- | | |
|--|-----|
| 1. Describe the female breast. | 3.0 |
| 2. Describe the lymphatic drainage of the thoracic wall, with emphasis on the axillary lymph nodes. | 3.0 |
| 3. Demonstrate the osteological features the thoracic vertebrae, sternum, ribs, and clavicle. | 4.0 |
| 4. Describe the costovertebral, sternocostal, and sternoclavicular joints. | 3.0 |
| 5. Describe the boundaries of the thoracic inlet and outlet, and identify the structures passing through them. | 4.0 |
| 6. Describe the sternal angle and its use as a reference point. | 4.0 |
| 7. List the vertebral levels of suprasternal notch, sternal angle, and xiphisternal joint. | 3.0 |
| 8. Describe the vertical reference lines for the following thoracic walls: | |
| a. midsternal | 4.0 |
| b. parasternal | 4.0 |

c. midclavicular	4.0
d. anterior axillary	4.0
e. midaxillary	4.0
f. posterior axillary	4.0
g. scapular lines	4.0
9. Describe the surface projections of the heart and great vessels, the trachea, the margins of the pleura, and the lobes and fissures of the lungs.	4.0
10. Describe the intercostal nerves and vessels.	4.0
11. Describe the segmental innervation (dermatomes) of the skin of the thoracic wall.	4.0
12. Describe the layers of the thoracic wall from the superficial to the deep.	4.0
13. Describe the fiber orientation, innervations, and actions of the intrinsic muscles of the thoracic wall.	3.0
14. Describe the structure and function of the diaphragm.	4.0
15. Describe the surface projection of the diaphragm.	3.0
16. Describe the phrenic nerves.	4.0
17. Describe the mechanisms by which the thoracic cavity diameters are altered during inspiration and expiration.	4.0
18. Describe the divisions of the thoracic cavity.	3.0
19. Describe the location of the organs within the thoracic cavity and their relationship to one another.	4.0
20. Describe the pleural cavity.	4.0
21. Describe the endothoracic fascia and suprapleural membrane.	3.0
22. Compare and contrast the visceral and parietal pleurae.	4.0
23. Describe the costomediastinal and costodiaphragmatic recesses.	4.0
24. Explain the structure and function of the lungs.	4.0
25. Compare and contrast the right and left lung, including root structures.	4.0
26. Describe the innervation of, and the blood flow to and from, the lungs.	4.0
27. Describe the trachea and bronchial tree.	4.0
28. Describe a bronchopulmonary segment.	3.0
29. Describe the lymph drainage of the lungs, trachea, and primary bronchi.	3.0
30. Label structures on cross-sections through the mediastinum.	4.0
31. Describe the superior mediastinum and its contents.	4.0
32. Identify the branches of the subclavian arteries that supply structures in the thorax.	4.0
33. Describe the vagus nerves in the thorax.	4.0
34. Compare and contrast the left and right recurrent laryngeal nerves.	4.0
35. Describe the anterior mediastinum and its contents.	3.0
36. Describe the thymus.	3.0
37. Describe the middle mediastinum and its contents.	4.0
38. Describe the pericardium.	4.0
39. Identify and describe the oblique and transverse pericardial sinuses.	3.0
40. Describe the pathway of blood flow through the heart.	4.0
41. Describe fetal circulation and the changes that occur at birth.	4.0
42. Describe the external and internal anatomy of the heart with emphasis on the chambers and valves.	4.0
43. Describe the cardiac skeleton.	3.0
44. Explain the structure and function of the cardiac valves.	4.0
45. Describe the arterial and venous coronary circulation.	4.0
46. Describe the conducting system of the heart.	4.0

47. Describe the autonomic innervation of the heart.	3.0
48. Describe the lymphatic drainage of the heart and epicardium.	2.0
49. Describe the posterior mediastinum and its contents.	4.0
50. Describe the esophagus.	4.0
51. Describe the thoracic aorta and its branches.	4.0
52. Describe the azygos system of veins.	4.0
53. Explain the lymphatic drainage of the thorax.	3.0
54. Compare and contrast the right lymphatic duct and the thoracic duct.	4.0
55. Describe the thoracic portion of the sympathetic chain.	4.0
56. Describe the thoracic splanchnic nerves.	4.0
57. Describe the autonomic nervous plexuses within the thorax.	4.0

VIII. Clinical Anatomy of Thorax

1. Describe the lymphatic drainage of the breast in relation to the spread of breast cancer.	4.0
2. Identify bony features and soft tissue structures of the thorax on radiographs, MRI, CT, and angiograms.	4.0
3. Describe cervical rib and thoracic outlet syndromes.	4.0
4. Describe the surface projection of the lungs and pleura as related to sites of auscultation.	4.0
5. Describe the significance of the differences in afferent innervation of the parietal and visceral pleura in clinical presentations.	4.0
6. Define pneumothorax, hemothorax, chylothorax, paradoxical respiration (flail chest) and pleurisy.	4.0
7. Describe the clinical significance of the costomediastinal and costodiaphragmatic recesses in relation to thoracocentesis.	4.0
8. Explain the functional significance of the bronchial tree and bronchopulmonary segments in relation to inhalation injury and surgical resection.	3.0
9. Describe the surface projection of the heart as related to sites of auscultation of the cardiac valves and describe the placement of ECG electrodes.	4.0
10. Explain the cardiac tamponade and routes of pericardiocentesis.	4.0
11. Describe the congenital and acquired anomalies of the heart and great vessels.	4.0
12. Describe the functional consequences of coronary artery obstruction.	4.0
13. Describe the mechanism of referred pain as related to thoracic organs.	4.0
14. Describe the clinical significance of the azygos venous system as it relates to esophageal varices.	4.0

IX. Basic Anatomy of Abdomen

1. Describe the structural relationships of the abdomen within the context of sectional anatomy.	4.0
2. Relate surface landmarks of the abdominal wall to underlying structures and organs.	4.0
3. Describe the regional and quadrant reference systems of the abdomen and identify their contents.	4.0
4. Describe structure and function of the abdominal wall.	4.0
5. Define aponeurosis.	3.0
6. Describe the muscles of the abdominal wall in terms of origins, insertions, actions, innervations, and blood supply.	4.0
7. Explain the structure and function of the rectus sheath.	4.0
8. Describe the dermatomes of abdominal wall.	4.0

9. Describe the vasculature of the abdominal wall.	4.0
10. Describe the inguinal canal, including contents in both males and females.	4.0
11. Describe the descent of the gonads.	3.0
12. List the components of the spermatic cord.	4.0
13. Describe the boundaries of the abdominal and peritoneal cavities.	4.0
14. Compare and contrast the visceral and parietal peritoneum.	4.0
15. Describe the abdominal mesenteries and relationship to the abdominal viscera; contrast intraperitoneal versus retroperitoneal structures.	4.0
16. Describe the lesser and greater peritoneal sacs and their relationships to the epiploic foramen.	4.0
17. Relate the portal vein, common bile duct, and proper hepatic artery within the hepatoduodenal ligament.	4.0
18. Describe the paracolic (lumbar) gutters.	4.0
19. Describe the abdominal aorta and its branches.	4.0
20. Describe the structure and function of the portal-caval system, including significant anastomoses.	4.0
21. Describe the autonomic plexuses of the abdomen.	3.0
22. Describe the lymphatic drainage of the abdominal viscera and wall to cisterna chyli.	3.0
23. Describe the blood supply, lymphatic drainage, and innervations of the abdominal viscera with reference to the divisions of the embryonic gut.	4.0
24. Describe the structure and function of the gastrointestinal abdominal viscera and spleen.	4.0
25. Describe the collateral circulation of the abdominal organs.	4.0
26. Describe the structure and function of the diaphragm from the abdominal perspective.	4.0
27. Describe the muscles of the posterior abdominal wall in terms of origin, insertion, action, innervations, and blood supply.	4.0
28. Describe the lumbar plexus and its branches.	4.0
29. Describe the inferior vena cava and its tributaries.	4.0
30. Describe the structure and function of the kidneys and ureters.	4.0
31. Describe the structure and function of the suprarenal glands.	4.0

X. Clinical Anatomy of Abdomen

1. Identify bony features and soft tissue structures of the abdomen on radiographs, MRI, CT, and angiograms.	4.0
2. Compare and contrast the inguinal (Hesselbach's) triangle in relation to the diagnosis of indirect versus direct inguinal hernias.	4.0
3. Compare and contrast inguinal and femoral hernias.	4.0
4. Define hydrocele, hematocele, and varicocele.	3.0
5. Describe pain referral patterns of the abdominal viscera and the diaphragm.	3.0
6. Describe the clinical significance of diaphragmatic herniation.	3.0
7. Integrate basic anatomy with the following clinical correlates:	
a. ascites and paracentesis	4.0
b. hepatorenal recess	4.0
c. portal hypertension, including common varices	4.0
d. biliary inflammation, stones, and ulcers (including triangle of Calot)	4.0
e. pancreatitis	4.0
f. ileal diverticulum	4.0
g. appendicitis	4.0
h. megacolon	4.0
i. pyelonephritis	4.0
j. renal calculi	4.0

XI. Basic Anatomy of Head & Neck

Head

1. Describe the structural relationships of the head and neck within the context of sectional anatomy. **3.0**
2. Describe the osteological features of the skull. **3.0**
3. Identify the sutures of the skull. **3.0**
4. Define fontanel. Locate and give the times of closure of the anterior and posterior fontanels. **3.0**
5. Identify the position, palpable and imaging landmarks of the bones of the skull and calvaria. **3.0**
6. Describe the boundaries, walls, floors, and contents of the cranial fossae. **3.0**
7. Describe the cranial foramina and fissures, listing the structures that each transmits. **3.0**
8. Identify the major grooves for the intracranial venous sinuses. **3.0**
9. Describe the relationships of three meningeal coverings of the brain. **3.0**
10. Describe the dural reflections and dural venous sinuses. **3.0**
11. Describe each cranial nerve in terms of: **4.0**
 - a. name and Roman numeral
 - b. where emerges from CNS
 - c. associated foramina
 - d. functional components
 - e. ganglia
 - f. course and distribution

A. Scalp and Face

1. Describe the layers of the scalp **3.0**
2. Describe the lymphatic drainage from the face and scalp. **3.0**
3. Describe the cutaneous innervation of the face. **3.0**
4. Discuss the muscles of facial expression and their innervation. **3.0**
5. Describe the superficial temporal artery. **3.0**
6. Describe the maxillary artery and its major branches. **3.0**
7. Describe the facial artery and its major branches. **3.0**
8. Describe the tributaries of the internal jugular system of veins to the face. **3.0**
9. Describe the parotid gland and its relationship to the facial nerve. **3.0**
10. Describe the parasympathetic innervation of the parotid gland. **3.0**
11. Describe the sympathetic innervations of the face. **3.0**

B. Orbit and its Contents

1. Describe the extraocular muscles, in terms of their attachments, innervations, and actions. **3.0**
2. Describe the muscles responsible for opening and closing the palpebral fissure. **3.0**
3. Describe the intrinsic muscles of the eye, as well as their actions and innervation. **3.0**
4. Describe the arterial supply and venous drainage of the orbit. **3.0**
5. Describe the parasympathetic and/or sympathetic innervation of the orbit and its contents. **3.0**

C. Infratemporal fossa

1. Describe the boundaries and contents of the infratemporal fossa in terms of: **3.0**
 - a. muscles of mastication (actions and innervations)
 - b. mandibular nerve and its major branches

c.	chorda tympani (origin and functions)	
d.	major branches of maxillary artery	
e.	pterygoid plexus of veins	
2.	Describe the temporomandibular joint (TMJ).	2.0
3.	Describe the major venous anastomoses of the head (e.g., cavernous sinus, pterygoid plexus, facial veins and veins of the scalp).	3.0
D.	<u>Nasal Cavity, Paranasal Sinuses & Pterygopalatine Fossa</u>	
1.	Describe the nasal cavity.	3.0
2.	Describe the paranasal sinuses and their innervations.	3.0
3.	Describe the pterygopalatine fossa and its contents.	3.0
E.	<u>Oral Cavity</u>	
1.	Describe the functional anatomy of the tongue, including its motor and sensory (general and special) innervations.	3.0
2.	Describe the neurovasculature of the oral cavity.	3.0
3.	Describe the major salivary glands.	3.0
4.	Discuss the roles of the otic and submandibular ganglia.	3.0
F.	<u>Pharynx and Palate</u>	
1.	Explain the structure and function of the pharynx, including the auditory tube.	3.0
2.	Describe the piriform recess.	3.0
3.	List the components and functions of the pharyngeal plexus.	3.0
4.	Describe the blood supply and venous drainage of the pharynx.	2.0
5.	Describe the roles the soft palate, pharyngeal constrictors, and tongue in swallowing.	3.0
6.	Describe the anatomic arrangement and functional significance of the lymphoid tissue in the tonsils, pharyngeal, and posterior nasal walls.	3.0
7.	Give the nerve and blood supply to the palatine tonsil.	3.0
G.	<u>Larynx</u>	
1.	Explain the structure and function of the hyoid bone and larynx.	3.0
2.	Describe the muscles of the larynx, in terms of attachments, actions, and innervations.	3.0
3.	Describe the internal structure of the larynx.	3.0
4.	Describe the course of the right and left recurrent laryngeal nerves.	3.0
H.	<u>Ear</u>	
1.	Explain the structure, function, and innervation of the ear.	3.0
<u>Neck</u>		
1.	Describe the fascial layers and spaces of the neck.	4.0
2.	Describe the sternocleidomastoid, suprahyoid, and infrahyoid muscles, including their attachments, actions, and innervations.	3.0

3. Describe the boundaries and contents of the anterior and posterior triangles of the neck (including subtriangles). 4.0
4. Describe the major structures passing between the neck and the thorax. 3.0
5. Describe the relationship between the trachea and the esophagus. 3.0
6. Describe the location and anatomic relations of the thyroid and parathyroid glands. 3.0
7. Describe the dermatomes and the cutaneous innervation of the neck. 3.0
8. Describe the cervical plexus and its distribution. 3.0
9. Describe the autonomic nervous system in the neck. 3.0
10. Describe the courses of the accessory, vagus, and phrenic nerves in the neck. 3.0
11. Describe the courses and important relationships of the subclavian arteries and veins. 3.0
12. Describe the carotid sheath and its contents. 4.0
13. Describe the common carotid artery and its branches. 3.0
14. Describe the carotid sinus and carotid body. 3.0
15. Describe the branches of the external carotid artery 3.0
16. Describe the brachiocephalic, external jugular and internal jugular veins. 3.0
17. Describe the arrangement of the cervical lymph nodes and lymphatic drainage. 3.0

XII. Clinical Anatomy of Head and Neck

1. Identify bony features and soft tissue structures of the head and neck on radiographs, MRI, CT, and angiograms. 4.0
2. Differentiate the appearance of extradural and subdural hematomas on transverse CT scans. 3.0
3. Describe how fractures of the cribriform plate can result in meningitis and anosmia. 3.0
4. Explain the clinical significance of emissary veins. 3.0
5. Describe the “danger areas” of the face and scalp, nature of scalp injuries and the spread of infection through the pterygoid plexus and/or into the dural venous sinuses. 4.0
6. Describe the major arteries that supply the lateral wall and nasal septum in relation to nosebleeds. 3.0
7. Explain dislocation of the temporomandibular joint. 3.0
8. Explain the rationale for, and perform, a cranial nerve examination. 4.0
9. Define Horner's syndrome. 4.0
10. Define Bell's palsy. 4.0
11. Explain resulting effects of nerve injuries of the larynx. 3.0
12. Describe common nerve block procedures. 3.0
13. Explain the spread of infections from the oral cavity into the neck. 3.0
14. Explain the clinical significance of the cervical fasciae in the spread of infection to the thoracic cavity. 3.0
15. Describe lymphatic metastasis and spread of infection. 3.0
16. Discuss the cervical triangles in relation to penetrating neck trauma and surgical approaches. 4.0
17. Locate the carotid pulse. 4.0
18. Describe the clinical importance of the cervical pleura in relation to trauma at the base of the neck. 3.0
19. Identify surface landmarks that are commonly used when inserting a central venous line. 4.0
20. Describe the anterior scalene syndrome (scalenus anticus syndrome) as it relates to thoracic outlet syndrome. 3.0
21. Palpate hyoid bone, thyroid cartilage, cricoid cartilage, and tracheal rings. 4.0
22. Identify common sites that foreign bodies can become lodged. 3.0
23. Describe the clinical anatomy of procedures that open or maintain the airway. 4.0

LOWER EXTREMITY ANATOMY

LEARNING OBJECTIVES

Anatomical Terminology and Gait Cycle
Osteology of the Thigh and Gluteal Region
Joints of the Thigh and Gluteal Region
Muscles of the Thigh and Gluteal Region
Vascularization of the Thigh and Gluteal Region
Lymphatics of the Thigh and Gluteal Region
Innervation of the Thigh and Gluteal Region

Osteology of the Leg
Joints of the Leg
Muscles of the Leg
Vascularization of the Leg
Lymphatics of the Leg
Innervation of the Leg
Osteology of the Foot
Joints of the Foot
Muscles of the Foot
Vascularization of the Foot
Lymphatics of the Foot
Innervation of the Foot

Cross Sections of the Lower Extremity
Lumbosacral Plexus
Surface Anatomy of the Lower Extremity
Prenatal Development of the Lower Extremity

I. Anatomical Terminology and Gait Cycle

1. Describe the anatomical position of the lower extremity. 3.0
2. Describe the major regions of the lower extremity and the skeletal structure of each region. 3.0
3. Identify the longitudinal axis of the thigh, leg and foot regions. 3.0
4. Apply anatomical terms to their related anatomical positions of the lower extremity. 3.0
5. Apply anatomical terms to their related movements of the lower extremity. 3.0
6. Describe axes and planes of motion for functional joints. 3.0
7. Define the stance and swing phases of the gait cycle. 3.0

II. Osteology of the Thigh and Gluteal Region

1. Describe the features of the sacrum. 4.0
2. Describe the features of the body and ala of the ilium. 4.0
3. Describe the features of the body and ramus of the ischium. 4.0
4. Describe the features of the body, superior ramus, and inferior ramus of the pubis. 4.0
5. Describe the features of the proximal extremity, shaft, and distal extremity of the femur. 4.0
6. Define the angle of inclination, angle of declination (femoral torsion), and angle of femoral shaft. 4.0
7. Distinguish the osteological features of the thigh and gluteal region in diagnostic images. 4.0
8. Describe the ossification of the femur and os coxae. 4.0

III. Joints of the Thigh and Gluteal Region

1. Describe the formation, axes of motion, and ligamentous structure of the sacroiliac joint. 4.0
2. Describe the formation, axes of motion, and ligamentous structure of the hip joint. 4.0
3. Distinguish the osteological features of the hip joint in diagnostic images. 4.0

IV. Muscles and Fasciae of the Thigh and Gluteal Region

1. Describe the superficial fascia and its contents of the thigh and gluteal regions. 3.0
2. Describe the deep fascia of the thigh and gluteal regions. 4.0
3. Describe how the deep fascia forms the anterior, medial and posterior compartments of the thigh. 4.0
4. Describe the formation and contents of the muscular and vascular compartments beneath the inguinal ligament (subinguinal space), including the femoral sheath. 4.0
5. Describe the origin, course, insertion, and action of the Iliacus and psoas major muscles 4.0
6. Identify the muscles in the gluteal region and describe the origin, course, insertion, and action for each muscle. 4.0
7. Identify the muscles in the anterior, medial and posterior compartments of the thigh and describe the origin, course, insertion, and action for each muscle. 4.0
8. Define the femoral triangle and identify the contents and their relationships. 4.0
9. Define the adductor canal and identify the contents and their relationships. 4.0
10. Describe the bursae of the hip and gluteal region. 3.0
11. Define the Trendelenburg Gait and relate its anatomical bases. 4.0

V. Vascularization of the Thigh and Gluteal Region

1. Distinguish the superficial and deep veins of the thigh, explain their formation and course. **4.0**
2. Describe the superior gluteal and inferior gluteal arteries and their branches in the gluteal and hip regions. **4.0**
3. Describe the obturator artery and its branches in the thigh and hip regions. **4.0**
4. Describe the femoral (superficial femoral) artery and its branches in the thigh region. **4.0**
5. Describe the profunda femoris (deep femoral) artery and its branches in the thigh and hip regions. **4.0**
6. Describe the collateral circulation of the hip joint. **4.0**
7. Describe avascular necrosis of the head and neck of the femur and its anatomical bases. **4.0**

VI. Lymphatics of the Thigh and Gluteal Region

1. Differentiate the superficial and deep lymphatic drainage patterns of the thigh and gluteal regions. **4.0**
2. Distinguish the groups of lymph nodes in the inguinal region. **4.0**
3. Explain the lymphatic flow from the inguinal lymph nodes to the cisterna chyli. **4.0**

VII. Innervation of the Thigh and Gluteal Region

1. Describe the superior and inferior gluteal nerves and their branches. **4.0**
2. Describe the femoral nerve and its branches. **4.0**
3. Describe the obturator nerve and its branches. **4.0**
4. Describe the lateral femoral cutaneous nerve and its branches. **3.0**
5. Describe the posterior femoral cutaneous nerve and its branches. **4.0**
6. Describe the sciatic nerve and its branches. **4.0**
7. **4.0**

VIII. Osteology of the Leg

1. Describe the features of the proximal extremity, shaft, and distal extremity of the tibia. **4.0**
2. Explain tibial torsion. **4.0**
3. Describe the features of the proximal extremity, shaft, and distal extremity of the fibula. **4.0**
4. Describe the features of the patella. **4.0**
5. Distinguish the osteological features of the leg in diagnostic images **4.0**
6. Describe the ossification of the tibia, fibula, and patella. **4.0**

IX. Joints of the Leg

1. Describe the formation and ligamentous structure of the tibiofibular joint (superior tibiofibular). **4.0**
2. Describe the interosseous membrane. **4.0**
3. Describe the formation and ligamentous structure of the tibiofibular syndesmosis (inferior tibiofibular). **4.0**
4. Describe the formation, axes of motion, ligamentous structure (extracapsular, capsular, and intracapsular), and bursae internal and external to the knee joint. **4.0**
5. Distinguish the osteological features of the tibiofibular joints and knee joint in diagnostic images. **4.0**

6. Explain common ligamentous, meniscal, and articular damage to the knee joint. 4.0

X. Muscles and Fasciae of the Leg

1. Describe the superficial fascia and its contents.. 4.0
2. Describe the deep fascia, crural intermuscular septae, and compartmentalization. 4.0
3. Describe the formation of the five retinacula around the ankle and proximal foot and the arrangement of structures passing deep to them. 4.0
4. Identify the muscles of the anterior, lateral, and superficial and deep posterior compartments and describe the origin, course, insertion, and action for each muscle. 4.0
5. Describe the relationship of the retrocalcaneal (deep) and superficial bursae to the tendo calcaneus. 4.0
6. Define the boundaries and describe the contents of the popliteal fossa and their relationships. 4.0
7. Describe anterior, posterior, and lateral compartment syndromes. 4.0

XI. Vascularization of the Leg

1. Distinguish the superficial and deep veins, explain their formation and course and explain the unction of the calf pump. 4.0
2. Describe the popliteal artery and its branches. 4.0
3. Describe the collateral circulation (genicular anastomosis) around the knee joint. 4.0
4. Describe the formation, course, branches, and termination of the anterior and posterior tibial, and fibular (peroneal) arteries. 4.0
5. Describe the collateral circulation (medial and lateral malleolar anastomoses) around the ankle joint. 4.0
6. Describe the anatomical bases for the formation of varicosities and thromboses. 4.0

XII. Lymphatics of the Leg

1. Describe the superficial and deep lymphatic drainage. 4.0
2. Describe the lymph nodes of the popliteal fossa and leg. 4.0

XIII. Innervation of the Leg

1. Describe the common fibular (peroneal) nerve and its course and branches. 4.0
2. Describe the deep and superficial fibular (peroneal) nerves, and their courses and branches in the leg region. 4.0
3. Describe the tibial nerve and its course and branches. 4.0
4. Describe the formation and course of the sural nerve in the leg. 4.0
5. Describe the saphenous nerve and its branches in the leg region. 4.0
6. Explain the anatomical bases for foot drop. 4.0

XIV. Osteology of the Foot

1. Describe the anatomical, biomechanical (medial and lateral column), and surgical (forefoot, midfoot, and rearfoot) divisions of the osteology of the foot. 4.0

2. Describe the features of the individual tarsal and metatarsal bones. 4.0
3. Compare and contrast the features of the proximal, middle, and distal phalanges. 4.0
4. Describe the location and functional relationships of the first metatarsal sesamoids. 4.0
5. Describe the location of variable sesamoids. 3.0
6. Describe the location of accessory ossicles.
7. Describe the ossification of the bones of the foot. 4.0
8. Distinguish the osteological features of the foot in diagnostic images, including ossification patterns and accessory ossicles. 4.0
9. Describe the following clinical aspects of the osteology of the foot: heel spurs, neutral triangle of the calcaneus, calcaneal apophysitis, Haglund's deformity, talar torsion, Steida's process, metatarsal stress fractures, fusion of the middle and distal phalanges of the fifth toe. 4.0

XV. Joints of the Foot

1. Compare and contrast anatomical versus functional definitions of the tarsal joints. 4.0
2. Describe the formation, axis of motion, and ligamentous structure of the ankle joint. 4.0
3. Describe the formation, axis, and motion of the functional subtalar joint. 4.0
4. Describe the formation, axes, and motions of the functional midtarsal (Chopart's) joint. 4.0
5. Describe the formation and ligamentous structure of Lisfranc's Joint (tarsometatarsal joints). 4.0
6. Describe the formation and ligamentous structure of the anatomical subtalar (Talocalcaneal) joint. 4.0
7. Describe the formation and ligamentous structure of the talocalcaneonavicular joint. 4.0
8. Describe the formation and ligamentous structure of the calcaneocuboid joint. 4.0
9. Describe the formation and ligamentous structure of the great tarsal joint (cuboideonavicular, cuneonavicular, intercuneiform, cuneocuboid, middle tarsometatarsal articulations). 4.0
10. Describe the formation and ligamentous structure of the medial and lateral tarsometatarsal joints. 4.0
11. Describe the formation and ligamentous structure of the intermetatarsal joints. 4.0
12. Describe the formation and ligamentous structure of the lesser metatarsophalangeal joints. 4.0
13. Describe the formation and ligamentous structure of the first metatarsophalangeal joint. 4.0
14. Describe the formation and ligamentous structure of the interphalangeal joints. 4.0
15. Distinguish the components of the joints of the foot in diagnostic images. 4.0
16. Identify the synovial cavities of the foot and list the articulations found within each synovial cavity. 4.0
17. Describe the formation and the osseous, ligamentous, and muscular support of the longitudinal and transverse arches of the foot. 4.0
18. Describe the anatomical bases of ankle sprains. 4.0

XVI. Muscles and Fasciae of the Foot

1. Compare and contrast the histological characteristics of dorsal and plantar skin and their appendages.. 3.0
2. Describe the superficial fascia on the dorsal and plantar aspects of the foot, including their contents. 4.0
3. Describe the deep fascial layers and their contents on the dorsum. 4.0
4. Review the attachments and relations of the retinacula. 4.0
5. Describe the origin, course, insertion, and actions of the extensor hallucis brevis and extensor digitorum brevis muscles. 4.0
6. Describe the formation and the functions of the extensor hood (expansion) of the hallux and lesser digits. 4.0
7. Describe the parts of the deep fascia, including the plantar aponeurosis and fascicles and their continuity with the intermuscular septa. 4.0

8. Describe the boundaries and contents of the longitudinal compartments in the plantar foot, and the layers of the central compartment. **4.0**
9. List the four layers of plantar muscles and describe the origin, course, insertion, and action for each muscle. **4.0**
10. Describe the relationship between the tendons of the extrinsic muscles and the intrinsic muscles on the dorsal and plantar surfaces of the foot. **4.0**
11. Describe the synovial sheaths of the extrinsic muscles found on the dorsal, medial, lateral, posterior, and plantar surfaces of the foot. **4.0**
12. List the common muscular variations found in the foot. **4.0**
13. Explain the spread of infections within and between compartments of the foot and leg. **4.0**
14. Explain the action of the extensor expansion and its attachments on the transverse and sagittal plane stability of the lesser toes. **4.0**
15. Explain the action of the extensor expansion and the extrinsic and intrinsic muscles on the transverse and sagittal plane stability of the hallux. **4.0**

XVII. Vascularization of the Foot

1. Describe the superficial and deep venous return. **4.0**
2. Describe the course and branches of the dorsalis pedis artery. **4.0**
3. Describe the formation, course, and branches of the medial and lateral plantar arteries. **4.0**
4. Describe the formation of the dorsal and plantar digital arteries. **4.0**
5. Describe the major anastomoses in the rearfoot and the forefoot. **4.0**
6. Identify common variations in the vascular supply of the foot. **4.0**
7. Describe avascular necrosis of the head of the talus and its anatomical bases. **4.0**

XVIII. Lymphatics of the Foot

1. Explain the superficial and deep lymphatic drainage. **4.0**

XIX. Innervation of the Foot

1. Describe the formation, course, and the branches of the deep fibular (peroneal) nerve. **4.0**
2. Describe the formation, course, and the branches of the superficial fibular (peroneal) nerve. **4.0**
3. Describe the lateral dorsal cutaneous nerve and its branches. **4.0**
4. Describe the formation and course of the saphenous nerve and its branches. **4.0**
5. Describe the formation, course and branches of the medial and lateral plantar nerves. **4.0**
6. Describe the formation and courses of the proper digital nerves. **4.0**
7. Describe the formation and course of the medial and lateral calcaneal nerves. **4.0**
8. Describe the anatomical bases for tarsal tunnel syndrome, Morton's neuroma, and digital nerve blocks. **4.0**

XX. Cross Sections of the Lower Extremity

1. Label the osteology, integument, superficial fascia, deep fascia, compartments, muscles/tendons, vessels, and nerves on a cross section through the mid-thigh. **4.0**
2. Label the osteology, integument, superficial fascia, deep fascia, compartments, muscles/tendons, vessels, and nerves on a cross section through the tibial tuberosity of the right and left leg. **4.0**

3. Label the osteology, integument, superficial fascia, deep fascia, interosseous membrane, compartment muscles/tendons, vessels, and nerves on a cross section through the middle one third of the right and left leg. **4.0**
4. Label the osteology, integument, superficial fascia, deep fascia, muscles/tendons, vessels, and nerves on a cross section through the malleoli of the right and left leg. **4.0**
5. Label the osteology, integument, superficial fascia, deep fascia, ligaments, muscles/tendons, vessels, and nerves on a frontal or coronal section through the mid metatarsal shaft regions of the right and left foot. **4.0**
6. Label the osteology, integument, superficial fascia, deep fascia, ligaments, muscles/tendons, vessels, and nerves on a frontal or coronal section through each of the metatarsophalangeal joints of the right and left foot. **4.0**
7. Label the osteology, integument, superficial fascia, deep fascia, ligaments, muscles/tendons, vessels, and nerves on a cross section through the proximal and distal interphalangeal joints of the right and left foot. **4.0**
8. Label the osteology, integument, superficial fascia, deep fascia, ligaments, muscles/tendons, vessels, and nerves on sagittal sections through the first and fifth rays of the foot. **4.0**

XXI. Lumbosacral Plexus

1. Describe the lumbar portion of the lumbosacral plexus and its branches. **4.0**
2. Describe the sacral portion of the lumbosacral plexus and its branches. **4.0**
3. Describe the dermatomes of the entire lower extremity. **4.0**
4. Describe the peripheral nerve innervation of the skin of the entire lower extremity. **4.0**
5. Explain the origin, course, and functions of the sympathetic system in this region. **3.0**
6. Describe the muscular innervation of the entire lower extremity. **4.0**
7. Describe the deep tendon reflexes of the lower extremity. **4.0**
8. Describe the Babinski reflex. **4.0**
9. Describe the anatomical bases of radiculopathies and both peripheral somatic and peripheral autonomic neuropathies of the lower extremity. **4.0**

XXII. Surface Anatomy of the Lower Extremity

1. Describe the surface anatomy of the thigh region. **3.0**
2. Describe the surface anatomy of the gluteal region. **3.0**
3. Describe the surface anatomy of the popliteal fossa and knee region. **4.0**
4. Describe the surface anatomy of the leg region. **4.0**
5. Describe the surface anatomy of the dorsal surface of the foot and ankle. **4.0**
6. Describe the surface anatomy of the medial surface of the foot and ankle. **4.0**
7. Describe the surface anatomy of the posterior surface of the foot and ankle. **4.0**
8. Describe the surface anatomy of the lateral surface of the foot and ankle. **4.0**
9. Describe the surface anatomy of the plantar surface of the foot. **4.0**
10. Describe Langer's lines (relaxed skin tension lines). **3.0**

XXIII. Prenatal Development of the Lower Extremity

1. Review the embryonic and fetal portions of prenatal development. **3.0**

2. Describe the early development of a limb bud and its differentiation into a foot, leg, and thigh region. **4.0**
3. Describe the development of the arterial system of the lower extremity. **3.0**
4. Describe the development of the innervation of the lower extremity. **3.0**
5. Describe the chondrification and ossification of the lower extremity. **4.0**
6. Describe the development of the muscles (pre-axial and post-axial) of the lower extremity. **3.0**
7. Describe the development of the joints of the lower extremity. **3.0**
8. Describe the rotation of the lower extremity. **4.0**

MEDICAL GENETICS LEARNING OBJECTIVES

I. Medical Knowledge

Genome Organization/Gene Regulation

Gene Variation

Population Genetics

Inheritance

Cytogenetics and Molecular Genetics

Biochemical Genetics

Cancer Genetics

II. Patient Care

Medical Genetics/Inheritance

Genetic Testing

Cancer Genetics

Reproductive and Prenatal Genetics

Treatment/Management

Interpersonal and Communication Skills

Practice-Based Learning and Improvement

Professionalism

Systems-Based Practice

I. Medical Knowledge

A. Genome Organization/Gene Regulation

1. Describe the organization of the human genome including the approximate number of genes, the number of chromosomes, and how DNA is packaged into chromatin. **3.0**
2. Describe the organization and distribution of the mitochondrial genome. **2.0**
3. Describe the structure and function of genes. **3.0**
4. Describe the process and regulation of gene expression including the steps of transcription and translation; the role of regulatory factors such as transcription factors and noncoding RNA; and the significance of heterochromatin versus euchromatin. **3.0**
5. Explain how errors in gene expression can result in disease. **4.0**
6. Explain how temporal and spatial patterns of gene expression vary throughout the life human cycle and how gene expression patterns can influence disease. **3.0**
7. Discuss the concept of epigenetics. **4.0**
8. Explain the role of epigenetics in regulation of gene expression, development, and disease. **3.0**
9. Describe how environmental exposures can influence epigenetic modifications. **3.0**

B. Genetic Variation

1. Explain the concept of genetic individuality as it applies to medicine. **4.0**
2. Describe the types and extent of variation in the human genome including sequence and structural variation in coding and non-coding sequences (e.g., single nucleotide variants, insertion-deletions, copy number variants). **3.0**
3. Define the terms mutation and polymorphism and describe their role in both normal human variation and disease. **4.0**
4. Describe missense, nonsense, frame shift, microdeletion, and splice site mutations that lead to human disease and their functional consequences. **3.0**
5. Explain the basis of genotype-phenotype correlations and how different types of mutations influence clinical outcomes and disease severity. **4.0**
6. Define dominant negative, loss of function, gain of function, haploinsufficiency mutations. **3.0**
7. Describe the role of allelic variation and its contribution to both normal and pathogenic phenotypic variation. **3.0**
8. Describe the spectrum of genetic contribution to disease, from disease-causing mutations in Mendelian disorders to genetic and non-genetic susceptibility factors in multifactorial disease. **3.0**
9. Compare and contrast rare (high risk) versus common (low risk) genetic variants with respect to their contribution to human health and disease susceptibility. **1.0**
10. Define *pharmacogenetics* and *pharmacogenomics*. **3.0**
11. Explain how genetic variants can affect drug response in individuals. **3.0**
12. Describe the principles of genetic linkage analysis and association studies, including the concept of linkage disequilibrium, and how they are used to identify genes contributing to disease. **3.0**
13. Explain the strengths and limitation of these approaches. **1.0**
14. Describe how understanding the pathophysiology of a specific genetic mutation could lead to more effective treatment. **3.0**
15. Describe the etiology of common genetic diseases. **3.0**

C. Population Genetics

1. Explain genetic variation with respect to geographic ancestry and evolution, and its effect on variation between populations. **2.0**
2. Explain basic concepts of population genetics, including founder effect and genetic drift. **1.0**
3. Apply the concepts of the Hardy-Weinberg law to determine genetic risk carrier frequency, gene frequency, and disease frequency. **3.0**
4. Explain how carrier frequency within populations influences local health care policy and practice. **3.0**

D. Inheritance

1. Compare and contrast Mendelian, monogenic, polygenic, and multifactorial inheritance. **4.0**
2. Describe the characteristic features of Mendelian inheritance patterns (autosomal dominant, autosomal recessive, X-linked, and Y-linked). **4.0**
3. Use information in a pedigree to deduce probabilities of transmission for Mendelian traits and diseases. **4.0**
4. Explain how factors such as reduced penetrance, delayed age of onset, variable expressivity, genetic heterogeneity (locus and allelic), anticipation, pleiotropy and environmental factors affect the phenotypic expression of a disease and the observed pattern of inheritance. **4.0**
5. Describe the how non-Mendelian inheritance, including somatic and germline mosaicism, uniparental disomy, epigenetics and genomic imprinting, unstable repeat expansion and contraction, and chromosomal rearrangements affect the phenotype and recurrence risk of genetic disorders. **3.0**
6. Describe the characteristic features of mitochondrial inheritance and explain the role of maternal inheritance and heteroplasmy in mitochondrial diseases. **3.0**
7. Explain the principles of multifactorial inheritance as it applies to complex disorders. **3.0**
8. Describe the threshold model and the factors that can be used as predictors of multifactorial inheritance. **3.0**

E. Cytogenetics and Molecular Genetics

1. Describe the structure and function of chromosomes. Compare and contrast their segregation in mitosis and meiosis. **2.0**
2. Demonstrate a basic understanding of cytogenetic nomenclature. **3.0**
3. Explain and contrast the uses and limitations of a G-banded karyotype, fluorescence *in situ* hybridization, and cytogenomic arrays, particularly with regard to detection of genomic copy number changes. **2.0**
4. Describe the types of numerical and structural variation seen in human chromosomes (e.g., translocations, inversions, deletions, and duplications). **3.0**
5. Define mosaicism and explain how it affects the phenotypic expression of a chromosomal disorder. **2.0**
6. Compare and contrast molecular diagnostic techniques used in genetic testing, including Southern blotting, polymerase chain reaction, DNA sequencing, array comparative genomic hybridization, fluorescence *in situ* hybridization, genomic and expression array-based technologies and next generation sequencing. **3.0**

F. Biochemical Genetics

1. Explain what is meant by an inborn error of metabolism. **3.0**
2. Describe the underlying genetic defect and pathogenesis for metabolic disorders, such as amino acid disorders, urea cycle defects, lysosomal storage diseases, fatty acid oxidation defects, organic acidurias, and carbohydrate disorders. **4.0**
3. Describe how allelic heterogeneity, environmental factors, and modifier genes contribute to variable presentation of metabolic diseases. **3.0**
4. Discuss the various approaches to treatment of metabolic disorders. **2.0**

G. Cancer Genetics

1. Describe the multistep genetic model of cancer. **3.0**
2. Describe the role of oncogenes, tumor suppressor genes and DNA repair genes in the neoplastic process. **4.0**
3. Explain why germline mutations in these genes are associated with an increased risk of cancer and with inherited and familial cancer syndromes. **4.0**
4. Differentiate between inherited, familial and sporadic cancers. **2.0**
5. Compare the genetic/epigenetic basis by which cancers arise, including somatic mutation, epigenetic changes, and germline mutation. **3.0**
6. Explain how current cytogenetic and DNA technologies are used to establish the diagnosis, prognosis, treatment and long term follow up of cancer. **3.0**
7. Explain how genotype of the tumor and/or patient influences rational/targeted drug design and individualized cancer treatment. **2.0**

II. Patient Care

A. Medical Genetics/Inheritance

1. Recognize the indications to refer for a genetics evaluation, including family history of disease, congenital anomalies, developmental disability, and multiple miscarriages or reproductive failure. **4.0**
2. Obtain and interpret medical, social, and family histories and physical exam findings in order to determine if a patient is at risk for a genetic disorder. **4.0**
3. Utilize a three-generation family history to construct a pedigree and interpret the mode of inheritance. **2.0**
4. Assess recurrence risks for Mendelian, multifactorial, and mitochondrial disorders. **3.0**
5. Explain the relevance of a genetics evaluation and basic concepts of inheritance. **4.0**
6. Obtain appropriate information regarding management and surveillance of the disorder after genetic diagnosis is made. **3.0**
7. Recognize intrinsic and extrinsic causes of congenital anomalies in isolation and/or part of a pattern. **4.0**
8. Differentiate among categories of anomalies including malformation, deformation, disruption, dysplasia, syndrome, sequence, and association. **3.0**
9. Provide information about appropriate patient support and resources including genetics support groups, community groups, or other resources that may benefit the patient and their family. **3.0**

B. Genetic Testing

1. Explain screening, diagnostic, and predictive genetic testing strategies as components in the evaluation of a patient. **3.0**
2. Identify the benefits, limitations and risks of genetic tests, including the ethical concerns associated with genetic testing and the importance of the informed consent process. **4.0**
3. Explain how genomic testing may be used as a component of personalized health care with a focus on prevention, assessment of disease risk, identification of pharmacogenetic variants and treatment options. **3.0**
4. List the indications for standard cytogenetic karyotype, FISH analysis, and cytogenomic array. **2.0**
5. Interpret the results of a cytogenetic report, and recognize their clinical features, etiologies and prognoses (e.g., trisomy 13, 18, 21; 47, XXY [Klinefelter syndrome]; 45,X [Turner syndrome]; del 22q; del 5p; etc). **3.0**
6. Describe the clinical indications for an inborn error of metabolism that would suggest the use of biochemical tests. **3.0**
7. Recognize clinical scenarios where biochemical testing strategies can provide more clinically applicable results than molecular testing results. **1.0**

C. Cancer Genetics

1. Differentiate among sporadic, familial, and hereditary cancer based on medical and family history, and identify individuals at increased personal risk for developing cancer. **3.0**
2. Describe the role of genetic testing, including the benefits, limitations, and ethical implications for cancer patients and their unaffected family members. **3.0**
3. Describe the manifestations of common hereditary cancer syndromes. **3.0**

D. Reproductive and Prenatal Genetics

1. Recognize the indications for preconception and prenatal carrier testing for genetic disorders depending on family history and specific ethnic background. **3.0**
2. Discuss commonly used prenatal screening tests, including first and/or second trimester serum screening, cell free fetal DNA testing, and ultrasound evaluation. **3.0**
3. Discuss risks, benefits, and limitations of commonly used prenatal diagnostic procedures. **3.0**
4. Discuss indications for preimplantation genetic diagnosis and the process of implementation. **1.0**
5. Describe the impact of teratogenic substances on development. **4.0**

E. Treatment/Management

1. Discuss the following treatment strategies for genetic disease, including when they are best utilized clinically:
 - a. Organ transplantation, stem cell therapy and regenerative medicine **3.0**
 - b. Correction, enhancement, or replacement of a defective structural protein or enzyme **3.0**
 - c. Dietary treatment **3.0**
2. Explain the basic theories and techniques for gene therapy, and the challenges toward its implementation. **2.0**

3. Describe how modification of non-genetic factors, such as diet, exercise and other lifestyle factors can prevent or mitigate disease in some genetically-predisposed individuals. 3.0
4. Explain how disease specific genetic variation and knowledge of the patient's genotype might alter medical management. 3.0
5. Describe the ways in which pharmacogenetics/pharmacogenomics can inform dosing of medication, including prediction of physiological response and/or adverse drug reactions. 3.0

F. Interpersonal Communication Skills

1. Describe the role of clinical genetics professionals (e.g., medical geneticists, genetic counselors, clinical laboratory directors) in patient care, and the process for making appropriate referrals for genetic evaluations. 4.0
2. Communicate with patients and families regarding genetic information in a culturally sensitive and non-judgmental manner in a way that can be understood by the patient accounting for differences in educational, socio-economic, and ethnic backgrounds. 4.0
3. Explain the medical and legal processes for diagnostic and predictive testing of adults and minors, including the risks, benefits, limitations, and implications for other family members, and obtaining informed consent. 3.0
4. Communicate family history and medical history pertinent to genetics with an interdisciplinary team of health care professionals. 4.0

G. Practice-Based Learning and Improvement

1. Use information technology to obtain current information about genetics.¹ 3.0
2. Demonstrate the ability to stay abreast of advances in genetics that relate to changes in medical practice. 3.0

H. Professionalism

1. Describe how genetic information is different from other medical information and how that difference may affect decisions of health care providers, patients, and their families. 4.0
2. Identify examples of misuse of genetic/genomic information and testing results. 2.0
3. Recognize the need to reduce public fear and misinformation about genetics. 4.0
4. Describe the potential impact of genetic information on insurance coverage and employment status. 3.0
5. Demonstrate effective and confidential communication regarding genetic information with patients and colleagues. 4.0
6. Collaborate with genetics health professionals to provide appropriate care. 4.0

¹ Gene Tests (<http://www.genetests.org>); Online Mendelian Inheritance in Man (OMIM); (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=OMIM>); National Human Genome Research Institute (NIH/NHGRI): Health <http://www.genome.gov/Health/>; NIH Genetic Testing Registry: <http://www.ncbi.nlm.nih.gov/gtr/>; Genetics Home Reference <http://ghr.nlm.nih.gov>; National Organization for Rare Disorders (NORD) <http://www.rarediseases.org>

I. Systems-Based Practice

1. Explain the implications of local, state and federal laws, including the Genetic Information Non-Discrimination Act (GINA), that affect the privacy, confidentiality and potential discrimination related to genetic information. **4.0**
2. Describe the rationale for newborn screening and population-based screening, including factors for successful genetic screening programs. **1.0**
3. Contrast screening versus diagnostic testing and explain why specific tests may be targeted towards a defined population. **1.0**
4. Explain implications and limitations of direct to consumer genetic testing, and the need for involvement of a genetics healthcare professional in interpretation of result. **3.0**
5. Identify the challenges of including genetic information in electronic medical records, including confidentiality, insurance coverage, and other unforeseen issues. **3.0**

MICROBIOLOGY/IMMUNOLOGY

LEARNING OBJECTIVES

Antimicrobial Agents and Control of Microbes

Basic Bacteriology

Basic Concepts in Immunology

Clinical Immunology

Basic Mycology

Basic Parasitology

Basic Virology

Microbial Pathogenesis

Cardiac Infections

Genitourinary Infections and STDs

Gastrointestinal Infections

Skin, Soft Tissue, and Bone Infections

Nervous System Infections

Respiratory Tract Infections

Zoonotic and Opportunistic Infections

Blood and Systemic Infections

I. Antimicrobial Agents and Control of Microbes

1. Define:
 - a. antiseptic 4.0
 - b. aseptic 4.0
 - c. bactericidal 4.0
 - d. bacteriostatic 4.0
 - e. disinfectant 4.0
 - f. germicide 4.0
 - g. sanitization 4.0
 - h. sterilization 4.0
2. Describe the general effects chemical and physical agents have on membranes, proteins, and nucleic acids that are lethal to cells. 3.0
3. Describe the differential effect that dry and moist heat have on cells. 3.0
4. Compare and contrast using boiling versus autoclaving to control microbial growth. 3.0
5. Identify when filtration is most appropriate for sterilization. 3.0
6. Describe the effects of ionizing and nonionizing radiation on microbes. 3.0
7. Differentiate between, and provide examples of, cationic and anionic detergents. 2.0
8. Identify the effects of surfactants on bacteria. 2.0
9. Identify the mechanism of action and uses of the following in controlling microbial growth:
 - a. alcohols 3.0
 - b. alkylating agents 2.0
 - c. ethylene oxide 2.0
 - d. formaldehyde 2.0
 - e. glutaraldehyde 3.0
 - f. halogens 2.0
 - g. heavy metals 2.0
 - h. hydrogen peroxide 3.0
 - i. iodine, iodophor, chlorine and its various forms 3.0
 - j. phenol and derivatives of phenol 2.0
 - k. quaternary ammonium compounds 2.0
10. Identify the basis on which antimicrobials are selected for patients. 3.0
11. Describe important side effects of antimicrobial agents and describe how each would be recognized in a patient. 4.0
12. Identify the purpose of antibiotic susceptibility testing. 4.0
13. Describe basic procedures used to perform antimicrobial susceptibility testing and to interpret the test results of:
 - a. agar disk diffusion (Kirby-Bauer) 3.0
 - b. broth dilution 3.0
 - c. colorimetric (chromogenic) 3.0
 - d. gradient diffusion (E-test) 3.0
14. Define Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC). 4.0
15. Define broad-spectrum, narrow-spectrum, and extended-spectrum as they apply to antimicrobial agents. 3.0
16. Define and provide examples of bactericidal and bacteriostatic drugs. 4.0

17. Identify the primary mode of action, mechanisms of bacterial resistance, spectrum of activity, adverse effects and any unique characteristics of the following classes of antimicrobial agents, and list examples when applicable
- Anti-mycobacterial inhibitors **4.0**
 - Cell wall inhibitors **4.0**
 - Membrane disruptors **4.0**
 - Metabolic inhibitors **4.0**
 - Nucleic acid inhibitors **4.0**
 - Protein synthesis inhibitors **4.0**
18. Discuss the role of gastric acid lability of antibiotics. **3.0**
19. Identify the essential features of a beta-lactam antibiotic. **3.0**
20. Explain the function of beta-lactamase. **4.0**
21. Explain the usage of the combination of sulfamethoxazole-trimethoprim. **3.0**
22. Explain what clavulanic acid, tazobactam, and sulbactam have in common and how they are used in clinical medicine. **4.0**
23. Explain why some antimicrobial agents are most effective against rapidly growing cells while other agents are active against both rapidly growing and resting cells. **3.0**
24. Explain the mechanisms of the following inherent resistances to antimicrobial agents: mycoplasma resistance to cell wall active antibiotics, anaerobe resistance to aminoglycosides, aerobic resistance to metronidazole, and gram-negative resistance to vancomycin. **3.0**
25. Discuss the pros and cons of antibiotic prophylaxis and of prescribing simultaneous antibiotics. **4.0**
26. Identify the primary mode of action, mechanisms of resistance, spectrum of activity, adverse effects and any unique characteristics of the following classes of antifungal agents, and list examples when applicable.
- Azoles **4.0**
 - Flucytosine **3.0**
 - Echinocandins **3.0**
 - Griseofulvin **2.0**
 - Polyenes **4.0**
 - Potassium iodide **2.0**
 - Terbinafine **3.0**
 - Tolnaftate **3.0**
27. Identify the primary mode of action, mechanisms of resistance, adverse effects and any unique characteristics of the following classes of antiviral agents, and list examples when applicable.
- Anti-hepatitis drugs **3.0**
 - Anti-herpes drugs **3.0**
 - Anti-influenza drugs **3.0**
 - Anti-retroviral drugs **3.0**
 - Antiviral drugs and immunomodulators **3.0**
28. Identify the spectrum of activity, adverse effects and any unique characteristics of antiparasitic agents **2.0**
29. Compare and contrast different types of vaccines, including advantages and disadvantages of each. **4.0**

II. Basic Bacteriology

1. Compare and contrast prokaryotic and eukaryotic cells, particularly with respect to cell wall structure, nuclear membranes, DNA structure, plasmids, and ribosomes. 4.0
2. Describe the morphology and arrangements of bacterial cells. 4.0
3. Explain the use and significance of both Gram and Acid-fast stains and describe how each staining procedure works. 4.0
4. Describe the structure and functions of prokaryotic flagella. 2.0
5. Describe the structure and functions of pili/fimbriae. 3.0
6. Explain antigenic variation of pili/other cell surface proteins and identify its clinical significance. 3.0
7. Describe the structure, function and pathogenicity of bacterial capsules. 4.0
8. Describe the formation and importance of bacterial biofilms. 3.0
9. Compare and contrast the structure of Gram-positive and Gram-negative cell wall. 4.0
10. Describe the role of peptidoglycan in bacteria and as a target for antibiotics. 4.0
11. Define lysozyme and explain where it is found, as well as its biological activity. 3.0
12. Describe teichoic acids in terms of importance and where they are located. 3.0
13. Describe the components and functions of the outer membrane of Gram-negative bacteria. 4.0
14. Describe porins found in Gram-negative bacterial cell walls and their importance. 3.0
15. Discuss the structure and biological activities of lipopolysaccharide. 4.0
16. Describe the bacterial secretion systems, including where they are found and their importance to pathogenicity. 3.0
17. Explain the uniqueness of mycoplasmas among bacteria. 2.0
18. Describe the structure and functions of cytoplasmic membranes in bacteria. 3.0
19. Explain the function of penicillin-binding proteins in bacteria. 3.0
20. Describe the structure and functions of endospores. 4.0
21. Identify the two major genera of clinically-relevant bacteria that produce endospores and describe the similarities and differences between them. 4.0
22. Explain the methods used to classify bacteria taxonomically. 3.0
23. Describe the methods used to identify bacteria from a clinical isolate in the clinical laboratory. 3.0
24. Explain the functions of siderophores and their role in pathogenicity. 2.0
25. Explain the term “fastidious” with respect to bacterial culture. 2.0
26. Classify bacteria based upon oxygen and temperature requirements and list examples of each classification. 3.0
27. Explain the importance of proper pH and proper osmotic pressure for microbial growth. 2.0
28. Explain the term “generation time” and the factors that affect it. 3.0
29. Describe the phases of the bacterial growth curve and explain their importance. 3.0
30. Explain “quorum sensing” and its importance. 3.0
31. Explain how to obtain a pure culture of bacteria and explain its significance in diagnosis. 4.0
32. Describe the various microscopic methods used to observe microbial pathogens. 3.0
33. Differentiate between nonselective, selective, and differential growth media and list examples of each. 3.0
34. Define glycolysis, fermentation, aerobic respiration, and anaerobic respiration. 3.0
35. Explain how metabolic capabilities of bacteria relate to bacterial identification and to pathogenicity. 2.0
36. Identify the active and passive transport mechanisms used by bacteria. 2.0
37. Describe the differences between bacterial and eukaryotic transcription and translation. 3.0
38. Define mutation, base-pair substitution mutation, frame-shift mutation, genotype, phenotype, transfection, homologous recombination, nonhomologous recombination, donor, recipient, and transformant. 3.0
39. Describe an operon and its regulation mechanisms. 2.0

40. Describe DNA repair mechanisms in bacteria.	2.0
41. Explain transformation as it occurs in bacteria.	3.0
42. Describe plasmids and the process of conjugation.	3.0
43. Describe resistance transfer factors and discuss their significance to human medicine.	4.0
44. Describe the selective pressures that favor the development of antibiotic-resistant bacteria.	3.0
45. Describe pathogenicity islands and their significance.	3.0
46. Define insertion sequence and transposon and explain their importance to virulence and disease.	3.0
47. Describe the lytic and lysogenic cycles as they occur in bacteriophage-infected bacteria and the significance of prophages in a clinical environment.	3.0
48. Describe transduction as it occurs in bacteria, and differentiate between generalized and specialized transduction.	3.0
49. Explain Koch's Postulates and its limitations.	3.0
50. Explain the strategies of how pathogenic microbes can evade host defenses.	4.0
51. Compare and contrast true pathogens versus opportunistic pathogens.	4.0
52. Differentiate between a toxigenic and an invasive pathogen.	3.0
53. Compare and contrast exotoxins and endotoxins and give examples of each.	4.0
54. Describe the source and function of superantigens, such as toxic shock syndrome toxin.	4.0
55. Describe AB exotoxin structure and function.	3.0
56. Explain the attributes of a microbe that contribute to invasiveness.	3.0
57. Describe the major normal flora microbes, where they are found, and which are important opportunistic pathogens/their disease associations.	4.0
58. Describe the human microbiome and its role in health and disease.	3.0
59. Describe the major mechanisms of transmission of infectious diseases.	4.0
60. Define the following terms:	
a. bacteremia	4.0
b. carrier	4.0
c. communicable disease	4.0
d. endemic	4.0
e. endotoxin	4.0
f. enterotoxin	4.0
g. epidemic	4.0
h. exotoxin	4.0
i. fomite	4.0
j. infectious dose	4.0
k. latent infection	4.0
l. microbiome	4.0
m. opportunistic pathogen	4.0
n. pandemic pathogenicity	4.0
o. pyemia	4.0
p. pyogenic	4.0
q. pyrogenic	4.0
r. subclinical infection	4.0
s. superinfection	4.0
t. systemic infection	4.0
u. systemic inflammatory response syndrome (SIRS), sepsis, severe sepsis, septic shock, and septicemia	4.0
v. toxoid	4.0
w. virulence	4.0
x. zoonosis	4.0

61. Describe proper specimen collection from various anatomical sites. 3.0

III. Basic Concepts in Immunology

1. Compare and contrast innate and adaptive immunity. 4.0
2. Define antigenicity, immunogenicity, antigen, antigenic determinant, epitope, hapten, immunogen, tolerogen, and mitogen, and give examples of each. 4.0
3. Describe the interaction between innate and adaptive immunity. 3.0
4. Characterize active and passive immunity. 4.0
5. Differentiate between self-antigen and foreign-antigen. 4.0
6. Identify physical and physiological barriers to infection. 4.0
7. Describe the process of white blood cell hematopoiesis. 3.0
8. Explain the role of antimicrobial peptides such as defensins or cathelicidins in innate immunity. 3.0
9. Identify the cells of the innate immune response and describe their general function in terms of recognition of microbes, production of cytokines, and destruction of microbes. 4.0
10. Explain the function of follicular dendritic cells. 3.0
11. Describe the characteristics and functions of the granulocytic cells, mast cells, dendritic cells, and natural killer cells. 4.0
12. Describe the characteristics and functions of monocytes and macrophages. 4.0
13. Describe the phagocytic barrier to infection. 4.0
14. Identify and describe the function of the phagocytic cells in the body. 4.0
15. Explain the concept of innate pattern recognition of microbes by phagocytic cells. 3.0
16. Explain the role of pattern recognition receptors (PRRs) and their interaction with pathogen associated molecular patterns (PAMPs) in the activation of innate immune cells. 4.0
17. Define the functional role of cell adhesion molecules including selectins, integrins, immunoglobulin superfamily members, and accessory molecules. 2.0
18. Describe the chemotactic factors involved in the recruitment of various inflammatory cells. 3.0
19. Explain the role of chemokines and chemokine receptors in regulation of immune cell trafficking and localization within immune organs. 3.0
20. Describe the steps involved in phagocytic cell recruitment and migration into sites of inflammation: rolling, activation, tight adhesion, and transendothelial migration. 3.0
21. Describe the inflammasome and its functions. 2.0
22. Explain the role of Fc receptors and complement receptors in phagocytosis, and activation of phagocytic cells. 4.0
23. Identify and describe the stages of phagocytosis. 3.0
24. Describe the possible effect of nitric oxide in inflammatory cell-mediated tissue injury. 2.0
25. Identify the pathways involved in reactive oxygen burst and the formation of reactive oxygen metabolites following tissue injury. 3.0
26. Explain the function of natural killer (NK) cells, the mechanism of activation, and the role of activating and inhibitory receptors in the control of their function. 3.0
27. Describe the lipopolysaccharide (LPS)-induced cytokine cascade. 2.0
28. Describe the cytokines involved in the acute phase response. 3.0
29. Describe the inflammatory response. 4.0
30. Describe the local and systemic effects of the inflammatory response. 3.0
31. Explain the role of the acute phase response and associated soluble effector proteins in the innate immune response. 3.0
32. Identify the key inflammatory cytokines and their local, as well as systemic, roles in innate immunity. 3.0

33. Describe the complement system and its regulation.	3.0
34. Describe the role that complement plays in innate immunity.	4.0
35. Describe the complement receptors, expression pattern and function.	3.0
36. Differentiate among the three complement pathways: classical, lectin, and alternative.	3.0
37. Describe the effector molecules of complement activation and their biologic functions.	3.0
38. Describe how complement mediates the following:	
a. B cell activation	4.0
b. cell lysis (membrane attack complex)	4.0
c. chemotaxis	4.0
d. clearance of immune complexes	4.0
e. inflammation due to anaphylatoxins	4.0
f. opsonization	4.0
39. Explain the use of plasma CH50 and AH50 levels in the assessment of disease processes.	1.0
40. Explain the basis of cytokine nomenclature and identify the major classifications of cytokines.	2.0
41. Describe the general functions of the following cytokines and their receptors:	
a. IL-1, IL-2, IL-4, IL-6, IL-10, IL-12, IFNs, TNF-alpha	4.0
b. IL- 5, IL-7, IL-8, IL-17, TGF-beta	3.0
c. IL-3, IL-15, CSFs	2.0
42. Explain the role of the lymphatic system in the transport of antigen and immune cells in the body.	4.0
43. Describe the distribution of lymph nodes in the body.	3.0
44. Describe the function of the secondary lymphoid organs in trapping and processing of antigens.	3.0
45. Explain the function of different regions of the spleen and lymph nodes in adaptive immune responses.	3.0
46. Explain the location and function of specialized lymphoid tissues, such as the mucosal-associated lymphoid tissues (MALT).	3.0
47. Identify the location and functions of MALT tissues in the periphery.	4.0
48. Describe the location and function of M cells in the intestinal mucosa.	4.0
49. Describe lymphocyte recirculation and the role of adhesion molecules in lymphocyte trafficking.	3.0
50. Describe the cells of adaptive immunity (T cells and B cells).	4.0
51. Describe the phases of the adaptive immune response.	3.0
52. Describe the general characteristics of humoral and cell-mediated immunity.	4.0
53. List and describe the features of the adaptive immune response – specificity, diversity, specialization, self-limitation, and memory.	4.0
54. Explain the essential role of gene families in the evolution of antigen recognition in the immune system.	2.0
55. Explain the theory of clonal selection.	3.0
56. Describe the basic aspects of naïve T and B cell activation and the role of professional antigen presenting cells in this process.	4.0
57. Describe the basic effector functions of T and B cells in an immune response.	4.0
58. Describe the maturation of B and T cells in primary lymphoid tissues	3.0
59. Describe the markers used to distinguish different lineages, subsets, and maturational stages of lymphocytes.	3.0
60. Describe the functional significance and/or cellular distribution of the following:	
a. CD3	3.0
b. CD4	3.0
c. CD8	3.0

d. CD19	3.0
e. CD20	3.0
f. CD40	3.0
g. CD25	3.0
h. TCR	3.0
i. BCR	3.0
61. Explain the role of the bone marrow in lymphocyte origin.	2.0
62. Describe the process of T cell maturation in the thymus:	
a. Role of thymic stromal cells and expression of AIRE	3.0
b. Stages of T cell maturation (developmental pathway)	3.0
c. Development and structure of the TCR complex	4.0
d. Expression of CD4/CD8	3.0
d. Positive and negative selection	4.0
e. Programmed cell death (apoptosis)	3.0
63. Describe the process of B cell maturation in the bone marrow:	
a. Order of rearrangement and expression of immunoglobulin heavy and light chain genes	3.0
b. Development and structure of the BCR complex.	4.0
c. Light chain editing	3.0
d. Negative selection	3.0
e. Programmed cell death (apoptosis)	3.0
64. Explain the fundamental difference between B cell and T cell epitopes.	3.0
64. Describe the function of MHC molecules in antigen presentation and in cell-cell interactions in the immune system.	4.0
65. Describe the genetic organization of the MHC (HLA) loci.	2.0
66. Describe and compare the major structural features of the MHC Class I and Class II glycoproteins.	3.0
67. Identify the tissue distribution of class I and class II MHC.	4.0
68. Identify examples of MHC/disease correlations and provide a hypothesis to account for this correlation.	3.0
69. Explain MHC polymorphism and the selective advantage of such a system.	3.0
70. Explain MHC restriction.	3.0
71. Define MHC haplotypes.	3.0
72. Explain how T lymphocytes recognize antigen bound to MHC molecules.	3.0
73. List and describe the functions of each type of antigen presenting cells (APC).	4.0
74. Compare and contrast the pathways of processing and presentation of both exogenous and endogenous protein antigens.	3.0
75. Identify and explain the steps involved in lymphocyte activation.	3.0
76. Identify the functional significance of Immunoreceptor Tyrosine-based Activation Motifs (ITAMs).	2.0
77. Describe the overall structure and function of the TCR complex on mature T cells.	3.0
78. Differentiate between the two types of TCRs (alpha/beta and gamma/delta).	2.0
79. Describe the molecular genetic mechanisms used to generate diversity in the TCR.	3.0
80. Compare the gene organization of the TCR loci with that of the BCR loci.	2.0
81. Explain the activation of T cells (e.g., the interactions between APCs and T cells leading to T cell activation).	4.0
82. Explain the two-signal model of T cell activation and the role of B7-CD28 costimulation.	3.0
83. Summarize the signal transduction cascades triggered in T and B cells by antigen recognition that result in transcription factor activation.	2.0

84. Explain the functional role of the T cell accessory protein CD4 and CD8 in recognition of antigen and T cell activation.	4.0
85. Identify examples of cell adhesion molecules, (e.g., ICAM, LFA-1) and describe their role in T cell activation.	2.0
86. Describe the mechanism of superantigen activation of T cells.	3.0
87. Describe the effector T cell populations in the periphery.	4.0
88. Describe the different T helper subpopulations and their role in controlling the immune response.	3.0
89. Identify the populations of effector T cells and explain their activation requirements.	4.0
90. Explain the role of cytokines in T helper cell differentiation into Th1, Th2, or Th17 cells and describe the production and function of cytokines by these distinct T helper cell subsets.	3.0
91. Explain the process whereby effector CTLs are generated from CTL precursors.	3.0
92. Explain the process by which effector CTLs recognize target cells.	3.0
93. Describe the two processes of effector CTL-mediated cell lysis.	3.0
94. Explain the role of CTLA-4 in attenuation of T cell activation.	3.0
95. Identify the antigen-independent and antigen-dependent phases in B cell ontogeny.	2.0
96. Describe the overall structure and function of the B cell antigen receptor complex.	3.0
97. Describe the mechanism of antigen induced B lymphocyte activation.	3.0
98. Compare and contrast the effects of T-independent and T-dependent antigens on B cell activation.	3.0
99. Describe the two signal model of B cell activation and the role of CD40-CD40L costimulation.	4.0
100. Describe the mechanism of CD4+ T cell--B cell collaboration	3.0
101. Explain the process by which B cell coreceptors modulate antigen receptor signaling through the recruitment of effector proteins to ITIMs and ITAMs.	2.0
102. Explain the induced tolerance of two basic mechanisms; clonal deletion and clonal anergy (or functional inactivation).	3.0
103. Identify and describe B cell subpopulations (B-1, B-2, and MZ B cells).	3.0
104. Explain the role of the germinal center in B cell responses to antigen.	3.0
105. Describe antigen-antibody interactions.	3.0
106. Define affinity and avidity, and explain their roles in immune processes.	3.0
107. Differentiate between soluble and insoluble immune complexes.	2.0
108. Describe the basic structure of the immunoglobulin (Ig) monomer and its functional domains.	4.0
109. Describe the overall chain structure of the 5 classes and subclasses of immunoglobulins.	4.0
110. Identify the two types of light chains (kappa and lambda).	3.0
111. Differentiate between isotype, allotype, and idiotype.	2.0
112. Describe constant, variable and hypervariable regions with respect to antibody structure.	3.0
113. Explain the specialized functions of the human Ig isotypes and their role in host defense.	4.0
114. Explain the process by which IgA crosses the epithelium and identify the role of the poly-Ig receptor in IgA secretion.	3.0
115. Explain molecular genetic mechanisms involved in the generation of antibody diversity (e.g., multiple V region gene elements, variable recombination, junctional diversity, etc.).	3.0
116. Explain allelic exclusion with respect to immunoglobulin gene expression.	2.0
117. Describe the genetic mechanism used to produce membrane-bound and secreted forms of Igs.	3.0
118. Explain isotype switching and its functional significance.	4.0
119. Describe the mechanism used to regulate expression of IgD.	1.0
120. Describe somatic hypermutation and explain its functional significance.	3.0
121. Describe how antigen-dependent signaling in the absence of costimulation leads to induction of anergy in T and B cells and explain the significance of anergy.	3.0

- | | |
|--|-----|
| 122. Describe the mechanisms of central and peripheral tolerance in T and B cells, including anergy, deletion and suppression by Treg cells. | 3.0 |
| 123. Explain the role of regulatory T cells (Treg cells) in mediating peripheral tolerance. | 3.0 |
| 124. Explain the role of Fas and Fas ligand in mediating apoptosis of activated T and B cells. | 2.0 |
| 125. Describe the process of antibody-dependent feedback in negative regulation of B cells. | 2.0 |
| 126. Explain the role of CD19 in regulating the activation of B cells. | 2.0 |
| 127. Describe antibody dependent cell-mediated cytotoxicity (ADCC). | 3.0 |

IV. Clinical Immunology

- | | |
|--|-----|
| 1. Describe the basis of classification of hypersensitivity reactions into hypersensitivity types. | 3.0 |
| 2. Describe the pathophysiologic mechanisms associated with Type I (IgE)-mediated injury. | 4.0 |
| 3. Explain the process of mast cell degranulation. | 4.0 |
| 4. Describe the primary effector mediators released by mast cells. | 4.0 |
| 5. Describe the pathologic changes in tissues during anaphylactic reactions. | 4.0 |
| 6. Compare and contrast the acute phase reaction with the late phase reaction in anaphylactic reactions. | 4.0 |
| 7. Explain the modulator role of eosinophils in allergic and anaphylactic reactions. | 3.0 |
| 8. Correlate the effect of mediators on target organs with clinical manifestations of allergic reactions. | 3.0 |
| 9. Identify therapeutic modulation of type I hypersensitivity. | 4.0 |
| 10. Describe the diagnosis of Type I hypersensitivity via skin tests, and the immunoassays RIST and RAST. | 4.0 |
| 11. Describe the clinical symptoms and basis of the symptoms of allergic asthma. | 3.0 |
| 12. Identify the mechanisms of the treatments for allergic asthma. | 3.0 |
| 13. Differentiate between type II and type III hypersensitivity reactions and give examples of each. | 4.0 |
| 14. Compare complement mediated cell lysis with antibody dependent cell cytotoxicity. | 3.0 |
| 15. Explain the pathogenesis of drug-induced hypersensitivities. | 3.0 |
| 16. Describe the immunological basis for erythroblastosis fetalis. | 2.0 |
| 17. Describe the mechanism and histopathology of Arthus reaction. | 2.0 |
| 18. Describe type IV hypersensitivity. | 4.0 |
| 19. Identify the basis for and examples of contact hypersensitivity. | 4.0 |
| 20. Identify the mechanisms involved in and manifestations of a positive tuberculin reaction. | 4.0 |
| 21. Describe the granulomatous response. | 4.0 |
| 22. Identify and describe autoimmune diseases associated with specific organs. | 3.0 |
| 23. Identify autoimmune diseases that are systemic in nature. | 3.0 |
| 24. Explain the role that gender, genetics, environment, and infectious disease play in the development of autoimmunity. | 3.0 |
| 25. Describe the mechanisms that help to explain anti--self-responses | 3.0 |
| 26. Explain the role of MHC genes in autoimmunity. | 3.0 |
| 27. Describe the basic types of therapeutic intervention used to treat autoimmune disease. | 3.0 |
| 28. Describe the immunologic basis of graft rejection. | 4.0 |
| 29. Define autograft, isograft, allograft, and xenograft. | 4.0 |
| 30. Explain why the non-self MHC molecules are the major molecular targets in graft rejection. | 3.0 |
| 31. Differentiate between major and minor MHC molecules. | 2.0 |
| 32. Describe hyperacute, acute, and chronic rejection and graft versus host disease. | 4.0 |
| 33. List tests used to measure tissue histocompatibility. | 2.0 |
| 34. Describe approaches to prolonging graft survival (e.g., immunosuppressive drugs, mAbs, and immune modulators). | 3.0 |

35. Describe the immunological complications that can be associated with bone marrow transplantation.	2.0
36. Differentiate congenital versus acquired immunodeficiency.	3.0
37. Identify the basic classification of congenital immunodeficiencies.	2.0
38. Describe the clinical presentation and pathophysiology associated with severe combined immunodeficiencies.	3.0
39. Describe the basic defect and clinical manifestations seen in the following immunodeficiencies:	
a. Ataxia-telangiectasia	2.0
b. Chediak-Higashi syndrome	3.0
c. Chronic granulomatous disease	3.0
d. Common variable immunodeficiency	2.0
e. DiGeorge syndrome	2.0
f. Hyper-IgM syndrome	3.0
g. IFN-gamma/IL-12 receptor deficiencies	2.0
h. Leukocyte adhesion deficiencies	2.0
i. Selective IgA deficiency	3.0
j. Wiskott-Aldrich syndrome	2.0
k. X-linked agammaglobulinemia	3.0
40. Explain the effects of specific complement deficiencies on patients.	3.0
41. Identify basic therapeutic approaches for treatment of immunodeficiencies.	2.0
42. Describe examples of acquired immunodeficiencies and identify their causes (e.g., AIDS, drug induced, radiation induced).	4.0
43. Identify the immunological abnormalities associated with HIV infection.	4.0
44. Describe the concept of immunosurveillance.	3.0
45. Explain the principle of tumor-specific antigens and what role they might have clinically.	3.0
46. Describe the roles of antibody, T cells, NK cells, and macrophages in tumor immunity.	3.0
47. Explain the involvement of MHC molecules in tumor immunity (e.g., the effect of virally induced low MHC expression).	2.0
48. Explain ways that tumors evade immune recognition.	3.0
49. Describe approaches to tumor immunotherapy.	3.0
50. Identify potential causes of lymphoproliferative disorders.	2.0
51. Describe the immune response to both intracellular and extracellular bacterial infections.	4.0
52. Explain the mode of action of adjuvants.	3.0
53. Describe delayed type hypersensitivity as it relates to host responses against intracellular bacteria.	4.0
54. Describe the host immune response to parasitic infection.	3.0
55. Identify mechanisms of pathogen mediated immune evasion.	3.0
56. Explain the basis for inactivated, attenuated, subunit and recombinant, vaccines.	3.0
57. Differentiate between active and passive immunity to microbes.	4.0
58. Differentiate between primary and secondary immune responses to vaccines and microbes.	4.0
59. Describe the use of monoclonal antibodies to modulate immune cell function or to remove specific immune cells from the body.	3.0
60. Describe the use of immunosuppressive drugs for the treatment of autoimmune disease or to prevent transplant rejection.	3.0
61. Describe the use of bone marrow transplantation in the treatment of congenital immunodeficiencies or cancer.	2.0
62. Describe the use of IVIG in the treatment of autoimmune disease and congenital immunodeficiencies.	3.0

- | | |
|--|------------|
| 63. Identify the potential therapeutic roles of cytokines or antibodies specific for cytokines and/or their receptors in the treatment of immune-mediated diseases. | 3.0 |
| 64. Describe the principles of the following diagnostic assays: ELISA, Western blot, flow cytometry/FACS, immunoprecipitation, agglutination, immunofluorescence, and RIA tests. | 3.0 |
| 65. Differentiate between immune tolerance and immune deficiency. | 3.0 |
| 66. Explain how tolerance mechanisms can fail, facilitating development of autoimmunity. | 3.0 |
| 67. Describe the role of specialized epithelial cells (Paneth cells, M cells, Goblet cells) in mucosal immunity. | 4.0 |
| 68. Explain the role of Th17 and Treg cells in mucosal immunity | 4.0 |
| 69. Describe the immune mechanisms involved with Celiac disease, Crohn's disease and ulcerative colitis | 3.0 |

V. Basic Mycology

- | | |
|--|------------|
| 1. Define: | |
| a. arthroconidia | 3.0 |
| b. ascospores | 2.0 |
| c. ascus | 2.0 |
| d. basidiospores | 2.0 |
| e. blastospores | 3.0 |
| f. chlamydoconidia | 2.0 |
| g. conidia | 3.0 |
| h. dematiaceous | 3.0 |
| i. dimorphism | 3.0 |
| j. hyaline | 2.0 |
| k. hyphae | 3.0 |
| l. macroconidia | 3.0 |
| m. microconidia | 3.0 |
| n. mycelium | 3.0 |
| o. nonseptate/aseptate/coenocytic | 3.0 |
| p. pseudohyphae/pseudomycelia | 3.0 |
| q. septate | 3.0 |
| r. sporangiospores | 2.0 |
| s. thallospores | 2.0 |
| t. zygozspores | 2.0 |
| 2. Compare the structure of fungal cells to other eukaryotic cells and to bacteria. | 4.0 |
| 3. Compare and contrast yeasts, molds, and dimorphic fungi. | 4.0 |
| 4. Explain the basis for fungal taxonomy. | 2.0 |
| 5. Describe the major attributes of Deuteromycetes (fungi imperfecta), Zygomycetes, Ascomycetes, Archiascomycetes (<i>Pneumocystis</i>), and Basidiomycetes. | 2.0 |
| 6. Describe the clinical laboratory identification of fungi. | 3.0 |
| 7. Describe the purpose of a KOH preparation in the identification of fungi. | 4.0 |
| 8. Define mycotoxicosis. | 2.0 |
| 9. Differentiate among endothrix, exothrix, and favic fungal infection of hair. | 2.0 |
| 10. Identify the primary genera that cause cutaneous mycoses (dermatomycoses). | 4.0 |
| 11. Differentiate among anthropophilic, zoophilic, and geophilic dermatophytes, and describe the clinical significance of associating the mycotic agent with its source. | 3.0 |

12. Describe the use of the UV or Wood's lamp in diagnosing mycotic infections. **3.0**
13. Describe the basis of the "Id reaction." **3.0**
14. Describe the use of macroconidia and microconidia identification in the determination of dermatophytes. **3.0**
15. Differentiate between eumycotic and actinomycotic mycetomas. **3.0**
16. Identify the causative agent, method of acquisition, geographic distribution, primary symptoms, and treatment for sporotrichosis, chromoblastomycosis, histoplasmosis, blastomycosis, coccidiomycosis, mucormycosis, cryptococcosis and candidiasis. **4.0**
17. Differentiate among superficial, cutaneous, subcutaneous, systemic and opportunistic mycoses and give examples of each. **4.0**

VI. Basic Parasitology

1. Define cyst, trophozoite, oocyst, vector, intermediate host, definitive host, and paratenic host. **3.0**
2. Describe the classification of protozoa. **3.0**
3. Describe the classification of helminths. **3.0**
4. Explain the roles of insects and arachnids as either ectoparasites or vectors in human disease. **3.0**
5. Describe the structural characteristics, mode of transmission, pathogenesis, clinical manifestations, and geographic distribution of the following parasitic organisms:
 - a. *Acanthamoeba* sp. **3.0**
 - b. *Cryptosporidium parvum* **3.0**
 - c. *Entamoeba histolytica* **3.0**
 - d. *Enterobius vermicularis* **3.0**
 - e. *Giardia lamblia* **3.0**
 - f. Hookworms **3.0**
 - g. *Naegleria fowleri* **3.0**
 - h. *Plasmodium* sp. **3.0**
 - i. *Schistosoma* sp. **3.0**
 - j. *Toxoplasma gondii* **3.0**
 - k. *Trichomonas vaginalis* **3.0**

VII. Basic Virology

1. Define:
 - a. cell culture **2.0**
 - b. cytopathic effect **3.0**
 - c. hemagglutination **2.0**
 - d. plaque **3.0**
 - e. reassortment **3.0**
 - f. syncytia **3.0**
2. Describe the size, shape, nucleic acid, capsid, capsomere, nucleocapsid, capsid symmetry, icosahedral, helical, and envelope of viruses. **4.0**
3. Explain the classification of DNA virus families, including whether they are enveloped or non-enveloped; the DNA structure (dsDNA, ssDNA, linear, circular); and replication site. **3.0**
4. Explain the classification of RNA virus families, including whether they are enveloped or non-enveloped; the RNA structure (dsRNA, ssRNA, linear, circular); sense (positive, negative, or ambisense); capsid symmetry; and replication site. **3.0**

- | | |
|---|-----|
| 5. Explain defective viruses. | 2.0 |
| 6. Explain prions. | 3.0 |
| 7. Describe virus replication, including adsorption, entry, uncoating, genome replication, viral protein synthesis, assembly, maturation, and release (lysis or budding). | 4.0 |
| 8. Differentiate between antigenic drift and antigenic shift. | 4.0 |
| 9. Describe the cultivation of viruses in the laboratory. | 2.0 |
| 10. Explain the use of viruses in gene therapy. | 2.0 |
| 11. Discuss malignant transformation, oncogenes and tumor suppressor proteins. | 3.0 |

VIII. Microbial Pathogenesis

- | | |
|---|-----|
| 1. Differentiate between endogenous (i.e., normal flora) and exogenous sources of infection. | 4.0 |
| 2. Explain how normal flora on skin or mucosal membranes can cause disease when introduced into deeper tissues. | 4.0 |
| 3. Compare and contrast endogenous and exogenous infections. | 4.0 |
| 4. Explain the significance of microbial adhesion in regards to the establishment of an infection. | 4.0 |
| 5. Explain which microbial surface structures can function as adhesins. | 4.0 |
| 6. Describe what structures act as adhesins for enveloped versus nonenveloped viruses. | 3.0 |
| 7. Describe how host cell surface components can act as receptors. | 3.0 |
| 8. Discuss the function of neutralizing antibodies in preventing microbial attachment. | 3.0 |
| 9. Explain how attachment helps microorganisms to remain at a particular location/evade innate defense mechanisms. | 3.0 |
| 10. Describe the action of invasins. | 2.0 |
| 11. Describe the role of secreted enzymes in invasiveness of bacteria. | 3.0 |
| 12. Describe the advantage of encapsulation for bacteria and give examples of encapsulated organisms. | 3.0 |
| 13. Describe the mechanism of hemolysin and cytolysin. | 3.0 |
| 14. Explain the mechanisms of action for the pore-forming and phospholipase cytolysins. | 3.0 |
| 15. Explain how hemolysis patterns on blood agar can help with species differentiation and disease diagnosis. | 3.0 |
| 16. Discuss the advantages of intracellular growth from a microbial perspective. | 3.0 |
| 17. Contrast mechanisms of bacterial entry into a phagocytic versus a non-phagocytic cell. | 2.0 |
| 18. Identify bacteria that rearrange actin to enable their entry and identify the basic steps in the process. | 1.0 |
| 19. Characterize the following intracellular survival mechanisms: | |
| a. alteration of phagolysosomal environment | 3.0 |
| b. escape from phagosome | 3.0 |
| c. prevention of phagolysosome fusion | 3.0 |
| 20. Describe the adaptations/virulence factors utilized by extracellular bacteria to evade the host's antimicrobial defenses. | 3.0 |
| 21. Assess the significance of intracellular growth when selecting an appropriate antimicrobial agent. | 3.0 |
| 22. Explain the significance of tissue tropism in microbial pathogenesis. | 4.0 |
| 23. Identify the factors, both host and microbial, that influence the colonization of a particular site by a microorganism. | 3.0 |
| 24. Define symbiosis, commensalism, parasitism, colonization, and mutualism. | 3.0 |
| 25. Explain the benefits of microorganism colonization to the host. | 3.0 |
| 26. Identify factors that predispose to the development of disease when a host encounters a microorganism. | 3.0 |

27. Identify mechanisms of host cell damage.	3.0
28. Explain the genetic basis of bacterial toxin production.	2.0
29. Differentiate between exotoxins and endotoxins.	3.0
30. Distinguish the determining factor(s) of the cell to which an exotoxin binds.	2.0
31. Explain pathogenesis of septic shock.	4.0
32. Explain infectious pathogenesis of disseminated intravascular coagulation.	3.0
33. Identify the mechanisms of tissue damage caused by fungi.	3.0
34. Describe the morphologic growth patterns of fungi and identify which are advantageous for allowing invasion of host tissue.	3.0
35. Describe the changes in the host cell seen as a result of viral infection.	3.0
36. Explain occurrences in a virally-infected cell that result in persistent or latent infection.	3.0
37. Describe the changes in a cell that is transformed by viral infection.	3.0
38. Identify bacterial components that are active in eliciting a host immune response.	3.0
39. Describe the mechanism of damage to the host that may occur from immune complexes.	4.0
40. Describe the mechanism of damage to the host that may occur from the cell-mediated response to a virus.	4.0
41. Explain the damage that may occur with autoimmune sequelae of an infection.	3.0
42. Describe how each of the following factors facilitates evasion of the host immune response (innate and/or adaptive):	
a. coagulase	3.0
b. IgA protease	3.0
c. leukocidin	3.0
d. lipoteichoic acid	2.0
e. M protein	3.0
f. pili/fimbriae	4.0
g. polysaccharide capsule	4.0
h. protein A	3.0
43. Explain the resilience of bacteria in a biofilm to antimicrobials and to host immune responses.	4.0
44. Explain how antigenic variation facilitates evasion of the host immune response by pathogens, and how this affects host and therapeutic/prophylactic mechanisms to prevent reinfection.	4.0
45. Explain how a microorganism might mediate the trait of serum resistance.	2.0
46. Describe several mechanisms used by viruses to evade the antiviral interferon response.	2.0
47. Explain how HIV- and CMV-mediated down regulation of MHC class I expression enhances their ability to evade the host immune response.	2.0
48. Identify and describe viruses that produce syncytia and explain the mechanism of cell-to-cell spread that enhances their ability to evade the host immune response.	3.0
49. Explain what is meant by “immune privileged” sites in the body and describe viruses that exhibit a tropism for these sites.	2.0
50. Describe mechanisms used by viruses to produce persistent infections.	3.0
51. Describe the mechanism through which herpes viruses produce a latent infection in their host and the contribution to the ability to evade the host immune response.	4.0
52. Describe the development of “immune tolerance” in neonates infected with hepatitis B virus, rubella virus, or CMV, and discuss the effects on the infected infant.	2.0
53. Compare and contrast the mechanisms of persistence for HBV and HCV.	2.0
54. Explain the lack of host immune response in prion diseases.	3.0

55. Explain the contribution of antigenic shift and antigenic drift to the ability of influenza virus to evade the host immune response. **3.0**
56. Explain the generation of viral “quasi-species” and its contribution to the ability of some viruses to evade the host immune response. **1.0**
57. Describe and give examples of the following modes of transmission:
- a. aerosols/aerosolization **4.0**
 - b. community-acquired **4.0**
 - c. endogenous infection **4.0**
 - d. fecal-oral **4.0**
 - e. fomites **4.0**
 - f. food/water **4.0**
 - g. horizontal transmission **4.0**
 - h. nosocomial/hospital-acquired **4.0**
 - i. percutaneous **4.0**
 - j. person-to-person **4.0**
 - k. rodent-borne **4.0**
 - l. sexual contact **4.0**
 - m. soil **4.0**
 - n. vector-borne **4.0**
 - o. vertical transmission **4.0**
 - p. zoonotic **4.0**
58. Describe structural features of viruses that often affect their stability in the environment and mode of transmission. **3.0**
59. Identify the major sites of entry for infectious agents into the body and the barriers they must overcome at these sites to survive. **3.0**
60. Define reservoir and vector in the context of zoonoses. **3.0**
61. Differentiate among self-limited infection, subacute infection, acute infection, atant infection, and chronic infection. **3.0**
62. Describe the steps that occur in an acute, self-limiting infection with respect to the pathogen, pathogenesis, and host immune response. **3.0**
63. Describe the role of international travel, exotic pets, and exotic food sources in the spread of emerging infectious diseases. **3.0**
64. Describe how the creation of new environmental niches have contributed to the development of several emerging infectious diseases. **3.0**
65. Explain how a microorganism might mediate the trait of serum resistance. **2.0**
66. Differentiate the roles of humoral versus cell-mediated immune responses in mediating clearance of viruses. **3.0**
67. Explain the term “chronic carrier.” **3.0**
68. Explain the term “slow virus infection.” **1.0**

IX. Cardiac Infections

- 1. Identify the organisms that commonly cause endocarditis. **3.0**
- 2. Explain the risk factors underlying etiologies in particular patients. **3.0**
- 3. Describe “vegetative” lesions associated with endocarditis and explain the contribution to the diagnosis and effect on therapeutic options. **2.0**
- 4. Differentiate between acute and subacute bacterial endocarditis (ABE and SBE) and give examples of each. **3.0**

5. Explain the laboratory procedures that distinguish among the organisms causing endocarditis. **3.0**
6. Describe the important virulence factors for pathogens causing endocarditis and discuss how these factors contribute to the virulence of these organisms. **3.0**
7. Explain the relationship between rheumatic fever and subacute bacterial endocarditis. **2.0**
8. Describe the role of lysogenized strains of *Corynebacterium diphtheriae* in causing congestive heart failure. **3.0**
9. Identify the most common infectious causes of myocarditis. **2.0**

X. Genitourinary Infections and STDs

1. Define cystitis and pyelonephritis. **3.0**
2. Distinguish acute from chronic pyelonephritis. **3.0**
3. Describe the most common causes of community-acquired versus nosocomial urinary tract infections (UTIs). **3.0**
4. Explain why some UTIs cause urolithiasis. **3.0**
5. Explain the routes of transmission of agents of UTIs. **3.0**
6. Identify the host defenses that protect against infection by UTI-causing bacteria. **3.0**
7. Identify factors that predispose patients to UTIs. **3.0**
8. Explain the prevalence of bacterial UTIs in females. **3.0**
9. Describe diagnostic methods for bacterial UTIs. **3.0**
10. Identify viral and parasitic agents of UTIs. **2.0**
11. Describe the risk factors and pathogenesis of agents causing UTIs, including:
 - a. *Enterococcus* spp. **3.0**
 - b. *Klebsiella* spp. **3.0**
 - c. *Proteus* spp. **3.0**
 - d. *Pseudomonas aeruginosa* **3.0**
 - e. *Staphylococcus saprophyticus* **3.0**
 - f. Uropathogenic *E. coli* and Extraintestinal Pathogenic *E. coli* **3.0**
12. Describe structural characteristics of *Treponema pallidum* spp *pallidum*. **3.0**
13. Describe the transmission, risk factors, epidemiology, pathogenesis, and clinical identification of syphilis, including primary, secondary, and tertiary manifestations of disease. **3.0**
14. Describe congenital syphilis and describe its manifestations and prevention. **3.0**
15. Explain the difference between non-specific and specific serological tests for syphilis and the pattern of the immune response vis-à-vis these tests in treated and untreated cases. **3.0**
16. Identify antibiotics of choice in treating syphilis. **3.0**
17. Describe structural and cultural characteristics of *Neisseria gonorrhoeae*. **3.0**
18. Describe the transmission, risk factors, epidemiology, pathogenesis, treatment and clinical identification of *N. gonorrhoeae* infection. **3.0**
19. Distinguish between gonococcal and non-gonococcal urethritis. **3.0**
20. Describe disseminated gonococcal infections and distinguish them from gonococcal infections of the eyes and throat. **3.0**
21. Describe the mechanisms of acquired penicillin resistance by *Neisseria gonorrhoeae* and alternative drugs for treating resistant strains. **2.0**
22. Explain the importance of phase and antigenic variation in pathogenesis of *Neisseria gonorrhoeae*. **2.0**
23. Describe the correlation between *N. gonorrhoeae* cervicitis and pelvic inflammatory disease (PID) in women. **4.0**

24. Identify the causative agents of non-gonococcal urethritis.	3.0
25. Describe the life cycle and unique properties of <i>Chlamydia trachomatis</i> .	3.0
26. Describe structural and cultural characteristics of <i>Mycoplasma genitalium</i> .	2.0
27. Describe the diagnosis and treatment of non-gonococcal urethritis (NGU).	3.0
28. Describe how NGU can lead to PID in women.	3.0
29. Describe the characteristics and causative agent of lymphogranuloma venereum (LGV).	2.0
30. Describe the characteristics and pathogenesis caused by <i>Klebsiella (Calymmatobacterium) granulomatis</i> .	1.0
31. Describe the characteristics and pathogenesis of <i>Haemophilus ducreyi</i> .	2.0
32. Describe how symptoms of chancroid can be confused with those of primary syphilis, LGV, granuloma inguinale, or genital herpes.	2.0
33. Describe the transmission, risk factors, epidemiology, pathogenesis, clinical identification and treatment of infections by the protozoan <i>Trichomonas vaginalis</i> .	3.0
34. Describe the signs associated with non-specific vaginitis and bacterial vaginosis.	2.0
35. Describe the characteristics, diagnosis, and treatment of vulvovaginal candidiasis.	4.0
36. Explain how <i>Candida</i> can cause disease as a member of normal human flora.	3.0
37. Describe the virion and genome structure of herpes simplex types 1 & 2 (HSV-1 and HSV-2).	3.0
38. Describe the transmission and pathogenesis of genital HSV 1 and HSV-2 infections.	3.0
39. Describe the concept of viral latency/reactivity and its significance of genital herpes infections.	4.0
40. Identify and explain current strategies for preventing and treating HSV-1 and HSV-2 infections.	3.0
41. Describe the virion and genome structure of human papillomavirus (HPV).	4.0
42. Explain the transmission and pathogenesis of HPV.	4.0
43. Explain the association of cervical cancer with certain types of HPV infections.	4.0
44. Describe methods for detection, treatment, and prevention of HPV infections.	4.0
45. Explain the relationship between <i>Schistosoma haematobium</i> with bladder cancer.	2.0
46. Explain the relationship between mumps infection and male sterility.	2.0

XI. Gastrointestinal Infections

1. Define inflammatory and non-inflammatory diarrhea.	3.0
2. Differentiate between gastroenteritis and enterocolitis.	2.0
3. Describe clinical findings in acute gastroenteritis.	3.0
4. Differentiate between an invasive infection and an enterotoxin-mediated illness based on clinical findings.	3.0
5. Describe the modes for transmitting infectious agents that cause gastroenteritis and diarrhea.	3.0
6. Describe the pathogenesis of viral, bacterial and parasitic diarrheas.	3.0
7. Explain the mechanisms of damage from enterotoxins, cytotoxins, and invasive organisms.	3.0
8. Describe the clinical and diagnostic techniques used to identify organisms causing gastroenteritis.	3.0
9. Explain the recommended treatment for gastroenteritis.	3.0
10. Describe the transmission, risk factors, epidemiology, pathogenesis, clinical identification, treatment and prevention of the major bacterial, viral, and parasitic organisms causing gastrointestinal infection:	
a. Caliciviruses (Norovirus)	4.0
b. <i>Clostridium difficile</i>	4.0
c. <i>Clostridium perfringens</i>	3.0
d. <i>Cryptosporidium parvum</i>	4.0
e. <i>Entamoeba histolytica</i>	3.0
f. <i>Escherichia coli</i>	4.0

- | | |
|-----------------------------------|-----|
| g. <i>Giardia lamblia</i> | 4.0 |
| h. <i>Listeria monocytogenes</i> | 4.0 |
| i. Rotavirus | 4.0 |
| j. <i>Salmonella</i> spp. | 4.0 |
| k. <i>Shigella</i> spp. | 4.0 |
| l. <i>Vibrio cholerae</i> | 4.0 |
| m. <i>Vibrio parahemolyticus</i> | 3.0 |
| n. <i>Yersinia enterocolitica</i> | 3.0 |
-
- | | |
|---|-----|
| 11. Define hepatitis and jaundice. | 3.0 |
| 12. Describe the symptoms and laboratory findings present in acute hepatitis. | 4.0 |
| 13. Explain the mechanism of liver damage in hepatitis. | 3.0 |
| 14. Identify the potential long-term sequelae of chronic hepatitis. | 4.0 |
| 15. Identify external factors that greatly accelerate microbe-induced liver damage. | 3.0 |
| 16. Identify the fatality rate of fulminant hepatitis. | 2.0 |
| 17. Describe the basic viral properties, principal routes of infection, global prevalence, potential to establish chronic infections, clinical symptoms, means of diagnosis (including serologic markers), and treatment options for Hepatitis A-E. | 4.0 |
| 18. Identify the viral hepatitis infections that can be prevented by immunization. | 4.0 |
| 19. Identify additional viruses (other than Hepatitis A-E), parasites and bacteria that target the liver. | 2.0 |
| 20. Describe the transmission, risk factors, epidemiology, pathogenesis, clinical identification, treatment and prevention of: | |
| a. <i>Bacillus cereus</i> intoxication | 3.0 |
| b. Botulism | 3.0 |
| c. <i>Campylobacter jejuni</i> infection | 3.0 |
| d. Infant botulism | 3.0 |
| e. <i>S. aureus</i> infections/intoxication | 3.0 |
| f. Typhoid fever | 3.0 |
-
- | | |
|--|-----|
| 21. Describe the characteristics of <i>Helicobacter pylori</i> and explain the inflammatory conditions of the GI tract with which it is associated. | 4.0 |
| 22. Differentiate among the conditions caused by the ETEC, EPEC, EIEC, EAaggEC and EHEC strain designations of <i>Escherichia coli</i> . | 3.0 |
| 23. Identify the bacteria that are associated with causing food intoxications; denote approximate time between ingestion of the toxin and the appearance of symptoms for each. | 3.0 |
| 24. Describe the epidemiology and pathogenesis of antibiotic-associated diarrhea. | 3.0 |
| 25. Describe the oral diseases and pathogenesis caused by <i>Candida</i> , HSV, HPV, <i>Actinomyces israelii</i> , viridans-group streptococci, <i>Histoplasma</i> , and Coxsackieviruses. | 3.0 |
| 26. Describe the infections caused by oral normal flora in other parts of the body. | 3.0 |

XII. Skin, Soft Tissue, and Bone Infections

- | | |
|---------------|-----|
| 1. Define: | |
| a. abscess | 4.0 |
| b. boil | 3.0 |
| c. bulla | 2.0 |
| d. carbuncle | 2.0 |
| e. cellulitis | 4.0 |
| f. enanthem | 2.0 |
| g. erysipelas | 4.0 |

h. erythrasma	3.0
i. eschar	4.0
j. exanthem	3.0
k. furuncle	2.0
l. folliculitis	3.0
m. impetigo	4.0
n. macule	3.0
o. pyoderma	3.0
p. papule	3.0
q. petechiae	3.0
r. plaque	3.0
s. purpura	3.0
t. pustule	3.0
u. vesicle	3.0
2. Identify infectious causes of myositis.	3.0
3. Describe the virulence factors for <i>Staphylococcus aureus</i> and describe the contribution of these factors to the pathogenicity of the organism.	4.0
4. Identify the causative agents of myonecrosis.	4.0
5. Explain the pathogenesis of myonecrosis and virulence factors that affect this pathogenesis.	4.0
6. Explain why surgery, even amputation, is often necessary in the treatment of myonecrosis.	4.0
7. Identify the infectious causes of osteomyelitis.	4.0
8. Describe the important microbial virulence factors associated with osteomyelitis and the contribution of each to the pathogenesis.	4.0
9. Describe the routes by which various microbes gain access to bone and explain why these lesions are often polymicrobial.	4.0
10. Explain the use of surgical debridement and prolonged bactericidal antibiotic therapy in chronic osteomyelitis.	4.0
11. Explain how laboratory procedures distinguish among the causative agents of osteomyelitis.	3.0
12. Explain gas gangrene's infrequency despite the presence of the organism in human intestines and in soil.	2.0
13. Explain the role of wounds in the pathogenesis of gas gangrene.	3.0
14. Explain why anaerobic or necrotic wounds are typically necessary for the development of tetanus.	3.0
15. Identify the condition in infants that has been associated with the ingestion of raw or unpasteurized honey.	3.0
16. Distinguish between septic arthritis, aseptic arthritis and reactive arthritis. Identify	
17. Distinguish between septic arthritis, aseptic arthritis and reactive arthritis. Identify etiological agents associated with each.	4.0
18. Explain the role of <i>Mycobacterium marinum</i> and other <i>Mycobacterium</i> species in causing cutaneous infections.	3.0
19. Explain the role of <i>Corynebacterium diphtheriae</i> and diphtheroid relatives in causing cutaneous infections.	3.0

A. Pathogens

[Apply the following learning objectives to each of the pathogens that follow]

1. Describe transmission, risk factors, epidemiology, clinical presentation, pathogenesis (virulence factors), clinical identification treatment and prevention of infections from the following organisms:
 - a. *Blastomyces dermatitidis*: Blastomycosis 3.0
 - b. *Borrelia burgdorferi*: Lyme disease 4.0
 - c. *Candida* spp.: Thrush 4.0
 - d. *Clostridium perfringens*: Gas gangrene 4.0
 - e. *Clostridium tetani*: Tetanus 4.0
 - f. *Coccidioides immitis*: Coccidioidomycosis 3.0
 - g. *Corynebacterium minutissimum*: Erythrasma 3.0
 - h. Coxsackievirus: Vesicles, hand foot and mouth disease 4.0
 - i. *Cryptococcus neoformans*: Cryptococcosis 3.0
 - j. *Erysipelothrix rhusiopathiae*: Erysipeloid 2.0
 - k. Herpes Simplex: Vesicles, herpetic whitlow, gladiatorium 4.0
 - l. Hookworms (*Ancylostoma* and *Necator*): Cutaneous larval migrans 3.0
 - m. *Hortaea werneckii*, *Trichosporon beigeli*, *Piedraia hortae*: Tinea nigra, white piedra, black piedra 3.0
 - n. HHV-6: Roseola 3.0
 - o. KSHV(HHV-8): Kaposi's sarcoma 4.0
 - p. *Leishmania braziliensis*: Mucocutaneous leishmaniasis 2.0
 - q. *Leishmania tropica*: Cutaneous leishmaniasis 2.0
 - r. *Malassezia furfur*: Tinea versicolor 3.0
 - s. Measles: Maculopapular rash, measles 3.0
 - t. *Microsporum*, *Trichophyton*, and *Epidermophyton*: Tinea corporis, tinea pedis, tinea cruris, tinea nigra, tinea capitis, onychomycosis 4.0
 - u. *Mycobacterium leprae*: Leprosy (Hansen's disease) 3.0
 - v. *Nocardia* sp.: Cutaneous nocardiosis/actinomycetoma 3.0
 - w. Papillomaviruses: Warts 4.0
 - x. Parvovirus B19: Maculopapular rash, arthritis 3.0
 - y. *Petrellidium* and *Madurella*: Eumycetoma 2.0
 - z. *Phialophora* and *Cladosporium*: Chromoblastomycosis 3.0
 - aa. Poxviruses – Molluscum contagiosum (fleshy papules) and Smallpox 4.0
 - bb. *Propionibacterium acnes*: Acne 3.0
 - cc. *Pseudomonas aeruginosa*: ecthyma gangrenosum, burn/wound infections 4.0
 - dd. *Rickettsia prowazekii*: Epidemic typhus 2.0
 - ee. *Rickettsia rickettsii*: Rocky Mountain spotted fever 3.0
 - ff. *Rickettsia typhi*: Endemic typhus 2.0
 - gg. Rubella: Maculopapular rash, German measles 3.0
 - hh. *Sporothrix schenckii*: Sporotrichosis 3.0
 - ii. *Staphylococcus aureus*: Scalded skin syndrome, carbuncle, furuncle, folliculitis, impetigo, wound infection, toxic shock syndrome, osteomyelitis, septic arthritis 4.0
 - jj. *Streptococcus pyogenes*: Impetigo, erysipelas, cellulitis, necrotizing fasciitis, scarlet fever, toxic shock syndrome, pharyngitis, post-infectious sequelae 4.0
 - kk. *Treponema pallidum* spp. *pallidum*: Syphilis 3.0
 - ll. *Treponema* sp.: Yaws, pinta, bejel 1.0

mm. <i>Trichinella spiralis</i> : Trichinosis	2.0
nn. Varicella zoster virus (VZV): Chickenpox and shingles	4.0

XIII. Nervous System Infections

- | | |
|---|-----|
| 1. Differentiate meningitis from encephalitis. | 3.0 |
| 2. Identify the organisms that cause 80% of cases of bacterial meningitis beyond the neonatal period. | 3.0 |
| 3. Identify the common causes of bacterial meningitis in infants less than 1 month of age. | 3.0 |
| 4. Describe host factors that may increase the risk for bacterial meningitis. | 3.0 |
| 5. Define aseptic meningitis. | 3.0 |
| 6. Describe the pathogenesis, clinical signs and symptoms, and diagnostic techniques that allow for differentiation among bacterial, viral, parasitic and fungal meningitis and encephalitis. | 4.0 |
| 7. Describe the structural characteristics, transmission, pathogenesis, clinical signs and symptoms, diagnostic techniques, and treatments for the following causes of meningitis/encephalitis: | |
| a. <i>Acanthamoeba</i> spp. | 3.0 |
| b. Arboviruses | 4.0 |
| c. CMV | 4.0 |
| d. <i>Coccidioides immitis</i> | 3.0 |
| e. <i>Cryptococcus neoformans</i> | 4.0 |
| f. <i>Escherichia coli</i> | 4.0 |
| g. <i>Haemophilus influenzae</i> | 3.0 |
| h. Herpesviruses | 4.0 |
| i. <i>Histoplasma capsulatum</i> | 3.0 |
| j. HIV | 4.0 |
| k. Influenza viruses | 4.0 |
| l. LCMV | 2.0 |
| m. <i>Listeria monocytogenes</i> | 4.0 |
| n. Mumps | 3.0 |
| o. <i>Mycobacterium tuberculosis</i> | 3.0 |
| p. <i>Naegleria fowleri</i> | 3.0 |
| q. <i>Neisseria meningitidis</i> | 4.0 |
| r. <i>Plasmodium falciparum</i> | 3.0 |
| s. Polio virus (poliomyelitis) | 3.0 |
| t. Rubella | 3.0 |
| u. <i>Streptococcus agalactiae</i> (Group B strep) | 4.0 |
| v. <i>Streptococcus pneumoniae</i> | 4.0 |
| w. <i>Toxoplasma gondii</i> | 3.0 |
| 8. Describe the pathophysiology of subacute sclerosing panencephalitis (SSPE) and progressive multifocal leukoencephalopathy (PML). | 2.0 |
| 9. Describe the pathogenesis, transmission pattern, and course of disease for both Creutzfeldt-Jakob disease (CJD) and variant CJD. | 3.0 |
| 10. Describe the risks to the fetus associated with Group B streptococci carriage as part of the normal vaginal flora in a pregnant woman. | 3.0 |
| 11. Describe the relationship between <i>Trypanosoma brucei</i> and sleeping sickness. | 3.0 |

- | | |
|---|-----|
| 12. Describe the role of <i>Taenia solium</i> in causing neurocysticercosis. | 2.0 |
| 13. Describe the role of certain bacteria and viruses in causing Guillian-Barre syndrome. | 3.0 |

XIV. Respiratory Tract Infections

- | | |
|---|-----|
| 1. Define rhinitis. | 3.0 |
| 2. Identify the types of viruses that cause most cases of rhinitis. | 3.0 |
| 3. Describe the means by which rhinitis viruses are spread. | 3.0 |
| 4. Identify host defenses preventing infections by rhinitis viruses. | 3.0 |
| 5. Define pharyngitis. | 3.0 |
| 6. Identify the characteristics and describe the means of spread of viruses causing pharyngitis: | |
| a. Adenoviruses | 4.0 |
| b. Coronaviruses | 3.0 |
| c. Epstein-Barr virus | 3.0 |
| d. Influenza | 3.0 |
| e. Rhinoviruses | 4.0 |
| 7. Identify the virulence factors, normal reservoirs, and mode of transmission of the bacterial causes of pharyngitis: | |
| a. <i>Bordetella pertussis</i> | 3.0 |
| b. <i>Corynebacterium diphtheriae</i> | 3.0 |
| c. <i>Neisseria gonorrhoeae</i> | 3.0 |
| d. <i>Streptococcus pyogenes</i> | 3.0 |
| 8. Describe the method of diagnosing bacterial pharyngitis. | 3.0 |
| 9. Identify complications of infection by <i>Streptococcus pyogenes</i> and describe the events that lead to the complications. | 4.0 |
| 10. Identify the antibiotics used to treat bacterial pharyngitis. | 3.0 |
| 11. Define sinusitis. | 3.0 |
| 12. Identify the bacterial causes of sinusitis and identify characteristics, normal reservoirs, and virulence factors associated with each. | 3.0 |
| 13. Identify the host defenses that protect against sinusitis-causing bacteria. | 2.0 |
| 14. Identify the factors that predispose a patient to sinusitis. | 2.0 |
| 15. Identify complications of sinusitis. | 2.0 |
| 16. Describe recommended treatments for sinusitis. | 2.0 |
| 17. Define otitis media and otitis externa. | 3.0 |
| 18. Identify bacterial causes of otitis media and otitis externa and identify characteristics, normal reservoirs, and virulence factors associated with each. | 3.0 |
| 19. Identify the host defenses that protect against bacteria that cause otitis media and otitis externa. | 2.0 |
| 20. Identify the factors that predispose a patient to otitis media and otitis externa. | 2.0 |
| 21. Identify complications that can arise due to otitis media and otitis externa. | 3.0 |
| 22. Describe recommended treatments for otitis media and otitis externa. | 3.0 |
| 23. Define bronchitis. | 2.0 |
| 24. Identify the infectious agents involved in bronchitis and bronchiolitis. | 3.0 |
| 25. Identify the clinical presentation associated with bronchitis and bronchiolitis-causing agents. | 3.0 |
| 26. Describe the means by which the etiologic agents of bronchitis and bronchiolitis are spread. | 3.0 |
| 27. Identify the host defenses preventing infection by agents causing bronchitis and bronchiolitis. | 2.0 |

28. Describe the method of diagnosing bronchitis and bronchiolitis.	2.0
29. Describe recommended treatments for bronchitis and bronchiolitis.	2.0
30. Define pneumonia.	3.0
31. Differentiate between acute and chronic pneumonia.	3.0
32. Name the bacterial agents causing pneumonia, their mode of transmission and describe the clinical presentations associated with each.	3.0
33. Describe the mode of transmission, risk factors, epidemiology, pathogenesis/virulence factors, clinical manifestations, diagnosis, treatments, and prevention of the following organisms that can cause pneumonia:	
a. Adenovirus	3.0
b. Anaerobic bacteria	3.0
c. <i>Aspergillus</i> spp.	3.0
d. <i>Blastomyces</i> spp.	3.0
e. <i>Chlamydomphila pneumoniae</i>	3.0
f. <i>Chlamydomphila psittaci</i>	2.0
g. <i>Coccidioides immitis</i>	3.0
h. <i>Cryptococcus neoformans</i>	3.0
i. <i>Haemophilus influenzae</i>	3.0
j. Hantavirus	2.0
k. <i>Histoplasma capsulatum</i>	3.0
l. Influenza	4.0
m. <i>Klebsiella pneumoniae</i>	3.0
n. <i>Legionella pneumophila</i>	3.0
o. <i>Moraxella catarrhalis</i>	2.0
p. <i>Mucor</i> spp.	2.0
q. <i>Mycobacterium tuberculosis</i>	4.0
r. <i>Mycoplasma pneumoniae</i>	4.0
s. <i>Nocardia asteroides</i>	3.0
t. <i>Pneumocystis jiroveci</i>	3.0
u. <i>Pseudomonas aeruginosa</i>	3.0
v. RSV	3.0
w. SARS/MERS	3.0
x. <i>Staphylococcus aureus</i>	3.0
y. <i>Streptococcus pneumoniae</i>	4.0
34. Describe the normal reservoir of each bacterial, fungal, and viral agent of pneumonia.	3.0
35. Identify pneumonia agents suggested by environmental history.	3.0
36. Discuss the differential diagnosis of cavitory lesions on chest radiograph.	2.0
37. Identify the host defenses preventing infection by these agents causing pneumonia.	3.0
38. Define miliary tuberculosis and describe its clinical manifestations.	3.0
39. Describe the pathogenesis of primary respiratory infection caused by the influenza virus followed by bacterial pneumonia.	4.0
40. Understand how certain parasitic worms can cause pneumonitis with eosinophilia.	2.0

XIII. Zoonotic and Opportunistic Infections

1. Describe the disease(s) caused by, the animal reservoir(s) of, the mode of transmission, diagnosis and treatment for the following etiologic agents:	
a. <i>Bacillus anthracis</i>	4.0

- | | | |
|----|--|-----|
| b. | <i>Bartonella henselae</i> | 2.0 |
| c. | <i>Borrelia</i> spp. | 2.0 |
| d. | <i>Brucella</i> spp. | 2.0 |
| e. | <i>Coxiella burnetii</i> | 2.0 |
| f. | <i>Francisella tularensis</i> | 3.0 |
| g. | <i>Pasteurella multocida</i> | 4.0 |
| h. | Rabies virus | 3.0 |
| i. | Viral hemorrhagic fever viruses, including dengue, yellow fever, Ebola, Marburg and Arenavirus | 3.0 |
| j. | <i>Yersinia pestis</i> | 4.0 |
| | | |
| 2. | Describe the opportunistic infections by the following agents: | |
| a. | <i>Actinomyces</i> | 3.0 |
| b. | <i>Bacteroides</i> | 3.0 |
| c. | <i>Eikenella corrodens</i> | 3.0 |
| d. | <i>Fusobacterium</i> | 2.0 |
| e. | <i>Haemophilus influenzae</i> (nontypeable) | 3.0 |
| f. | <i>Mycobacterium avium-intracellulare</i> | 3.0 |
| g. | <i>Peptostreptococcus</i> | 2.0 |
| h. | <i>Pneumocystis jiroveci</i> | 3.0 |
| i. | <i>Porphyromonas</i> | 2.0 |
| j. | <i>Prevotella</i> | 2.0 |
| k. | <i>Pseudomonas aeruginosa</i> | 3.0 |
| l. | <i>Vibrio vulnificus</i> | 3.0 |

XVI. Blood and Systemic Infections

- | | | |
|----|---|-----|
| 1. | Describe transmission, risk factors, epidemiology, clinical presentation, pathogenesis (virulence factors), clinical identification, treatment and prevention of infections from the following organisms: | |
| a. | Arenaviruses | 3.0 |
| b. | <i>Babesia microti</i> | 2.0 |
| c. | Chikungunya virus | 2.0 |
| d. | CMV | 3.0 |
| e. | Dengue virus | 3.0 |
| f. | Ebola and Marburg viruses | 4.0 |
| i. | EBV | 3.0 |
| g. | HHV6 and HHV7 | 3.0 |
| h. | HIV | 4.0 |
| i. | HTLV-1 and HTLV-2 | 3.0 |
| j. | Measles virus | 3.0 |
| k. | <i>Plasmodium</i> spp. | 4.0 |
| l. | <i>Schistosoma</i> spp. | 3.0 |
| m. | <i>Trypanosoma cruzi</i> | 3.0 |
| n. | Yellow fever virus | 3.0 |
| o. | Zika virus | 3.0 |

NEUROSCIENCE (formerly Neuro Anatomy)

LEARNING OBJECTIVES

Gross Structure of the Brain

Gross Structure of the Spinal Cord and Spinal Nerves

- Meninges and Ventricles
- Vasculature of the Central Nervous System
- Somatosensory and Proprioceptive Systems of the Body
- Somatosensory of the Head
- Motor Systems – Somatic Motor System, Cerebellum, and Basal Ganglia
- Visual System
- Vestibular System and Medial Longitudinal Fasciculus
- Auditory System
- Olfactory and Gustatory Systems
- Hypothalamus
- Autonomic Nervous System
- Limbic System
- Reticular Formation
- Cerebral Cortex
- Neuroembryology

Clinical Correlations of Neuroanatomy

- Gross Structure of the Spinal Cord and Peripheral Nerves
- Meninges and Ventricles
- Vasculature of the Central Nervous System
- Somatosensory Systems of the Body
- Somatosensory and Motor Systems of the Head
- Motor Systems – Somatic Motor System, Cerebellum, and Basal Ganglia
- Special Sensory Systems-Visual, Auditory, Vestibular, Olfaction and Taste
- Hypothalamus
- Autonomic Nervous System
- Limbic System-Learning and Memory Disorders
- Cerebral Cortex
- Neuroplasticity
- Pain Science
- Sleep
- Imaging for Neuroanatomy

I. Gross Structure of the Brain

1. Describe the central axis of the portions of the brain and the anatomical directions for each portion. 4.0
2. Explain the divisions of the CNS. 4.0
3. Describe the external (topographical) anatomy of the lobes of the cerebrum. 4.0
4. Explain the functional and somatological organization of the lobes of the cerebrum. 4.0
5. Describe the distribution of the gray and white matter of the cerebrum. 4.0
6. Describe the external (topographical) anatomy of the cerebellum. 4.0
7. Describe the distribution of the gray and white matter of the cerebellum. 4.0
8. Describe the structure and functions of each division of the diencephalon. 3.0
9. Describe the external anatomy of each region of the brainstem. 3.0
10. Describe the nuclei and tracts of each region of the brainstem. 4.0
11. Describe the sensory components of the cranial nerves. 4.0
12. Describe the motor components of the cranial nerves. 4.0
13. Distinguish between the use of computerized tomography (CT) and magnetic resonance image (MRI) for normal and pathological neuroimaging. 3.0

II. Gross Structure of the Spinal Cord and Spinal Nerves

1. Describe the external (topographical) anatomy of the spinal cord. 4.0
2. Discuss the relationship of spinal nerves to roots and rami upon entrance and exit of the spinal cord. 4.0
3. Compare and contrast the effects of lesions to a dorsal root, ventral root, and spinal nerve. 4.0
4. Describe the divisions (Rexed-laminae) in the gray matter regions of the spinal cord. 3.0
5. Describe the funiculi (dorsal, lateral, and anterior) in the white matter of the spinal cord. 4.0

III. Meninges and Ventricles

1. Describe the dura mater, dural reflections, and the formation of venous sinuses. 4.0
2. Describe the relationship of epidural and subdural hematomas to the layers of the meninges. 4.0
3. Describe the arachnoid mater and the formation of the subarachnoid space. 4.0
4. Explain the differences between the cranial and spinal meningeal layers. 3.0
5. Describe the ventricular system of the brain and the production and flow of cerebrospinal fluid. 4.0
6. Discuss the structural and functional basis of the blood-brain barrier. 4.0

IV. Vasculature of the Central Nervous System

1. Discuss the vascular supply to the brain. 4.0
2. Explain the venous drainage of the brain. 4.0
3. Discuss the vascular supply to the spinal cord. 4.0
4. Explain the venous drainage of the spinal cord. 4.0
5. Describe angiography and its clinical uses. 3.0

V. Somatosensory and Proprioceptive Systems of the Body

1. Describe the peripheral receptors and sensory modalities of the somatosensory systems of the body. 4.0
2. Describe the transduction of mechanical stimuli into action potentials. 4.0
3. Describe the sensory neurons and the nerve fibers of the somatosensory systems of the body. 4.0
4. Discuss the dorsal column-medial lemniscus pathway. 4.0
5. Describe the tracts of the anterolateral system. 4.0
6. Describe the anatomy and function of the peripheral receptors associated with proprioception (muscle spindles & GTOs). 4.0
7. Describe the spinocerebellar tracts. 4.0

VI. Somatosensory of the Head

1. Describe the peripheral receptors and sensory modalities of the trigeminal system. 4.0
2. Describe the mesencephalic, principal (main, chief) sensory, and spinal trigeminal nuclei. 4.0
3. Describe the central pathways of the trigeminal system. 4.0
4. Identify and describe trigeminal reflexes. 4.0

VII. Motor Systems – Somatic Motor System, Cerebellum, and Basal Ganglia

1. Describe the components of the somatic motor system. 4.0
2. Describe the cortical descending pathways (corticospinal and corticonuclear tracts). 4.0
3. Identify the components of the basal nuclei. 4.0
4. Describe the connections between components of the basal nuclei, and their function (direct and indirect pathways). 4.0
5. Recognize the neuroanatomical and functional relationships of major brainstem descending pathways. 4.0
6. Describe the three layers of the cerebellar cortex, connections and their functions. 4.0
7. Describe the divisions (modules) of the cerebellum, connections and their functions. 4.0
8. Describe the pathways of the myotatic reflex, reciprocal inhibition, flexor reflex, and the crossed extension reflex. 4.0

VIII. Visual System

1. Describe the functional anatomy of the eye, the retina, and photoreceptors in the image formation process. 4.0
2. Discuss the transduction of light into neural impulses. 3.0
3. Describe the visual pathways and the visual cortex. 4.0
4. Identify and describe pupillary light, accommodation, corneal, and convergence reflexes. 4.0

IX. Vestibular System and Medial Longitudinal Fasciculus

1. Describe the functional anatomy of the vestibular apparatus. 4.0
2. Discuss vestibular pathways and the associated nuclei. 3.0
3. Describe the neuroanatomical basis of the vestibulo-ocular and vestibulospinal reflexes. 3.0

4. Describe the anatomy and function of the ascending and descending portions of the medial longitudinal fasciculus. 3.0
5. Describe neuroanatomical basis of nystagmus. 4.0

X. Auditory System

1. Describe the functional anatomy of the ear (outer, middle, inner). 4.0
2. Describe the transduction of sound waves into neural impulses and their tonotopic relationships. 3.0
3. Describe the neuroanatomical basis for localization and recognition of sound. 3.0
4. Describe the auditory pathways and auditory cortex. 4.0
5. Identify and describe the auditory reflexes. 2.0

XI. Olfactory and Gustatory Systems

1. Describe the location and structure of olfactory receptor neurons. 2.0
2. Describe transduction of odorants into neural impulses. 2.0
3. Describe the olfactory pathway. 2.0
4. Describe the location and structure of taste receptor cells, taste buds, and receptors. 2.0
5. Describe basic transduction of tastants into neural impulses. 2.0
6. Describe the taste pathway. 2.0

XII. Hypothalamus

1. Describe the functional anatomy of the hypothalamus. 3.0
2. Describe the afferent and efferent pathways of the hypothalamus. 3.0
3. Identify and describe the hypothalamic reflexes. 2.0
4. Describe the role of the hypothalamus in the control of ANS function. 4.0

XIII. Autonomic Nervous System

1. Describe the functional anatomy of the central nervous system and peripheral nervous system portions of the autonomic nervous system. 4.0
2. Describe the functional anatomy of the enteric nervous system. 3.0
3. Describe the central regulation of the autonomic nervous system. 4.0
4. Identify and describe the autonomic reflexes. 4.0

IX. Limbic System

1. Describe the functional anatomy of the limbic lobe and the limbic system. 3.0
2. Describe the functional anatomy of the hippocampal formation. 3.0
3. Describe the functional anatomy of the amygdaloid nuclear complex. 2.0
4. Describe the functional anatomy of the septal nuclei. 2.0
5. Describe the functional anatomy of the nucleus accumbens. 2.0

X. Reticular Formation

1. Describe the location of the reticular formation. **3.0**
2. Describe the reticular formation's contribution to: modulation of pain transmission, control of movement, autonomic reflexes, and the ascending reticular activating system (ARAS). **3.0**

XI. Cerebral Cortex

1. Describe the six histological layers of the neocortex. **3.0**
2. Compare and contrast archi-, paleo-, and neo-cortices. **3.0**
3. Describe the projection, association, and commissural fibers of the cerebral cortex. **4.0**

Clinical Correlations of Neuroanatomy

A. Central Nervous System

1. Explain spinal shock. **4.0**
2. Describe developmental disorders of the spinal cord. **3.0**
3. Discuss the disorders associated with formation, circulation, and reabsorption of cerebrospinal fluid. **4.0**
4. Describe the neuroanatomical basis of meningitis. **3.0**
5. Describe subarachnoid and epidural hemorrhage. **3.0**
6. Describe the criteria used for localizing cerebral and brainstem lesions due to hemorrhage and vascular occlusion. **4.0**
7. Describe alternating hemiplegia. **4.0**
8. Describe gaze palsies. **4.0**
9. Describe lesions at different points in the dorsal column-medial lemniscus pathway. **4.0**
10. Describe tabes dorsalis. **4.0**
11. Describe sensory ataxia. **4.0**
12. Describe the neurological deficits related to occlusion of the posterior spinal artery. **4.0**
13. Describe lesions at different points in the anterolateral system. **4.0**
14. Describe referred pain. **4.0**
15. Describe neuroanatomical basis of phantom limb pain. **4.0**
16. Describe syringomyelia. **4.0**
17. Compare and contrast lesions in the primary and association somatosensory cortices. **4.0**
18. Describe the deficits associated with lesions of each of the cranial nerves. **4.0**
19. Discuss the underlying cause of one-and-a-half syndrome. **2.0**
20. Discuss the underlying cause of internuclear ophthalmoplegia. **3.0**
21. Describe oculosympathetic paresis (Horner's syndrome). **4.0**
22. Describe the deficits of a unilateral lesion in the primary motor cortex. **4.0**
23. Describe the deficits of a unilateral lesion in the supplementary motor cortex. **4.0**
24. Describe the effects of a unilateral lesion in the premotor cortex. **4.0**
25. Describe the effects of lesions in the corticonuclear tract. **4.0**
26. Describe the effects of lesions at different points in the corticospinal tract. **4.0**
27. Describe alternating hemiplegia. **4.0**
28. Compare and contrast upper motor neuron and lower motor neuron lesion signs. **4.0**

- | | |
|---|-----|
| 29. Describe the deficits expected with complete or partial spinal cord injury. | 4.0 |
| 30. Describe clinical signs and symptoms commonly associated with multiple sclerosis. | 3.0 |
| 31. Describe the neuroanatomical basis of amyotrophic lateral sclerosis. | 3.0 |
| 32. Discuss the neuroanatomical basis of poliomyelitis post-polio syndrome. | 3.0 |
| 33. Correlate the symptoms and of movement disorders. | 4.0 |
| 34. Describe the effects of occlusion of the lenticulostriate arteries. | 3.0 |
| 35. Describe Friedrich's ataxia. | 3.0 |
| 36. Describe symptoms of dysfunction in each cerebellar module. | 4.0 |
| 37. Describe the role of cerebral cortex in kinesthesia. | 4.0 |
| 38. Describe deficits of lesions of the visual pathways. | 4.0 |
| 39. Compare and contrast central and peripheral lesions of the auditory pathways. | 3.0 |
| 40. Compare and contrast the mechanisms, symptoms, and tests for conduction deafness and nerve deafness. | 4.0 |
| 41. Describe symptoms of dysfunction in the olfactory and gustatory systems. | 2.0 |
| 42. Describe impairments associated with the vestibular system. | 4.0 |
| 43. Describe the autonomic dysreflexia. | 3.0 |
| 44. Describe the signs, symptoms, and lesions associated with Klüver-Bucy syndrome. | 3.0 |
| 45. Describe the hippocampal memory disorders. | 3.0 |
| 46. Describe the signs, symptoms associated with dementia/Alzheimer's disease. | 4.0 |
| 47. Describe apraxia, aphasia and agnosias. | 4.0 |
| 48. Describe contralateral (hemispatial) neglect syndrome. | 4.0 |
| 49. Describe the signs and symptoms of seizure disorders. | 3.0 |
| 50. Describe the continuum of traumatic brain injury its clinical presentation from mild to severe. | 3.0 |
| 51. Describe complex regional pain syndrome. | 3.0 |
| 52. Compare and contrast different types of pain, including nociceptive, neuropathic, and central. | 4.0 |
| 53. Describe symptoms of narcolepsy, sleep apnea, disorders of initiating and maintaining sleep, and REM sleep behavior disorder. | 3.0 |
| 54. Describe myelography and its clinical uses. | 3.0 |

B. Peripheral Nervous System

- | | |
|--|-----|
| 1. Describe the use of ultrasound in imaging the peripheral nervous system. | 3.0 |
| 2. Describe the result of damage to peripheral nervous tissue, and the mechanisms of collateral and regenerative recovery. | 3.0 |
| 3. Describe Wallerian degeneration and transneuronal anterograde/retrograde degeneration. | 4.0 |
| 4. Describe the autonomic contribution to peripheral neuropathy. | 4.0 |
| 5. Describe peripheral nerve neuropathies. | 4.0 |

PATHOLOGY LEARNING OBJECTIVES

I. General Pathology

Cell Adaptation, Injury, and Death
Inflammation
Control of Cell Growth and Repair
Fluid and Hemodynamics
Coagulation
Genetics
Immunity
Neoplasia
Infectious Disease
Environmental Pathology
Nutritional Disease
Principles of Laboratory Testing

II. Systemic Pathology

Vascular Disease
Cardiac Disease
Chemistry of Cardiac Disease
Hematopoietic System Disorders
Myeloid Neoplasms
Lymphoid Neoplasms
Pulmonary Disease
Gastrointestinal Disease
Pathology of the Liver and Extra-hepatic Biliary System
Pancreatic Disease
Genitourinary Disease
Renal Disease
Renal Function Tests
Breast Disease
Endocrine Disorders
Diabetes
Dermatopathology
Joint Disease
Bone Disease
Soft Tissue Disease
Head, Neck, and Special Sensory Organ Pathology
Neuromuscular Disease
Central Nervous System Disease

I. General Pathology

A. Cell Adaptation, Injury, and Death

1. Compare cell and tissue adaptation, reversible cell injury, and irreversible cell injury (cell death) in terms of etiology, pathogenesis, and morphology (gross, histologic, and ultrastructural). **4.0**
2. Describe the biochemical mechanisms associated with both reversible and irreversible cell injury, including:
 - a. depletion of ATP **4.0**
 - b. mitochondrial damage **3.0**
 - c. influx of calcium and loss of calcium homeostasis **3.0**
 - d. damage to DNA **3.0**
 - e. defects in membrane permeability **4.0**
 - f. synthesis and degradation of molecules **4.0**
3. Explain free radicals, including their generation, their roles in cell injury, and their removal. **3.0**
4. Describe the mechanisms for the following types of injury:
 - a. hypoxic **4.0**
 - b. ischemic **4.0**
 - c. reperfusion injury **4.0**
 - d. chemical (toxic) injury **4.0**
 - e. immunologic injury **4.0**
5. Explain hypertrophy, hyperplasia, atrophy, and metaplasia in terms of physiologic versus pathologic, etiologies and the mechanisms of their development. **4.0**
6. Compare and contrast the morphologic differences in the following types of necrosis, including common sites or tissues where the processes occur as well as causative mechanisms
 - a. coagulative **4.0**
 - b. liquefactive **4.0**
 - c. gangrenous **4.0**
 - d. caseous **3.0**
 - e. fat **3.0**
 - f. fibrinoid **3.0**
7. Explain the process of apoptosis, necroptosis, and pyroptosis, including physiologic and pathologic apoptosis, morphology, and mechanisms. **4.0**
8. Identify the significance of intracellular accumulations and the mechanisms for the accumulation of
 - a. lipids **3.0**
 - b. proteins **3.0**
 - c. glycogen **3.0**
 - d. endogenous pigments **3.0**
 - e. exogenous pigments **3.0**
 - f. hyaline change **3.0**
9. Compare and contrast dystrophic and metastatic calcification in terms of etiology/pathogenesis, morphologic appearance, and clinical significance. **4.0**
10. Explain mechanisms of cellular aging, including telomere shortening, environmental insults, DNA repair defects, and abnormal growth factor signaling. **2.0**

B. Inflammation

1. Identify stimuli that trigger an acute inflammatory reaction. **2.0**

2. Describe the classic vascular changes and cellular events of acute inflammation with an emphasis on:
 - a. activation **4.0**
 - b. adhesion **4.0**
 - c. chemotaxis **4.0**
 - d. emigration **4.0**
 - e. margination **4.0**
 - f. rolling **4.0**

3. Name the five cardinal signs of inflammation in terms of pathogenesis and morphology. **4.0**

4. Describe the mechanisms responsible for increased vascular permeability in acute inflammation and describe their importance. **4.0**

5. Discuss the following chemical mediators of inflammation in terms of their origin (cells versus plasma), interrelationships, and their chief functions:
 - a. arachidonic acid metabolites **3.0**
 - b. chemokines **3.0**
 - c. coagulation cascade **3.0**
 - d. complement cascade **3.0**
 - e. cytokines **3.0**
 - f. kinin system **3.0**
 - g. lysosomal granule contents **3.0**
 - h. neuropeptides **3.0**
 - i. nitric oxide **3.0**
 - j. oxygen-derived free radicals **3.0**
 - k. platelet activating factor **3.0**
 - l. vasoactive amines **3.0**

6. Identify each of the following and the role it plays in the development of either the acute or chronic inflammatory reaction:
 - a. adhesion molecules **3.0**
 - b. endothelial cells **3.0**
 - c. eosinophils **3.0**
 - d. fibroblasts **3.0**
 - e. giant cells **3.0**
 - f. lymphocytes **3.0**
 - g. mast cells/basophils **2.0**
 - h. monocyte/macrophage **3.0**
 - i. neutrophils **3.0**
 - j. plasma cells **3.0**
 - k. platelets **3.0**

7. Describe the steps involved in the isolation and destruction of an infectious agent by neutrophils and macrophages. **3.0**

8. Explain the extracellular factors (vascular supply, foreign bodies, and nutritional Status) that might influence the outcomes of inflammation. **3.0**

9. Compare and contrast acute inflammation in terms of etiology, pathogenesis, morphology, laboratory findings, outcomes and systemic effects. **4.0**

- | | |
|--|------------|
| 10. Compare and contrast resolution and organization with respect to the termination of an inflammatory response. | 3.0 |
| 11. Compare and contrast lymphangitis and lymphadenitis in terms of etiology and pathogenesis. | 3.0 |
| 12. Discuss defects in leukocyte function, especially inherited defects in leukocyte adhesion; inherited defects in phagolysosome function; inherited defects in microbicidal activity; and acquired deficiencies. | 3.0 |
| 13. Discuss the systemic effects of inflammation, including pathogenesis, laboratory values, and clinical signs and symptoms. | 4.0 |

C. Control of Cell Growth & Repair Objectives

- | | |
|---|------------|
| 1. Distinguish between continuously dividing cells (labile cells), quiescent cells (stable), and nondividing cells (permanent) and categorize cells accordingly. | 3.0 |
| 2. Describe the role of stem cells in tissue regeneration and maintenance. | 3.0 |
| 3. Compare and contrast embryonic stem cells and somatic stem cells. | 3.0 |
| 4. Describe the cell cycle and define the following abbreviations (M, G ₀ , G ₁ , S, and G ₂). | 3.0 |
| 5. Discuss the actions of epidermal growth factor, transforming growth factor, fibroblast growth factor 1 and 2, transforming growth factor, platelet derived growth factor, and vascular endothelial growth factor, including both growth promoting and growth inhibiting functions. | 4.0 |
| 6. Discuss the roles of cytokines, specifically TNF and IL-1, in repair. | 4.0 |
| 7. Explain the role of receptors, signal transduction pathways, and transcription factors in the regulation of cell growth, with special emphasis on the MAP kinase pathway. | 3.0 |
| 8. Define the following terms and describe their role in tissue repair and regeneration: | |
| a. cadherins | 3.0 |
| b. elastic fibers | 4.0 |
| c. hyaluronan | 3.0 |
| d. elastin | 3.0 |
| e. integrins | 3.0 |
| f. collagen type I | 4.0 |
| g. collagen type II | 3.0 |
| h. collagen type III | 4.0 |
| i. collagen IV | 4.0 |
| j. fibrillin | 3.0 |
| k. laminin | 3.0 |
| l. fibronectin | 3.0 |
| m. proteoglycans | 3.0 |
| n. heparin sulfate | 3.0 |
| 9. Discuss the mechanisms of angiogenesis, including the growth factors important to the process. | 4.0 |
| 10. Compare and contrast healing by first intention (primary union) and second intention (secondary union). | 4.0 |
| 11. Describe the local and systemic factors that influence wound healing, including whether each of these accelerates or delays the rate of healing. | 4.0 |
| 12. Discuss the pathologic aspects of repair including contracture, keloid, excessive granulation (proud flesh), ulceration, fibrosis, wound dehiscence, and hypertrophic scar. | 4.0 |
| 13. Describe aspects of cutaneous wound healing as it relates to wound strength. | 4.0 |

D. Fluid and Hemodynamics

1. Discuss the pathogenesis of edema, giving examples associated with the following mechanisms and be able to describe it as being systemic or localized:
 - a. reduced plasma oncotic pressure **4.0**
 - b. increased hydrostatic pressure **4.0**
 - c. sodium retention **4.0**

 - d. lymphatic obstruction **4.0**
 - e. vascular changes in inflammation **4.0**
2. Compare edema of the following on the basis of pathogenesis morphologic changes, and clinical effects:
 - a. subcutaneous tissue: **4.0**
 - i. dependent edema
 - ii. pitting edema
 - b. lungs **4.0**
 - c. brain **4.0**
3. Compare and contrast active hyperemia and passive congestion, in terms of mechanisms of development and clinically important examples. **3.0**
4. Describe chronic passive congestion of the skin, lungs, liver, kidneys, and spleen, in terms of morphologic features, functional alterations, and clinical effects. **4.0**
5. Compare acute and chronic hemorrhage in terms of common causes, clinical manifestations, and compensatory mechanisms. **4.0**
6. Describe the following stages of shock, in terms of pathophysiology, morphologic changes, and prognosis:
 - a. non-progressive – Stage I (compensated) **4.0**
 - b. progressive – Stage II (decompensated) **4.0**
 - c. irreversible – State III **4.0**
7. Compare and contrast the following types of shock in terms of pathogenic mechanism, common causes, structural changes, functional changes, and clinical features and prognoses:
 - a. neurogenic / hypothalamic **4.0**
 - b. hypovolemic **4.0**
 - c. hemorrhagic **4.0**
 - d. septic **4.0**
 - e. cardiogenic **4.0**
 - f. anaphylactic **4.0**
 - g. obstructive **4.0**
8. List the morphologic changes and functional effects of shock on the lungs, kidneys, liver, adrenals, brain, and gastrointestinal tract. **3.0**
9. Describe thrombi in terms of factors conditioning the development of thrombi. **4.0**
10. Distinguish between venous thrombi and arterial thrombi on the basis of:
 - a. etiologic and precipitating factors **4.0**
 - b. common sites of occurrence **4.0**
 - c. type and size of vessel involved **4.0**
 - d. morphologic appearance **4.0**
 - e. organs commonly involved **4.0**

- f. local and distant effects 4.0
 - g. fate of lesions and prognosis 4.0
 - h. clinical and laboratory features 4.0
11. Compare and contrast the following types of emboli with emphasis on defining morphologic features, etiologic/precipitating factors, organs commonly involved, type and size of vessels involved, complications, and clinical manifestations:
- a. pulmonary 4.0
 - b. systemic 4.0
 - c. fat 4.0
 - d. air 3.0
 - e. amniotic fluid 3.0
12. Compare and contrast arterial and venous infarcts on the basis of location, pathogenesis, morphology, and clinical manifestations. 4.0

E. Coagulation

1. Outline the process of normal hemostasis, in terms of the following and describe the role and interaction of each of the following elements of hemostasis:
- a. intrinsic pathway 4.0
 - b. extrinsic pathway 4.0
 - c. final common pathway 4.0
 - d. fibrin formation and fibrinolysis 4.0
 - e. protein C/protein S pathway 4.0
 - f. role of platelets 4.0
 - g. role of vascular integrity 4.0
 - h. events in dissolution of a thrombus 4.0
2. Describe thrombocytopoiesis in terms of morphology of megakaryocytes; fate of megakaryocytes; life span of platelets; factors which influence thrombocytopoiesis; and abnormal morphologic forms of platelets and megakaryocytes. 3.0
3. Describe thrombocytopenia in terms of differential diagnosis, clinical features, bone marrow morphology, and laboratory findings. 4.0
4. Compare and contrast bleeding due to vascular defect (localized or generalized), platelet defect, and coagulation defect, in terms of:
- a. etiologic/precipitating factors 4.0
 - b. genetics 4.0
 - c. common sites of occurrence 4.0
 - d. organs affected 4.0
 - e. type and size of vessels involved 4.0
 - f. results, complications, and fate of lesions 4.0
 - g. clinical features 4.0
 - h. laboratory findings 4.0
5. Discuss thrombocytosis in terms of diagnosis and differential diagnosis. 2.0
6. Outline the processes for stepwise evaluations of bleeding patients, patients with suspected platelet disorder, and patients with suspected hypercoagulability. 4.0
7. List and discuss the laboratory diagnostic procedures used to approach patients with bleeding disorders and thrombotic disorders. 4.0

8. Compare and contrast bleeding disorders due to the following, in terms of etiology, genetics, pathogenesis, clinical presentation, laboratory diagnosis, and clinical course:
 - a. factor VII deficiency (hemophilia A) 4.0
 - b. factor IX deficiency (hemophilia B) 4.0
 - c. factor XI deficiency (hemophilia C) 4.0
 - d. von Willebrand disease 4.0
 - e. vitamin K deficiency 4.0
 - f. liver disease 4.0

9. Describe disseminated intravascular coagulopathy (DIC) in terms of etiology, pathogenesis, morphologic features, clinical presentation and course, laboratory diagnosis, and complications and prognosis. 3.0
10. Describe the pathogenesis of hypercoagulable states in terms of Virchow's triad. 3.0
11. Compare and contrast genetic and acquired hypercoagulable disorders due to the following, in terms of etiology, pathogenesis, clinical presentation, laboratory diagnosis, and clinical course:
 - a. antithrombin III deficiency 4.0
 - b. antiphospholipid syndrome (Lupus anticoagulant) 4.0
 - c. protein C, protein S 4.0
 - d. factor V Leiden 4.0
 - e. pro-thrombin mutation 4.0

12. Describe the mechanism(s) by which aspirin, NSAIDs, coumadin (warfarin), and heparin and other anticoagulants affect hemostasis, and describe the methods by which each is monitored. 4.0

F. Genetics

1. Compare and contrast congenital and familial abnormalities, and provide examples of each. Emphasis should be placed on demonstrating an understanding of etiology, morphology, laboratory finding, and clinical features. 4.0
2. Describe each of the following genetic diseases and provide examples of each:
 - a. simple autosomal dominant 4.0
 - b. simple autosomal recessive 4.0
 - c. X-linked recessive 4.0

3. Given the mode of inheritance for a family history involving a disease with classic mendelian inheritance, predict the likelihood of various phenotypes and genotypes in family members. 3.0
4. Given a family history or pedigree, indicate the most likely mode of inheritance:
 - a. autosomal dominant 3.0
 - b. autosomal recessive 3.0
 - c. sex-linked dominant 3.0
 - d. sex-linked recessive 3.0

5. Describe diseases with multifactorial inheritance (Diabetes mellitus, Rheumatoid arthritis) emphasizing the pathogenesis, morphology, laboratory studies and clinical presentation. 3.0
6. List examples of teratogenic agents and compare and contrast their methods of action. 2.0
7. Describe lysosomal storage diseases, citing mode of inheritance and major defect

- and clinical symptoms. 2.0
8. Describe two major disorders involving the sex chromosomes. 2.0
9. Describe Trisomy 21, 18, and 13 including pathogenesis, morphology, clinical presentation, clinical course, and complications. 4.0
10. Describe the following in terms of methodology of performance of test, appropriateness in various types of clinical situations, and clinical implications:
- a. karyotyping 3.0
 - b. RFLP 3.0
 - c. PCR 3.0
 - d. DNA sequencing 3.0
11. Describe the modes of inheritance of mitochondrial disorders and give two examples of diseases associated with them. 3.0

G. Immunity

1. Discuss and classify the MHC (Major Histocompatibility Complex) molecules as class I or II. 4.0
2. Compare and contrast the four types of hypersensitivity reactions in terms of type of reaction, prototypic disorder, immune mechanisms, mediators, pathologic lesions, and clinical disorders. 4.0
3. Compare and contrast hyperacute, acute, and chronic transplant rejection in terms of etiology, pathogenesis, and morphology. 3.0
4. Define *immunologic tolerance* and describe the mechanisms of both central and peripheral tolerance. 2.0
5. Discuss the mechanisms of autoimmune diseases in terms of the breakdown of self-tolerance, environmental triggers, and genetics. 3.0
6. Correlate the following autoantibodies with the major autoimmune disease(s) it is associated with and provide the diagnostic significance:
 - a. antinuclear (ANA) 4.0
 - b. anti-double-stranded DNA 4.0
 - c. SS-A (Ro) 4.0
 - d. nuclear RNP 4.0
 - e. anticentromere 4.0
 - f. anti-Smith (Sm) 4.0
 - g. anti-histone 4.0
 - h. SS-B (La) 3.0
 - i. Scl-70 3.0
 - j. Jo-1 3.0
7. Describe and describe the genetics, etiology, immunologic basis, clinical presentation, morphology, and complications of the following primary immunodeficiencies
 - a. X-linked agammaglobulinemia of Bruton 3.0
 - b. common variable immunodeficiency 3.0
 - c. DiGeorge syndrome (thymic hypoplasia) 3.0
 - d. severe combined Immunodeficiency syndrome 3.0
 - e. Wiskott-Aldrich syndrome 3.0
8. Describe secondary immunodeficiencies (chemotherapy, diabetic, steroids) in terms of etiologies. 4.0

9. Describe acquired immunodeficiency syndrome (HIV infection, AIDS) in terms of epidemiology, diagnostic criteria, incidence, risk factors, pathogenesis, immunologic defects, associated infections and neoplasms, morphology, and clinical presentation. **4.0**
10. Describe amyloidosis, with emphasis on pathogenesis, classification, morphology, and complications. **4.0**
11. Describe the following disorders in terms of etiology, incidence, prevalence, genetic factors, age, gender, pathogenesis, anatomic distribution, morphology, associated disorders, laboratory findings, clinical course, and prognoses: **4.0**
 - a. scleroderma **4.0**
 - b. Sjogren syndrome **4.0**
 - c. lupus erythematosus **4.0**
 - i. discoid **4.0**
 - ii. systemic **4.0**
 - iii. drug induced **4.0**
 - d. mixed connective tissue disease **4.0**

H. Neoplasia

1. Describe the principles of carcinogenesis, including fundamental genetic changes, unregulated cell proliferation, monoclonal nature of tumor cells, and loss of apoptosis. **3.0**
2. Differentiate between benign and malignant tumors. **4.0**
3. Discuss the following terminology applied to tumors and explain how it reflects the tissue of origin:
 - a. benign tumors **3.0**
 - b. carcinoma (epithelial) **3.0**
 - c. sarcoma (mesenchymal) **3.0**
 - d. lymphatic **3.0**
4. Compare and contrast *anaplasia*, *dysplasia*, and *carcinoma in situ*. **4.0**
5. Compare and contrast tumor invasion and tumor metastasis. **4.0**
6. Describe the mechanisms by which tumors metastasize. **3.0**
7. Describe the mechanism for invasion including the function of E cadherin and their significance in invasion of ECM and stromal response. **4.0**
8. Briefly describe the role of the enzyme family of proteases in tumor metastasis including tumor location, vascular drainage recognizing that carcinogenesis is a multistep process. **3.0**
9. Discuss the factors which determine the site of metastasis. **3.0**
10. Describe the metastasis of malignant tumors to regional lymph nodes with emphasis on the term "sentinel lymph node". **3.0**
11. List the most frequent genetic mutations occurring in malignancies and categorize as to the following functions:
 - a. oncogenes **4.0**
 - b. tumor suppressor genes **4.0**
 - c. genes regulating apoptosis **4.0**
 - d. DNA repair genes **4.0**
 - e. proto-oncogenes **4.0**
 - f. cellular signaling pathways **4.0**

12. Describe molecular changes leading to progression from normal epithelium to carcinoma. 4.0
13. Define *cachexia* and explain why it is encountered in cancer patients. 4.0
14. Describe paraneoplastic syndrome and discuss its clinical significance. 4.0
15. Compare and contrast *staging* and *grading* of malignant tumors. 4.0
16. Identify the different morphologic diagnostic procedures and laboratory methods used in the diagnosis of malignancies such as: cytology, FNAC, biopsy types (incisional, excisional). 4.0
17. Describe the appropriate use of tumor markers and correlate the following with Cancer type:
 - a. PSA 3.0
 - b. CEA 3.0
 - c. alpha-fetoprotein 3.0
 - d. estrogen receptor 3.0
 - e. progesterone receptor 3.0
 - f. alkaline phosphatase 3.0
 - g. beta HCG 3.0
18. Describe the use of molecular techniques in assessing prognosis and hereditary predisposition in the diagnosis of cancer. 2.0
19. Identify important tumor antigens and describe their known uses. 2.0
20. Explain the mechanisms by which tumor cells escape immunosurveillance. 2.0
21. Describe the role of gender, age, diet, and environment in the development of malignancy. 4.0
22. Define the terms *progression*, *genomic instability* and *heterogeneity* as they relate to the behavior of tumor cells. 4.0

I. Infectious Disease

1. Describe the mechanisms by which viruses enter and damage cells. 4.0
2. Compare and contrast viruses that result in acute transient, chronic latent, chronic productive and transformative infections and describe how these differences result in different disease pathogenesis. 4.0
3. Compare and contrast the histopathological features of viral hemorrhagic fevers, herpes virus, cytomegalovirus, human papilloma virus, and adenovirus in terms of nuclear features, inclusions, size of cells, and other unique characteristics; recognize these histopathological features of viral infections in images of different tissues. 4.0
4. Describe the mechanisms by which bacteria damage cells and tissues, comparing and contrasting mechanisms characteristic of infection with particular categories of bacteria. 4.0
5. Describe the different patterns of transmission of bacterial diseases as a function of both the type of organism and the organ systems involved in the infection. 4.0
6. Describe the histologic patterns of tissue response to bacterial infection as a function of differences in the organisms involved, the specific organ affected, and the manner by which the bacterium enters the organ. 4.0
7. Recognize and compare morphology and cell wall features of bacteria using gram stain, Warthin Starry (silver) stain, Acid Fast stain, Partial Acid Fast stain, and Periodic Acid Schiff stain. 4.0
8. List the different types of fungal organisms that infect humans and compare and contrast the mechanisms by which they damage tissues, the inflammatory responses they induce and the resultant diseases that arise. 4.0
9. Recognize histopathologic evidence of fungal infections and compare and contrast

- the histopathological features and staining characteristics of the following fungi: *Candida albicans*, *Cryptococcus neoformans*, *Aspergillus*, *Histoplasma capsulatum*, *Coccidioides immitis*, *Blastomyces dermatitis*, *Pneumocystis jiroveci*, and Zygomycetes. 4.0
10. Compare and contrast the types of fungal infections that occur in immunosuppressed and immunocompetent patients with respect to the organisms involved, the mechanisms of organ damage, and the resultant clinical manifestations. 4.0
 11. List, with examples, classes of parasites that produce human disease, and describe their life cycle within humans and within other hosts. 4.0
 12. Describe, with examples, the mechanisms of pathologic damage caused by different parasites in different tissues, and describe the diseases, complications and possible outcomes associated with such infections. 4.0
 13. Recognize tissues involved with parasitic infections and compare the histopathological features and staining characteristics of parasites producing the following parasitic diseases: Toxoplasmosis, Giardiasis, Amoebiasis, Malaria, Babesiosis, Leishmaniasis, Trypanosomiasis, Strongyloidiasis, Schistosomiasis, Filariasis and Cestode infections. 4.0
 14. Identify and describe the following prion infections:
 - a. Creutzfeldt-Jakob disease 2.0
 - b. Variant Creutzfeldt-Jakob disease 2.0

J. Environmental Pathology

1. Describe the effects of tobacco abuse and pneumoconioses, with special emphasis on morphology, clinical effects, and comorbidities. 4.0
2. Describe ethanol, fetal alcohol syndrome, methanol, and ethylene glycol, in terms of morphology, clinical effects, and comorbidities. 4.0
3. Describe the abuse of cocaine, amphetamines, narcotics, and marijuana in terms of morphology, clinical effects, and comorbidities. 4.0
4. Describe arsenic, lead, mercury, and organophosphate insecticides and toxic agents, with special emphasis on morphology, clinical effects, and comorbidities. 3.0
5. Describe estrogen oral contraceptives (OCTs), NSAIDs, and acetaminophen as therapeutic drugs, in terms of morphology, clinical effects, and comorbidities. 3.0
6. Describe the following mechanical injuries in terms of cause and physical appearance:
 - a. abrasion 4.0
 - b. avulsion 4.0
 - c. contusion 4.0
 - d. incision 4.0
 - e. laceration 4.0
 - f. puncture wound 4.0
 - g. stab wound 4.0
 - h. asphyxia 4.0
 - i. pattern injury recognition 4.0
 - j. gunshot wounds (shotgun versus gunshot) 4.0
7. Describe the effects of systemic hypothermia, hyperthermia and frostbite in terms of pathophysiologic mechanisms, morphology, clinical effects, and comorbidities. 4.0
8. Differentiate full thickness burns versus partial thickness burns, specifically in terms of pathophysiologic mechanisms, morphology, clinical effects, and comorbidities. 4.0
9. Describe the effects of electrical injuries, in terms of pathophysiologic mechanisms,

- morphology, clinical effects, and comorbidities. 3.0
10. Describe the effects of radiation injuries—both whole body and localized—in terms of pathophysiologic mechanisms, morphology, clinical effects, and comorbidities. 3.0

K. Nutritional Disease

1. Compare and contrast primary and secondary dietary insufficiencies. 3.0
2. Compare and contrast the following protein-energy malnutrition:
 - a. kwashiorkor 4.0
 - b. marasmus 4.0
 - c. secondary protein energy malnutrition 4.0
3. Describe fat soluble vitamin deficiencies and excesses for vitamins A, D, E, and K with respect to morphology and clinical effects. 4.0
4. Describe the water-soluble vitamin deficiencies for vitamins B1, B2, B6, B12, C, niacin, folate, pantothenic acid, and biotin, with respect to morphology and clinical effects. 4.0
5. Describe the effects of the following mineral deficiencies: zinc, iron, iodine, copper, fluoride, and selenium. 2.0
6. Describe the effects of obesity on hypertension, atherosclerosis, diabetes mellitus, and cancer with emphasis on morphology, clinical effects, and co-morbidities. 4.0
7. Describe the effects of Anorexia nervosa and bulimia, with emphasis on morphology, clinical effects, and co-morbidities. 4.0
8. Describe the effects of diet on cancer, with emphasis on morphology, clinical effects, and co-morbidities. 3.0
9. Describe the effects of diet on atherosclerosis, with emphasis on morphology, clinical effects, and co-morbidities. 4.0

L. Principles of Laboratory Testing

1. Identify units of measure used in basic laboratory principles and describe collection and transportation of specimens. 3.0
2. Describe the appropriate uses of clinical laboratories, surgical pathology, frozen sections, cytopathology, and autopsies. 4.0
3. Calculate sensitivity and specificity, given raw data. 4.0
4. Compare and contrast precision and accuracy. 4.0
5. Explain the concept of quality assurance and its role in the clinical laboratory. 2.0
6. Define reference range and explain its role in the diagnosis of disease. 3.0
7. Explain and provide examples of the use of decision levels in clinical medicine. 4.0
8. Describe the use of laboratory tests to screen for and to monitor disease. 3.0
9. Discuss the effects of sample handling on laboratory results, including turnaround time, type of tube used for blood collection, timing of collection, transport, and storage. 4.0

II. Systemic Pathology

A. Vascular Disease

1. Discuss the effects of age, gender, geographic location, and risk factors on the Pathogenesis, morphology and anatomic distribution of atherosclerosis and vascular disease. 4.0

2. Describe the pathogenesis and clinical complications of peripheral vascular disease. **4.0**
3. Describe the following forms of vasculitis in terms of incidence, etiology, pathogenesis, morphology, and clinical features, complications, and prognoses:
 - a. Infectious vasculitis **3.0**
 - b. giant cell arteritis **3.0**
 - c. polyarteritis nodosa **3.0**
 - d. hypersensitivity vasculitis **3.0**
 - e. thromboangiitis obliterans (Buerger disease) **3.0**
 - f. granulomatosis with polyangiitis (Wegener granulomatosis) **3.0**
4. Compare and contrast the following disorders in terms of etiology, pathogenesis, type and distribution of vessels involved, clinical features, and complications and prognoses:
 - a. atherosclerotic aneurysm **4.0**
 - b. syphilitic aneurysm **3.0**
 - c. aortic (dissecting) aneurysm **3.0**
 - d. cystic medial necrosis **4.0**
 - e. congenital malformations **3.0**
5. Describe the following disorders in terms of etiology, complications, and clinical features and prognoses:
 - a. varicose veins **4.0**
 - b. thrombophlebitis **4.0**
 - c. lymphangitis **4.0**
 - d. lymphedema **4.0**
 - e. venous insufficiency **4.0**
6. Compare and contrast the pathophysiologic, morphologic, and clinical differences between atherosclerosis, arteriolosclerosis, and medial calcinosis. **3.0**
7. Describe the differences between primary and secondary Raynaud phenomenon, with emphasis on the pathophysiology and clinical presentation. **4.0**
8. Compare and contrast the following vascular tumors in terms of epidemiology, variants, morphology, clinical features, and prognoses:
 - a. hemangioma **3.0**
 - b. lymphangioma **2.0**
 - c. glomus tumor **3.0**
 - d. Kaposi sarcoma **4.0**
 - e. angiosarcoma **2.0**

B. Cardiac Disease

1. List the most common forms of heart disease in the United States. **4.0**
2. Compare and contrast the following: congestive heart failure, left-sided heart failure, right-sided heart failure, HFrEF (systolic heart failure) and HFpEF (diastolic heart failure) in terms of etiology, pathogenesis, compensatory mechanisms, and morphology. **4.0**
3. Describe congenital heart disease in terms of left-to-right and right-to-left shunts, with special attention to the most common forms of congenital heart disease (ventricular septal defect, atrial septal defect) and Tetralogy of Fallot. **2.0**
4. Describe endocarditis, myocarditis, and pericarditis in terms of classification, epidemiology, etiology/pathogenesis, morphology, clinical features, and prognosis. **4.0**

5. Compare and contrast acute rheumatic fever and chronic rheumatic heart disease, including pathogenesis, diagnostic criteria (Jones criteria), morphology (cardiac and extracardiac), complications, and clinical features. 4.0
6. Compare and contrast the following forms of valvular heart disease, in terms of epidemiology, etiology, pathogenesis, morphology, clinical features, morphology, clinical features, complications, and prognosis:
 - a. calcific aortic stenosis 4.0
 - b. aortic insufficiency 4.0
 - c. mitral stenosis/insufficiency 4.0
 - d. mitral valve prolapse 4.0
 - e. mitral annular calcification 4.0
 - f. tricuspid insufficiency 4.0
 - g. pulmonic insufficiency 4.0
7. Compare and contrast primary cardiac myopathies including: dilated (congestive) cardiomyopathy, hypertrophic cardiomyopathy, and restrictive cardiomyopathy in terms of etiology, pathogenesis, morphology, and clinical course. 4.0
8. Describe coronary artery disease in terms of epidemiology, risk factors, etiologic factors, pathogenesis, and complications. 4.0
9. Describe myocardial infarct in terms of etiologic factors; risk factors; pathogenesis; morphology; clinical, laboratory, and electrocardiographic findings; complications; and prognosis. 4.0
10. Compare and contrast right-sided and left-sided hypertensive heart disease in terms of
 - a. etiologic factors 4.0
 - b. pathogenesis 4.0
 - c. morphology 4.0
 - d. clinical features 4.0
 - e. prognosis 4.0
11. Describe sudden cardiac death in terms of cause, relationship to arrhythmias, and cardiac morphology. 4.0
12. Describe the following cardiac tumors:
 - a. myxoma 2.0
 - b. rhabdomyoma/ rhabdomyosarcoma 2.0
13. Describe the origin, function, and disease states seen with elevations of serum creatinine phosphokinase (CPK), cardiac troponins, and myoglobin. 4.0
14. Describe the way that C-reactive protein (CRP), homocysteine, beta natriuretic peptide, and lipids (triglycerides and HDL and LDL cholesterol) serve as markers for an increased risk of cardiovascular disease. 4.0
15. Describe familial hypercholesterolemia with emphasis on genetics, pathophysiology, morphology, and clinical presentation. 4.0
16. Compare and contrast causes of secondary hyperlipidemias. 4.0

C. Hematopoietic System

1. Define and describe the significance in a complete blood count of normal and abnormal findings in the following:
 - a. band form 4.0
 - b. neutrophil 4.0

- c. basophil 4.0
 - d. eosinophil 4.0
 - e. plasma cell 4.0
 - f. lymphocyte 4.0
 - g. megakaryocyte 4.0
2. Describe the function of important growth factors in hematopoiesis including erythropoietin, granulocyte stimulating growth factor, thrombopoietin, and others. 3.0
 3. Define and state the significance of the following red cell parameters in a complete blood count:
 - a. hemoglobin 4.0
 - b. hematocrit 4.0
 - c. mean corpuscular volume (MCV) 4.0
 - d. mean corpuscular hemoglobin (MCH) 4.0
 - e. mean corpuscular hemoglobin concentration (MCHC) 4.0
 - f. red cell distribution width 4.0
 - g. reticulocyte count 4.0
 4. Compare and contrast the pathogenesis of anemia (in terms of incidence, etiology and pathogenesis, marrow and peripheral blood morphology, laboratory diagnostic criteria, and clinical features and course):
 - a. acute versus chronic blood loss 3.0
 - b. increased rate of destruction (hemolytic anemias) 3.0
 - c. impaired red cell production (erythropoiesis) 3.0
 5. Compare and contrast hemolytic anemias in terms of etiology, pathogenesis, laboratory diagnosis, and clinical findings and course, according to
 - a. hereditary versus acquired 3.0
 - b. intravascular versus extravascular hemolysis 3.0
 - c. intrinsic (hereditary spherocytosis and G-6-PD deficiency) versus extrinsic RBC (antibody-mediated, mechanical trauma, and chemical injury) defects. 3.0
 6. Describe the following types of anemia in terms of etiology, marrow and peripheral blood morphology, laboratory diagnostic criteria, and clinical features and course:
 - a. iron deficiency anemia 4.0
 - b. megaloblastic anemia 3.0
 - c. folate deficiency anemia 3.0
 - d. pernicious anemia 3.0
 - e. anemia of chronic disease 4.0
 - f. aplastic anemia 3.0
 7. Describe iron in terms of requirements, sources, GI absorption, storage and transport forms, interpretation of test results, and altered levels and association with disease. 4.0
 8. Compare and contrast the following types of hemoglobinopathies in terms of etiology, genotype, morphology on peripheral smear, clinical symptoms, and laboratory diagnostic criteria:
 - a. sickle cell disease 4.0
 - b. hemoglobin C disease 2.0
 - c. hemoglobin SC disease 2.0

9. Compare and contrast alpha and beta thalassemias in terms of
 - a. major versus minor types 3.0
 - b. morphology on peripheral smear 3.0
 - c. laboratory diagnostic criteria 3.0
 - d. clinical symptoms 3.0
 - e. genotypes 3.0

D. Myeloid Neoplasms

1. Describe the pathogenesis, morphology, immunophenotype, laboratory findings, and clinical features of acute myeloid leukemia (AML). 2.0
2. Explain the WHO classification system for acute myeloid leukemia with emphasis on the four major classes and their prognostic implications. 2.0
3. Compare and contrast the general features common to the myeloproliferative neoplasms (chronic myelogenous leukemia, polycythemia vera, and primary myelofibrosis), in terms of clinical presentation, laboratory findings, morphology, clinical presentation, and risk of transformation. 3.0
4. Define the following:
 - a. Philadelphia chromosome 3.0
 - b. BCR-ABL fusion gene 3.0
 - c. hyperviscosity syndrome 2.0
 - d. extramedullary hematopoiesis 2.0
5. Describe polycythemia vera (PV) in terms of pathogenesis, morphology, laboratory studies, clinical presentation, and complications with emphasis on the following:
 - a. hyperviscosity syndrome 3.0
 - b. spent phase 2.0
 - c. blast crisis 2.0
6. Compare and contrast the pathogenesis of the different myeloproliferative neoplasms. 3.0
7. Describe myelodysplastic syndromes in terms of pathogenesis, morphology and clinical course. 2.0
8. Distinguish amongst reactive leukocytosis, leukemoid reactions and leukemia in terms of pathogenesis, etiology, and laboratory data. 3.0

E. Lymphoid Neoplasms

1. Differentiate lymphoma and leukemia. 4.0
2. Compare and contrast the general features of Hodgkin lymphoma and non-Hodgkin lymphoma in terms of incidence; principle of classification, grading, and staging; laboratory methods of diagnosis; clinical features; prognosis; methods of staging in and extra-lymphatic organs involved. 3.0
3. Describe acute lymphoblastic leukemia (ALL) in terms of incidence, age distribution, cytogenetics, morphology (bone marrow and peripheral blood), immunophenotyping, laboratory diagnosis, clinical features, and prognosis. 3.0
4. Describe hairy cell leukemia in terms of incidence, age distribution, morphology, laboratory diagnosis, clinical features and prognosis. 2.0
5. Describe chronic lymphocytic leukemia/small lymphocytic lymphoma in terms of incidence, pathogenesis, morphology, and clinical presentation. 3.0
6. Explain the WHO classification system for lymphoid neoplasms and classify lymphoid neoplasms. 3.0

7. Describe multiple myeloma in terms of clinical presentation, etiology, diagnosis, morphology and sites of lesions, laboratory findings, clinical course, complications, and prognosis. **3.0**

F. Pulmonary Disease

1. Compare and contrast resorption (obstruction) atelectasis, compression atelectasis, and contraction atelectasis, in terms of etiology, pathogenesis, morphology, and clinical features. **4.0**
2. Compare and contrast the two major causes of pulmonary edema with special emphasis on pathophysiology and morphology. **4.0**
3. Describe acute respiratory distress syndrome (ARDS) in terms of pathogenesis, morphology, and clinical course. **4.0**
4. Compare and contrast the major differences between obstructive and restrictive pulmonary disease, with emphasis on laboratory findings. **4.0**
5. Describe the use of the term COPD (chronic obstructive pulmonary disease). **4.0**
6. Compare and contrast the following obstructive pulmonary diseases in terms of etiology, pathogenesis, morphology, clinical course, and complications:
 - a. emphysema **4.0**
 - b. chronic bronchitis **4.0**
 - c. asthma **4.0**
 - d. bronchiectasis **4.0**
7. Compare and contrast idiopathic pulmonary fibrosis and pulmonary involvement in connective tissue diseases (rheumatoid arthritis, SLE, PSS, and sarcoidosis), in terms of etiology, pathogenesis, morphology, clinical course, and complications. **4.0**
8. Describe pulmonary embolism, hemorrhage, and infarction in terms of etiology, pathogenesis, morphology, clinical course, and complications. **4.0**
9. Describe pulmonary hypertension in terms of etiology, pathogenesis, morphology, clinical course, and complications. **3.0**
10. Describe Goodpasture syndrome in terms of pathogenesis, morphology, and clinical course. **2.0**
11. Describe the pulmonary features of cystic fibrosis (CF) in terms of lung involvement, pathogenesis, genetics, morphology, clinical manifestations, pulmonary complications, treatment, and prognosis. **3.0**
12. Compare and contrast bronchopneumonia, aspiration pneumonia, lobar pneumonia, lung abscess, and chronic pneumonia in terms of etiologic organisms, pathogenesis, morphology, and clinical course. **4.0**
13. Compare and contrast the following lung tumors in terms of epidemiology, etiology, pathogenesis, morphology, clinical course, paraneoplastic syndromes, and prognoses:
 - a. adenocarcinoma **3.0**
 - b. large cell carcinoma **3.0**
 - c. metastatic tumor **3.0**
 - d. neuroendocrine tumors (including small cell carcinoma) **3.0**
 - e. squamous cell carcinoma **3.0**
14. Describe inflammatory pleural effusions, non-inflammatory pleural effusions, and pneumothorax in terms of etiology, pathogenesis, morphology, and clinical course. **3.0**
15. Compare and contrast solitary fibrous tumor and malignant mesothelioma in terms of etiology, pathogenesis, morphology, clinical course, and prognoses. **3.0**
16. Describe the innate and adaptive immunity of the lung. **4.0**

G. Gastrointestinal Tract Disease

1. Describe diverticula, stenosis, esophageal mucosal webs, esophageal rings, and achalasia as causes of esophageal obstruction, in terms of anatomic location, morphology, and clinical features. 2.0
2. Compare and contrast the following causes of esophagitis: lacerations (including Mallory-Weiss tears), chemical and infectious esophagitis, reflux esophagitis (GERD), hiatal hernia, and eosinophilic esophagitis. 3.0
3. Describe esophageal varices, including pathogenesis and clinical course. 3.0
4. Describe Barrett esophagus, in terms of pathogenesis, morphologic findings, clinical course, and complications. 3.0
5. Describe the etiology, pathogenesis, morphology, clinical course, and prognosis for esophageal carcinomas. 2.0
6. Compare and contrast acute, autoimmune, atrophic, and chronic gastritis in terms of etiology, pathogenesis, morphology, and clinical features. 3.0
7. Describe acute gastric ulceration in terms of etiology, pathogenesis, morphology, and clinical features. 3.0
8. Describe chronic gastritis in terms of etiology (with emphasis on *Helicobacter pylori* and autoimmune gastritis), pathogenesis, morphology, and clinical features. 3.0
9. Describe the complications of chronic gastritis, including peptic ulcer disease, mucosal atrophy, intestinal metaplasia and dysplasia. 3.0
10. Compare and contrast gastric polyps, inflammatory polyps, hyperplastic polyps, and gastric adenomas. 2.0
11. Describe gastric carcinoma in terms of epidemiology, pathogenesis, morphology, and clinical features. 3.0
12. Describe carcinoid tumor in terms of morphology and clinical features. 2.0
13. Identify and describe causes of intestinal obstruction, including hernias, adhesions, volvulus, and intussusception. 4.0
14. Describe ischemic bowel disease in terms of pathogenesis, morphology, and clinical features. 4.0
15. Compare and contrast cystic fibrosis, celiac disease, and lactase deficiency in terms of pathogenesis, morphology, and clinical features. 4.0
16. Describe morphologic changes and clinical features of irritable bowel syndrome. 2.0
17. Compare and contrast Crohn disease and ulcerative colitis in terms of pathogenesis, morphology, clinical features, and complications. 4.0
18. Describe sigmoid diverticular disease in terms of pathogenesis, morphology, clinical features, and complications. 3.0
19. Compare and contrast inflammatory, hamartomatous, hyperplastic, and neoplastic polyps in terms of morphology and complications. 3.0
20. Compare and contrast familial adenomatous polyposis and hereditary non polyposis colorectal cancer in terms of genetics and clinical features. 3.0
21. Describe adenocarcinoma of the colon in terms of epidemiology, pathogenesis, morphology, and clinical features. 4.0
22. Describe hemorrhoids in terms of pathogenesis, morphology, and clinical features. 4.0
23. Describe acute appendicitis in terms of pathogenesis, morphology, and clinical features. 4.0

H. Pathology of the Liver and Extrahepatic Biliary System

1. Identify and describe histologically intracellular accumulations, necrosis, inflammation, and cirrhosis as patterns of hepatic injury. 2.0

2. List the common manifestations of hepatic dysfunctions and be able to explain the mechanism of the following manifestations:
 - a. ascites 4.0
 - b. caput medusa 3.0
 - c. esophageal varices 4.0
 - d. gynecomastia 3.0
 - e. hemorrhoids 4.0
 - f. hepatic encephalopathy 4.0
 - g. hypoalbuminemia 4.0
 - h. hypogonadism 3.0
 - i. jaundice 4.0
 - j. palmar erythema 4.0
 - k. spider angioma 3.0
 - l. splenomegaly 3.0

3. Interpret the values of different components of the liver function tests. 4.0
4. Differentiate between acute and chronic liver dysfunction. 4.0
5. Differentiate between primary renal dysfunction and renal dysfunction due to hepatorenal syndrome. 3.0
6. Explain the major three mechanisms that contribute to the development of cirrhosis. 4.0
7. List the three different patterns of alcoholic liver injury, their key morphological findings, and describe their clinical relationship to each other. 3.0
8. List the main drugs which cause damage to the liver. 4.0
9. Explain the mechanisms by which alcohol, drugs and iron damage the hepatocytes. 3.0
10. Compare and contrast the different forms of viral hepatitis (A, B, C, D, and E) with emphasis on etiology, morphology, laboratory findings, clinical course, and complications. 4.0
11. Describe the pathogenesis, morphology (including possible extrahepatic manifestations), and clinical course for the following: Wilson disease, hemochromatosis, α 1-antitrypsin deficiency, and Reye syndrome. 3.0
12. Describe the different causes of jaundice with emphasis on whether the pathophysiologic mechanism produces predominantly unconjugated hyperbilirubinemia or predominantly conjugated hyperbilirubinemia. 4.0
13. Differentiate between neonatal cholestasis and physiological jaundice and describe extrahepatic biliary atresia. 2.0
14. Differentiate between primary biliary cirrhosis (cholangitis), autoimmune hepatitis and primary sclerosing cholangitis, in terms of epidemiology, radiographic findings, associated conditions, morphology, laboratory findings, and clinical course. 3.0
15. Identify and describe primary and metastatic neoplasms of the liver. 3.0
16. Describe the pathogenesis of gallstones. 3.0
17. Compare and contrast the different types of cholecystitis (acute calculous, acute acalculous, and chronic) with emphasis on clinical presentation, laboratory findings and morphology. 4.0
18. Describe disorders of extrahepatic bile ducts with emphasis on choledocholithiasis and cholangitis. 3.0
19. Describe carcinoma of the gallbladder with emphasis on morphology and clinical features. 2.0

I. Pancreatic Disease

1. Describe the following congenital anomalies of the pancreas:
 - a. agenesis 2.0
 - b. pancreas divisum 2.0
 - c. annular pancreas 2.0
 - d. ectopic pancreas 3.0
2. Compare and contrast acute pancreatitis and chronic pancreatitis with emphasis on etiology, pathogenesis, morphology, laboratory studies, clinical features, and complications. 4.0
3. Describe cystic fibrosis in terms of genetics, primary defect, morphologic findings, laboratory findings, and clinical course. 3.0
4. Describe non-neoplastic pancreatic cysts with emphasis on congenital cysts and pseudocysts, specifically in regard to etiology and morphology. 2.0
5. Describe neoplastic cysts of the pancreas, including serous cystadenomas, mucinous cystadenomas, and intraductal papillary mucinous neoplasms. 2.0
6. Describe pancreatic carcinoma in terms of precursor lesions, molecular carcinogenesis, epidemiology, etiology, pathogenesis, morphology, and clinical features. 3.0
7. Describe the following pancreatic endocrine neoplasms, including hyperinsulinism and Zollinger-Ellison syndrome in terms of clinical presentation, laboratory findings, and morphology. 2.0

J. Genitourinary Disease Objectives

1. Compare and contrast infectious and interstitial cystitis, in terms of etiology, pathogenesis, clinical course, and complications. 2.0
2. Describe urothelial carcinoma, squamous cell carcinoma, and adenocarcinoma, in terms of epidemiology, etiology, and clinical and pathological features. 2.0
3. Describe and describe hypospadias and epispadias. 2.0
4. Describe the following testicular tumors; germ cell tumors; sec-cord tumors; and malignant lymphoma in terms of incidence, risk factors, clinical symptoms, main pathological features, and prognosis. 3.0
5. Describe squamous cell carcinoma of the penis and scrotum including etiology, clinical features, laboratory diagnostics, morphology and grading. 3.0
6. Compare and contrast prostatitis, orchitis, and torsion of the spermatic cord in terms of etiology, pathogenesis, clinical course, and complications. 2.0
7. Describe nodular hyperplasia of the prostate in terms of incidence, clinical symptoms, and morphology. 3.0
8. Describe adenocarcinoma of the prostate including etiology, clinical features, laboratory diagnostics, morphology and grading 4.0
9. Describe cryptorchidism in terms of incidence, morphology and complications. 2.0
10. Describe infections of the lower genital tract (vulva, vagina, and cervix) in terms of common etiologic agents, and clinical symptoms. 3.0
11. Describe pelvic inflammatory disease in terms of common etiologic agents, clinical symptoms, and prognosis. 2.0
12. Describe vaginal adenosis and vaginal adenocarcinoma in terms of epidemiology, etiology, pathogenesis, and clinical significance. 2.0
13. Describe cervical polyps in terms of clinical symptoms and pathogenesis. 2.0
14. Describe carcinoma of the cervix in terms of incidence, risk factors, precursor lesions, clinical features, pathogenesis, and prognosis. 4.0

- | | |
|--|------------|
| 15. Describe endometriosis in terms of incidence, clinical presentation, pathogenesis, and complications. | 3.0 |
| 16. Describe endometrial hyperplasia in terms of etiology, classification, and relationship to malignancy. | 3.0 |
| 17. Describe endometrial carcinoma in terms of risk factors, pathology, clinical symptoms, and prognosis. | 4.0 |
| 18. Describe leiomyoma in terms of incidence, pathology, and clinical symptoms. | 3.0 |
| 19. Compare and contrast ovarian surface epithelial tumors, sex cord-stromal tumors, germ cell tumors, and metastatic malignancy to ovary in terms of incidence, age predilection, morphology, hormonal effects, clinical features, and prognosis. | 3.0 |

K. Renal Disease

- | | |
|---|------------|
| 1. Explain the general histologic pattern of glomerular injury with emphasis on the terms: | |
| a. sclerosis | 2.0 |
| b. proliferative | 2.0 |
| c. focal, segmental | 2.0 |
| d. diffuse | 2.0 |
| 2. Describe the patterns of immunofluorescence (granular and diffuse) and correlate them with the different types of glomerulonephritis. | 2.0 |
| 3. Describe the immunological mechanisms of glomerular diseases and give examples for each mechanism. | 3.0 |
| 4. Compare and contrast nephrotic syndrome and nephritic syndrome, and correlate them with the renal disease. | 4.0 |
| 5. For each of the following glomerulonephritides (acute proliferative, rapidly progressive, membranous, minimal-change disease, focal segmental, and membranoproliferative) describe the pathogenesis, morphology (light microscopy, electron microscopy, and immunofluorescence), laboratory findings, and clinical features. | 3.0 |
| 6. Describe the morphology of glomeruli in the following systemic diseases: | |
| a. systemic lupus erythematosus(SLE) | 4.0 |
| b. diabetes mellitus | 4.0 |
| c. amyloid deposition | 3.0 |
| d. HIV | 3.0 |
| e. hypertension | 4.0 |
| f. Thrombotic microangiopathy | 3.0 |
| 7. Compare and contrast pre-renal azotemia, renal azotemia, and post-renal azotemia in terms of pathophysiology and laboratory findings. | 4.0 |
| 8. Describe the pathogenesis and clinical findings of acute tubular injury/necrosis. | 4.0 |
| 9. List the causes of urinary tract obstruction. | 3.0 |
| 10. Describe the characteristic features of dialysis-associated cysts, and adult polycystic diseases of the kidney. | 3.0 |
| 11. Describe the pathogenesis and common causes and complications of chronic renal failure. | 4.0 |
| 12. Describe renal cell carcinoma with respect to epidemiology, classification, morphology, laboratory findings, and clinical features. | 3.0 |
| 13. Compare and contrast acute and chronic pyelonephritis with emphasis on pathophysiology, laboratory findings, morphology, and clinical course. | 4.0 |
| 14. Describe the conditions commonly associated with renal papillary necrosis. | 3.0 |
| 15. Describe hemolytic uremic syndrome with emphasis on associated organisms, laboratory findings, and clinical course. | 3.0 |

16. Compare and contrast benign nephrosclerosis (arterionephrosclerosis) and accelerated nephrosclerosis (malignant nephrosclerosis) with emphasis on pathophysiology, morphology, and clinical features. 3.0
17. Describe serum creatinine and its relationship to renal function, including factors contributing to its serum level; creatinine clearance and glomerular filtration rate and uses; and diseases associated with increased and decreased serum creatinine. 4.0
18. Describe blood urea nitrogen and its relationship to renal function, including factors contributing to its serum level and diseases associated with increased and decreased blood urea nitrogen. 4.0
19. Describe the components of a macroscopic/dipstick urinalysis and disorders associated with abnormal values. 3.0
20. Describe the components of a microscopic urinalysis and disorders associated with abnormal values. 4.0
21. Describe the use of quantitative protein urinalysis and the conditions associated with abnormal values. 4.0
22. Describe urolithiasis in terms of:
 - a. Composition and relative incidence of various types of stones 3.0
 - b. Pathophysiological abnormalities associated with the common types of stones 3.0
 - c. Etiology and pathogenesis of stone formation 3.0
 - d. Effect of location of stones on clinical and anatomic findings. 3.0
 - e. Clinical course and complications 3.0

L. Breast Disease

1. Describe the following inflammatory disorders of the breast, including epidemiology, clinical presentation, and morphology;
 - a. acute mastitis 2.0
 - b. periductal mastitis 2.0
 - c. mammary duct ectasia 2.0
 - d. fat necrosis 2.0
2. Classify and describe the epidemiology, morphology, clinical features, and risk of progression to cancer of the spectrum of fibrocystic change. 3.0
3. Describe the significance of the epidemiology, genetics, prognostic markers, demographics, hormonal influence, and premalignant lesions as risk factors for the development of breast cancer. 4.0
4. Understand the role of mammography in screening for breast cancer. 4.0
5. Compare and contrast the epidemiology, morphology, clinical features, clinical course, and prognosis of ductal carcinoma in situ (DCIS), including its architectural subtypes (comedocarcinoma, solid, cribriform, papillary, and micropapillary); and lobular carcinoma in situ (LCIS). 4.0
6. Compare and contrast the other types of invasive breast cancer, in terms of epidemiology, and prognosis. 2.0
7. Compare and contrast fibroadenoma and phyllodes tumor in terms of incidence, clinical presentation, morphology, and clinical course. 2.0
8. Describe male gynecomastia and carcinoma in terms of etiology/pathogenesis, clinical features, and prognosis. 3.0

M. Endocrine Disorders

1. Describe all the feedback mechanisms of the endocrine system. **3.0**
2. Differentiate between primary and secondary hyperfunction and hypofunction. **3.0**
3. Describe the clinical manifestations of pituitary disease caused by local mass effects, including visual field disturbances, increased intracranial pressure, and pituitary apoplexy. **2.0**
4. Describe hyperpituitarism, including causes and the classification system for adenomas and genetic abnormalities associated with pituitary adenomas. **2.0**
5. Describe prolactinomas, growth hormone cell (somatotroph) adenomas, and ACTH cell (corticotroph) adenoma in terms of etiology, morphology, laboratory studies, and clinical presentation. **3.0**
6. Describe the etiology of hypopituitarism including tumors (adenomas), traumatic brain injury, subarachnoid hemorrhage, pituitary surgery or radiation, pituitary apoplexy, ischemic necrosis of the pituitary, empty sella syndrome, and hypothalamic lesions. **2.0**
7. Describe the clinical presentation and laboratory studies associated with hypopituitarism. **3.0**
8. Compare and contrast diabetes insipidus and the syndrome of inappropriate ADH secretion, including etiology, pathogenesis, laboratory findings and clinical signs and symptoms. **3.0**
9. Define and interpret the laboratory studies related to thyroid function. **4.0**
10. Describe the etiology, pathogenesis and clinical course and complications of Hyperthyroidism. **3.0**
11. Describe hypothyroidism, in terms of etiology and pathogenesis, with an emphasis on physical appearance, age, skeletal manifestation, CNS/cognitive defects, and clinical presentation and complications. **4.0**
12. Compare and contrast Hashimoto thyroiditis and Graves disease with emphasis on etiology, pathogenesis, morphology, clinical course, and laboratory studies. **4.0**
13. Compare and contrast diffuse nontoxic (simple) and multinodular goiter with emphasis on etiology, pathogenesis, morphology, clinical presentation, clinical course, and laboratory studies. **2.0**
14. Describe thyroid adenomas in terms of pathogenesis, morphology, and clinical features. **3.0**
15. Compare and contrast papillary, follicular, anaplastic, and medullary thyroid carcinomas in terms of genetics, pathogenesis, environmental factors, morphology, clinical course, and prognosis. **3.0**
16. Compare and contrast primary, secondary, and tertiary hyperparathyroidism, with emphasis on etiology, pathogenesis, morphology, clinical presentation, clinical course, and laboratory studies. **3.0**
17. Describe hypoparathyroidism, with emphasis on etiology, pathogenesis, morphology, clinical course, and laboratory studies. **2.0**
18. Describe hypercortisolism (Cushing Syndrome), with emphasis on pathogenesis, morphology, clinical course, and laboratory studies. **3.0**
19. Describe the use of the dexamethasone suppression test. **3.0**
20. Compare and contrast primary and secondary hyperaldosteronism with emphasis on etiology, pathogenesis, morphology, clinical course, and laboratory studies. **3.0**
21. Compare and contrast the different forms of 21-hydroxylase deficiency, with emphasis on etiology, pathogenesis, morphology, clinical course, and laboratory studies. **2.0**
22. Compare and contrast the differences between primary and secondary adrenocortical insufficiency, with emphasis on etiology, pathogenesis, morphology, clinical course, and laboratory studies. **3.0**

- | | |
|--|------------|
| 23. Explain Waterhouse-Friderichsen Syndrome, Addison Disease, Autoimmune polyendocrine syndrome type 1 (APS1), and autoimmune polyendocrine syndrome type 2 (APS2). | 3.0 |
| 24. Compare and contrast adrenocortical adenoma and adrenocortical carcinoma with emphasis on etiology, morphology, clinical course, and laboratory studies. | 2.0 |
| 25. Describe pheochromocytoma in terms of etiology, pathogenesis, morphology, clinical course, and laboratory studies. | 3.0 |
| 26. Compare and contrast the different multiple endocrine neoplasia syndromes (MEN syndromes), with emphasis on etiology, pathogenesis, genetics, morphology, and clinical course. | 2.0 |

N. Diabetes

- | | |
|--|------------|
| 1. Define and use in proper context: | |
| a. advance Glycosylation End Product (AGE's) | 4.0 |
| b. albuminuria | 4.0 |
| c. C-peptide | 4.0 |
| d. dawn phenomenon | 4.0 |
| e. diabetes mellitus | 4.0 |
| f. gestational diabetes | 4.0 |
| g. glycosuria | 4.0 |
| h. glycosylated hemoglobin | 4.0 |
| i. glycosylation (glycation) | 4.0 |
| j. HgbA1c | 4.0 |
| k. hyperglycemia | 4.0 |
| l. hyperinsulinemia | 4.0 |
| m. hypoglycemia | 4.0 |
| n. impaired fasting glucose | 4.0 |
| o. impaired glucose tolerance | 4.0 |
| p. insulin | 4.0 |
| q. insulin resistance | 4.0 |
| r. insulinitis | 4.0 |
| s. ketosis | 4.0 |
| t. metabolic syndrome | 4.0 |
| u. microalbuminuria | 4.0 |
| v. microangiopathy | 4.0 |
| w. MODY (maturity onset diabetes of youth) | 4.0 |
| x. polydipsia | 4.0 |
| y. polyphagia | 4.0 |
| z. polyuria | 4.0 |
| aa. pre-diabetes | 4.0 |
| bb. primary diabetes | 4.0 |
| cc. secondary diabetes | 4.0 |
| dd. rebound phenomenon | 4.0 |
| ee. type 1 diabetes | 4.0 |
| ff. type 2 diabetes | 4.0 |

2. Classify and define *diabetes mellitus* and list the distinguishing features of type 1, type 2, and gestational diabetes in terms of etiology and pathogenesis; role of inheritance or environmental factors; age and frequency; mode of onset; clinical and morphological manifestations; and insulin requirements. 4.0
3. Describe the pathogenesis of complications of type 1 and type 2 diabetes, including non-enzymatic glycosylation, intracellular hyperglycemia with disturbances in the polyol pathway, and activation of protein kinase C. 4.0
4. Compare and contrast the acute complications in terms of pathogenesis, laboratory findings and clinical presentation:
 - a. diabetic ketoacidosis 4.0
 - b. hyperosmolar non-ketotic coma 4.0
 - c. hypoglycemia 4.0
5. Describe the following chronic complications in terms of pathogenesis, morphology, laboratory findings and clinical presentation and role in mortality:
 - a. proliferative retinopathy 4.0
 - b. non-proliferative retinopathy 4.0
 - c. nephropathy (diabetic renal disease) 4.0
 - d. diabetic neuropathy 4.0
 - e. vascular complications (both microvascular and macro-vascular) 4.0
6. Describe the use of laboratory tests for screening, diagnosing and monitoring patients with pre-diabetes, gestational diabetes, and diagnosed diabetes. 4.0
7. Explain the role fasting glucose, random glucose, glucose tolerance test, glycosylated hemoglobin level (HbA1C), and urine glucose ketones in screening, diagnosing, and monitoring patients with pre-diabetes, gestational diabetes, and diagnosed diabetes. 4.0
8. Describe the diabetes control and complications trial (DCCT), including the effects of tight glycemic control on the development of diabetic complications. 4.0

O. Dermatopathology

1. Define and use in proper context:
 - a. acantholysis 4.0
 - b. acanthosis 4.0
 - c. dyskeratosis 4.0
 - d. eczema 4.0
 - e. erosion 4.0
 - f. excoriation 4.0
 - g. exocytosis 4.0
 - h. hydropic swelling 4.0
 - i. hypergranulosis 4.0
 - j. hyperkeratosis 4.0
 - k. lentiginous 4.0
 - l. lichenification 4.0
 - m. macule 4.0
 - n. onycholysis 4.0
 - o. papillomatosis 4.0
 - p. papule 4.0
 - q. parakeratosis 4.0
 - r. plaque 4.0
 - s. psoriasis 4.0

t. pustule	4.0
u. scale	4.0
v. spongiosis	4.0
w. ulceration	4.0
x. vacuolization	4.0
y. vesicle	4.0
z. wheal	4.0
2. Compare and contrast contact dermatitis and atopic dermatitis with emphasis on clinical manifestation of lesions, previous antigen exposure, and type of hypersensitivity reaction.	4.0
3. Describe the morphologic characteristics of acute, subacute, and chronic eczema.	4.0
4. Describe lichen simplex chronicus with emphasis on etiology, morphology, and clinical features.	3.0
5. Describe psoriasis with emphasis on pathogenesis, morphology, and clinical features.	4.0
6. Describe pemphigus vulgaris with emphasis on pathogenesis, morphology, and clinical features.	4.0
7. Describe bullous pemphigoid with emphasis on pathogenesis, morphology, and clinical features.	4.0
8. Describe dermatitis herpetiformis with emphasis on pathogenesis, morphology, clinical features, and disease associations.	3.0
9. Describe erythema multiforme with emphasis on pathogenesis, morphology, and clinical features.	4.0
10. Describe albinism with emphasis on the pathogenesis, morphology, and clinical features.	3.0
11. Describe vitiligo with emphasis on the pathogenesis, morphology, and clinical features.	4.0
12. Compare and contrast lentigo and ephelides with emphasis on pathogenesis morphology and clinical features.	3.0
13. Describe nevocellular nevus with emphasis on pathogenesis, morphology, and clinical features.	4.0
14. Compare and contrast the difference between junctional, compound, intradermal, congenital, acquired, Spitz, and dysplastic nevi.	4.0
15. Describe molluscum contagiosum with emphasis on etiology, morphology, and clinical features.	3.0
16. Describe verruca vulgaris and verruca plantaris with emphasis on etiologic agent, classification, morphology, and clinical features.	4.0
17. Describe acrochordon with emphasis on gross and microscopic morphology.	4.0
18. Describe epidermal inclusion cysts with emphasis on pathogenesis, morphology, and clinical features.	4.0
19. Describe dermatofibroma with emphasis on pathogenesis, morphology, and clinical features.	4.0
20. Describe seborrheic keratosis with emphasis on morphology and disease associations.	4.0
21. Describe keratoacanthoma with emphasis on morphology and clinical features.	3.0
22. Describe actinic keratosis with emphasis on pathogenesis, morphology, and clinical course.	4.0
23. Describe acanthosis nigricans focusing on morphology and disease associations.	3.0
24. Describe xanthoma, focusing on morphology and disease associations.	4.0
25. Describe the morphology and clinical manifestations of hemangioma.	4.0
26. Describe pyogenic granuloma with emphasis on pathogenesis and clinical features.	4.0
27. Describe squamous cell carcinoma with emphasis on pathogenesis, morphology, clinical features, and prognosis.	4.0

28. Describe basal cell carcinoma with emphasis on pathogenesis, morphology, clinical features, and prognosis. **4.0**
29. Describe malignant melanoma with emphasis on risk factors, pathogenesis, and morphology, including staging and gross appearance, prognostic factors, and clinical features. **4.0**
30. Describe acral-lentiginous melanoma and describe its prognosis. **4.0**

P. Joint Disease

1. Classify the different types of arthritis based on their primary pathological processes, radiologic appearance, gross and microscopic appearance, laboratory findings and clinical presentation into the following classifications system:
- a. non-inflammatory **4.0**
 - b. inflammatory **4.0**
 - c. infectious **4.0**
 - d. crystal induced **4.0**
 - e. hemorrhagic **4.0**
2. Describe the following terms associated with osteoarthritis (degenerative joint disease):
- a. Bouchard nodes **4.0**
 - b. chondroitin sulfate **4.0**
 - c. crepitus **4.0**
 - d. eburnation **4.0**
 - e. exostosis **4.0**
 - f. fibrillation **4.0**
 - g. Heberden nodes **4.0**
 - h. joint space incongruity **4.0**
 - i. osteophyte **4.0**
 - j. sclerosis **4.0**
 - k. subluxation/dislocation **4.0**
 - l. synovial fluid viscosity **4.0**
3. Describe osteoarthritis (degenerative joint disease) in terms of age, gender, incidence, etiology, pathogenesis, laboratory findings, and clinical findings and course. **4.0**
4. Describe the following disorders in terms of etiology, incidence, prevalence, genetic factors, age, gender, pathogenesis, anatomic distribution, morphology, associated disorders, laboratory findings, clinical course, and prognoses:
- a. rheumatoid arthritis **4.0**
 - b. seronegative spondyloarthropathies **4.0**
 - i. ankylosing spondylitis
 - ii. reactive arthritis/Reiter's syndrome
 - iii. psoriatic arthritis
 - iv. enteropathic arthritis
 - c. fibromyalgia **4.0**
 - d. juvenile idiopathic arthritis **4.0**
5. Compare and contrast gout and pseudogout/calcium pyrophosphate dehydrate (CCPD) arthropathy, in terms of etiology, pathogenesis, clinical presentation, complications, laboratory studies, primary versus secondary, and acute versus chronic. **4.0**

6. Describe infectious arthritis including pathogenesis, organisms, radiographic findings, laboratory findings, and clinical course with emphasis on supportive arthritis and Lyme arthritis. 4.0
7. Describe tenosynovial giant-cell tumor, localized and diffuse (pigmented villonodular synovitis and giant-cell tumor of tendon sheath). 4.0

Q. Bone Disease

1. Define and use in proper context:
 - a. Brodie abscess 4.0
 - b. Involucrum 4.0
 - c. Sequestrum 4.0

2. Describe the following hereditary disorders, in terms of pathogenesis, morphology, and clinical presentation:
 - a. achondroplasia 3.0
 - b. osteochondromatosis 3.0
 - c. osteopetrosis 3.0

 - d. enchondromatosis 3.0
 - e. osteogenesis imperfecta 4.0

3. Describe the following non-neoplastic bone disorders, in terms of etiology, pathogenesis, morphology, and clinical findings and course:
 - a. osteoporosis 4.0

 - b. osteomyelitis (acute and chronic) 4.0
 - c. Paget disease 4.0
 - d. hyperparathyroidism 4.0
 - e. renal Osteodystrophy 4.0
 - f. fractures (healing process and factors that alter healing) 4.0

4. Describe the following tumors (i.e., masses) of bone in reference to: biology (neoplastic vs. non-neoplastic, benign vs. malignant), age distribution, etiology and pathogenesis, cell type and site of origin, morphologic and radiologic features and clinical findings and course:
 - a. fibrous dysplasia 4.0
 - b. osteoma 4.0
 - c. osteoblastoma 4.0
 - d. osteochondroma 4.0
 - e. chondroma 4.0
 - f. osteoid osteoma 4.0
 - g. osteosarcoma 4.0
 - h. chondrosarcoma 4.0
 - i. giant cell tumor of bone 4.0
 - j. Ewing sarcoma (including primitive neuroectodermal tumor (PNET)) 4.0
 - k. metastatic malignancy to bone 4.0

5. Describe the types, repairs, and complications of fractures. 4.0
6. Describe osteonecrosis (avascular necrosis). 4.0

R. Soft Tissue Disease

1. Describe the following tumors (masses) of joint and soft tissue in terms of biology (neoplastic versus non-neoplastic, benign versus malignant); epidemiology; etiology; pathogenesis; cell type and site of origin; and clinical course:
 - a. benign fibrous histiocytoma 4.0
 - b. fibroma 4.0
 - c. fibromatosis (plantar and palmar) 4.0
 - d. ganglion 4.0
 - e. leiomyoma 4.0
 - f. leiomyosarcoma 4.0
 - g. lipoma 4.0
 - h. liposarcoma 4.0
 - i. undifferentiated pleomorphic sarcoma 4.0
 - j. myositis ossificans 4.0
 - k. neurofibroma 4.0
 - l. neuroma 4.0
 - m. perineural fibrosis 4.0
 - n. plexiform neurofibroma 4.0
 - o. rhabdomyosarcoma 4.0
 - p. schwannoma 4.0
 - q. synovial cyst 4.0
 - r. synovial sarcoma 4.0

S. Head, Neck, and Special Sensory Organs Pathology

1. Describe the following oral lesions in terms of etiology, pathogenesis, morphology and clinical features:
 - a. leukoplakia 3.0
 - b. erythroplakia 2.0
 - c. carcinoma 3.0
2. Describe the following inflammatory conditions of the upper airways in terms of etiology, pathogenesis, morphology, and clinical features:
 - a. allergic rhinitis 2.0
 - b. infectious rhinitis 2.0
 - c. chronic rhinitis 2.0
 - d. nasal polyps 2.0
3. Describe nasopharyngeal carcinoma with emphasis on etiology, morphology, and clinical course. 2.0
4. Compare and contrast reactive nodules of the vocal cords, squamous papilloma, and papillomatosis. 2.0
5. Describe carcinoma of the larynx with emphasis on etiology, pathogenesis, morphology, and clinical course. 3.0
6. Define *cataract* and describe in terms of its formation, clinical presentation, and its association with certain systemic diseases. 3.0
7. Compare and contrast the open-angle glaucoma and angle-closure glaucoma, in terms of etiology, pathogenesis, morphology, and clinical course. 3.0
8. Describe the retinal vascular changes associated with hypertension and malignant hypertension with emphasis on ophthalmoscopic findings. 4.0

9. Describe the pathogenesis and effects of diabetes mellitus on the eye including:
 - a. cataract; 4.0
 - b. glaucoma; 4.0
 - c. retinal changes; 4.0
 - i. background retinopathy 4.0
 - a. *microaneurysms* 4.0
 - b. macular edema 4.0
 - c. retinal edema 4.0
 - d. hard exudates 4.0
 - e. hemorrhages 4.0
 - ii. proliferative retinopathy 4.0
 - a. neovascularization 4.0
 - b. vitreous hemorrhages 4.0
 - c. fibrosis 4.0
 - d. retinal detachment 4.0
10. Describe age-related macular degeneration, in terms of type, etiology, pathogenesis, morphology, and clinical course. 4.0
11. Describe uveitis and list disease associations. 3.0

T. Neuromuscular Disease

1. Describe the reactions of the motor unit, including demyelination, axonal degeneration, muscle fiber atrophy, nerve regeneration, and re-innervation of muscle. 4.0
2. Describe diseases of the peripheral nerve, including:
 - a. Inflammatory neuropathies (immune-mediated) 4.0
 - i. Guillain-Barre syndrome 4.0
 - ii. demyelinating polyradiculoneuropathy 4.0
 - b. Infectious Polyneuropathies; 3.0
 - i. leprosy (Hansen disease) 3.0
 - ii. diphtheria 3.0
 - iii. varicella-zoster virus 3.0
 - c. Hereditary motor and sensory neuropathies 4.0
 - i. Charcot-Marie-Tooth disease 3.0
 - ii. Dejerine-Sottas disease 3.0
 - d. Genetic metabolic diseases: leukodystrophies 3.0
 - e. Acquired metabolic and toxic neuropathies: diabetic neuropathy 4.0
 - f. Traumatic neuropathies: traumatic, compression, Morton's neuroma 4.0
 - g. Tumors of peripheral nerve. 4.0
3. Describe diseases of skeletal muscle, including:
 - a. denervation atrophy (Spinal Muscular Atrophy) 3.0
 - b. Muscular dystrophies 4.0
 - m. Duchenne, Becker and other muscular dystrophies 4.0
 - ii. myotonic dystrophy 4.0
 - c. ion channel myopathies (channelopathies) 4.0
 - i. malignant hyperthermia 4.0
 - d. congenital myopathies 3.0
 - e. genetic myopathies of metabolism 3.0
 - i. lipid myopathies 3.0
 - ii. mitochondrial myopathies (oxidative phosphorylation diseases) 3.0

f. inflammatory myopathies (noninfectious)	4.0
i. dermatomyositis	4.0
ii. polymyositis	4.0
g. toxic myopathies	3.0
i. thyrotoxic	3.0
ii. ethanol	3.0
iii. drug induced	3.0
h. diseases of the neuromuscular junction	4.0
i. myasthenia gravis	4.0
ii. Lambert-Eaton myasthenic syndrome	4.0
i. tumors of skeletal muscle	3.0
i. rhabdomyoma, rhabdomyosarcoma	3.0
ii. nodular fasciitis	3.0
j. trauma: myositis ossificans	3.0
k. infectious	3.0
i. AIDS associated myopathy	3.0
ii. viral myositis	3.0

U. Central Nervous System Disease

1. Explain the reactions of cells of the CNS to injury (neurons, astrocytes, other glial cells).	4.0
2. Describe features unique to the CNS that affect clinical presentation of diseases, complicate outcomes, and affect therapy, including	
a. blood-brain barrier	4.0
b. CSF	4.0
c. localization of function	4.0
d. selective vulnerability	4.0
e. skull	4.0
f. vascular supply	4.0
3. Compare and contrast the causes of cerebral edema, including vasogenic edema, cytotoxic edema, and interstitial edema.	4.0
4. Describe communicating and noncommunicating hydrocephalus, with emphasis on etiology, morphology, and clinical course.	3.0
5. Compare and contrast the subfalcine, transtentorial, and tonsillar herniations of the brain, in terms of pathogenesis, morphology, clinical findings, and sequelae.	4.0
6. Describe the following malformations in terms of relative frequency, etiology, pathogenesis, morphology, and clinical features:	
a. agenesis of corpus callosum	3.0
b. anencephaly	3.0
c. Chiari type I malformation	3.0
d. Chiari type II (Arnold-Chiari) malformation	3.0
e. Dandy-Walker malformation	3.0
f. encephalocele	4.0
g. hydromyelia	3.0
h. meningomyelocele	4.0
i. spina bifida	4.0
j. syringomyelia	3.0
7. Describe perinatal brain injury including cerebral palsy, intraparenchymal hemorrhage, and infarcts in terms of pathogenesis, morphology, and clinical presentation and course.	4.0

8. Identify and describe the types of skull fractures (displaced, diastatic) and describe the clinical relevance of each. **4.0**
9. Define *concussion* and describe the etiology, morphology, and clinical significance of the syndrome. **4.0**
10. Describe direct parenchymal injury in the brain, including contusion, laceration, coup injury, contrecoup injury, and hyperextension of the neck, in terms of etiology, pathogenesis, morphology, and clinical presentation and course. **4.0**
11. Describe diffuse axonal injury in terms of pathogenesis, morphology, and clinical course. **4.0**
12. Describe epidural hematoma and subdural hematoma (acute and chronic), in terms of pathogenesis, morphology, clinical presentation, and clinical course. **4.0**
13. Explain the consequences of brain trauma with emphasis on post-traumatic hydrocephalus, post-traumatic dementia, dementia pugilistica, post-traumatic epilepsy, tumors, infectious diseases, and psychiatric disorders
 - a. dementia pugilistica **3.0**
 - b. infectious diseases **3.0**
 - c. post-traumatic dementia **3.0**
 - d. post-traumatic epilepsy **3.0**
 - e. post-traumatic hydrocephalus **3.0**
 - f. psychiatric disorders **3.0**
 - g. tumors **3.0**
14. Explain the consequences of spinal cord trauma with emphasis on sensory deficits, gait abnormalities, and paralysis. **4.0**
15. Explain cerebrovascular disease and compare and contrast global cerebral ischemia and focal cerebral ischemia, in terms of pathogenesis, morphology, and clinical features. **4.0**
16. Describe the etiology and pathogenesis of spinal cord infarction. **4.0**
17. List the important effects of hypertension on the brain, including arteriolosclerosis, lacunar infarcts, slit hemorrhages, hypertensive encephalopathy, Charcot-Bouchard aneurysms, and intracerebral hemorrhage and describe the morphologic appearance of each. **4.0**
18. Explain causes of non-traumatic intraparenchymal hemorrhage, such as cerebral amyloid angiopathy. **3.0**
19. Describe the pathogenesis and morphology of saccular aneurysms and describe its role in the development of subarachnoid hemorrhage. **4.0**
20. Describe the clinical signs and symptoms of subarachnoid hemorrhage and list the possible complications and causes. **4.0**
21. Classify and describe the clinical features of arteriovenous malformations, cavernous malformation, capillary telangiectasias, and venous angiomas. **3.0**
22. Compare and contrast the pathogenesis, causative organisms, laboratory findings, and clinical presentation and course for acute pyogenic (bacterial) meningitis, acute aseptic (viral) meningitis, and chronic bacterial meningitis (tuberculosis, neurosyphilis, neuroborreliosis). **4.0**
23. Describe the etiology, pathogenesis, morphology, and clinical course of progressive multifocal leukoencephalopathy and subacute sclerosing panencephalitis. **3.0**
24. Compare and contrast Creutzfeldt-Jakob disease and variant Creutzfeldt-Jakob disease, including etiology, pathogenesis, morphology, and clinical presentation. **3.0**
25. Describe multiple sclerosis (MS) in terms of geographic distribution, etiology, pathogenesis, morphology, laboratory findings, and clinical course. **4.0**

26. Compare and contrast the following degenerative diseases with special attention to pathogenesis, morphology, and clinical features:
- a. Alzheimer disease **4.0**
 - b. corticobasal degeneration **4.0**
 - c. dementia with Lewy Bodies **4.0**
 - d. Friedreich ataxia **4.0**
 - e. Huntington disease **4.0**
 - f. Parkinsonism / Parkinson disease **4.0**
 - g. Pick disease **4.0**
 - h. spinocerebellar ataxias **4.0**
 - i. vascular dementia **4.0**
27. Describe amyotrophic lateral sclerosis (ALS) in terms of pathogenesis, morphology, and clinical course. **3.0**
28. Compare and contrast the following neoplasms in terms of epidemiology, genetics, pathogenesis, morphology, clinical features, and prognosis:
- a. astrocytoma, infiltrating, all grades: **3.0**
 - b. ependymoma **2.0**
 - c. ganglioneuroma **2.0**
 - d. medulloblastoma **4.0**
 - e. meningioma **2.0**
 - f. metastatic tumor **4.0**
 - g. oligodendroglioma **2.0**
 - h. pilocytic astrocytoma **3.0**
 - i. primary CNS lymphoma **2.0**

PHARMACOLOGY LEARNING OBJECTIVES

General Principles

Autonomic Nervous System Drugs

Cardiovascular and Respiratory Pharmacology

Renal Drugs

Pulmonary Drugs

Gastrointestinal Drugs

Drugs Acting on the Central Nervous System

Antacids

Endocrine Pharmacology

Hemostasis and Blood Forming Organs

Toxicology and Therapy of Intoxication

Chemotherapy

Herbal Medicine

Vitamins

Introduction to the Pharmacology Section

For each of the groups below, and for each drug in the groups, these overall objectives should be addressed and emphasized:

1. Define the mechanism of action, site of action and receptor(s) interactions.
2. Define the physiological effects.
3. Discuss any unique pharmacokinetic features of the drug.
4. Discuss the major adverse effects and contraindications.
5. Describe significant drug interactions.
6. Define the major therapeutic indications.

I. General Principles

1. Define: pharmacology, pharmacokinetics, and pharmacodynamics. 4.0
2. Define: what is meant by the terms “drug” and “receptor”. 4.0
3. Explain drug-receptor binding. 3.0
4. Explain the concepts of agonist (full, partial, inverse), and antagonist (competitive and non- competitive) drugs. 4.0
5. Explain *affinity*, *intrinsic activity*, *efficacy*, and *potency* as applied to drug receptor interactions. 4.0
6. Explain graded and quantal dose-response relationships. 4.0
7. Explain the long-term effects of drugs, including tolerance and regulation of gene expression. 4.0
8. Discuss developmental, age-related, and disease-related changes in drug absorption and distribution. 4.0

A. Pharmacokinetics - Chemical Aspects

1. Discuss weak acids and bases, the Henderson-Hasselbalch equation, and the relationship between pH and ionization of drugs. 4.0
2. Discuss the effect of lipid solubility of drug species, polar, and nonpolar drugs. 4.0
3. Identify the properties of biological membranes, mechanisms of drug movement across membranes, and differentiate between which are active and which are passive processes. 4.0
4. Explain ion-trapping of drugs, with emphasis on stomach contents and urine. 4.0

B. Absorption

1. Explain the effects of pH and lipid solubility on absorption 4.0
2. Discuss bioavailability and the concept of first pass metabolism. 4.0
3. Identify factors affecting absorption. 4.0
4. Identify routes and special sites of absorption. 3.0
5. Explain the systemic absorption of drugs applied for local effects. 4.0

C. Distribution

1. Define the volume of distribution and discuss the factors that affect it. 4.0
2. Explain the effects of plasma protein binding on drug distribution. 3.0
3. Explain the concept of redistribution as a mode of termination of drug action. 3.0
4. Describe the distribution of drugs into special compartments, with respect to the blood-brain barrier, tight endothelial junctions, bone, and placenta. 2.0
5. Discuss the importance of membrane transporters for both entry and efflux of drugs. 3.0

D. Biotransformation

1. Identify and describe the major pathways of metabolism, including Phase I versus Phase II, general properties, oxidation, reduction, hydrolysis and conjugation: glucuronides, glycine, sulfate esters, acetylation, glutathione, mercapturic acids. 3.0
2. Explain the cytochrome P450 system in liver and other tissues. Know the major CYP450s involved in drug metabolism, including CYP1A2, CYP2D6, CYP2E1, and CYP3A4. 4.0
3. Explain enzyme induction and inhibition, including mechanisms, time course, clinical implications, and examples of common inducers and inhibitors. 4.0

E. Elimination

1. Explain the concepts of drug elimination and excretion. **4.0**
2. Identify and describe concepts important for renal excretion, including role of filtration, secretion and reabsorption, molecular size, polarity, weak acids/bases, urine pH, and transporters, as well as the importance of plasma protein binding. **4.0**
3. Explain biliary/alimentary excretion, including biliary transport, direct secretion of drugs from blood to intestine, importance of plasma protein binding, molecular size, polarity, weak acids, and weak bases. **2.0**
4. Explain the consequences of enterohepatic circulation. **4.0**
5. Explain the concept of clearance and the Cockcroft-Gault equation. **3.0**
6. Discuss the concept of pro-drugs and active metabolites. **4.0**

F. Quantitative Pharmacokinetics

1. Compare and contrast *first order* and *zero-order* kinetics. **4.0**
2. Explain one and two compartment systems, as well as the noncompartmental model and its clinical utility. **4.0**
3. Describe the distribution and elimination phases when plotting log concentration versus time. **2.0**
4. Identify the pharmacokinetic parameters that determine and can be estimated from the log C versus time plot, and explain their relationships to Vd1, Vdextrap, Vdarea, AUC, ke, elimination $t_{1/2}$, and Cl. **3.0**
5. Explain the effect of ka, ke, and dose on Cmax, tmax, and AUC. **4.0**
6. Define *steady state*, and explain the time to steady state as a function of half-life, as well as the effects of stopping infusion or changing infusion rate. **4.0**
7. Identify the calculation for loading dose, and explain repeated dosing in a one compartment model, including drug accumulation and plateau principle: $C_{ssav} = DxF/T \times Cl$, independent of ka, peak to trough variation as a function of dose, F, $t_{1/2}$, dosing interval (T), and ka:ke ratio. **4.0**

G. Pharmacodynamics

1. Explain the concept of receptor occupancy: $EA/EM = [A]/([A] + KA)$. **4.0**
2. Explain the log concentration-response relationship and interpret log concentration-response curves. **4.0**
3. Discuss the relationship of potency (ED50 and EC50) to affinity (KA). **3.0**
4. Explain the concepts of intrinsic activity and efficacy. **3.0**
5. Describe the effects of partial and inverse agonists. **4.0**
6. Identify the mechanisms of antagonists, and differentiate the concepts of competitive versus noncompetitive and reversible versus irreversible antagonists. **4.0**
7. *Explain the concept of spare receptors.* **2.0**
8. *Explain the concepts of ED50 (potency) versus LD50 or TD50.* **3.0**
9. Explain the calculation and clinical significance of the therapeutic index as it relates to patient safety. **4.0**

H. Receptors

1. Explain ligand-gated ion channels, including the nicotinic ACh receptor and GABA_A receptor. 4.0
2. Explain G Protein-coupled receptors, including muscarinic ACh receptors, and adrenergic receptors (alpha₁, alpha₂, beta₁, beta₂, beta₃). 4.0
3. Describe tyrosine kinase receptors, such as those for insulin and cytokines. 4.0
4. Describe intracellular receptors, such as those for steroid hormones. 4.0
5. Explain the concepts of receptor down-regulation and desensitization, and as well as the inverse relationship between agonist concentration and receptor levels. 4.0
6. Explain the concepts of receptor up-regulation and sensitization. 4.0
7. Describe non-receptor targets as sites of drug action, including enzymes (acetylcholinesterase, MAO), nucleic acids (actinomycin D), or target uniqueness as a basis for selective chemotherapy (penicillin). 4.0

I. Pharmacogenetics/genomics

1. Define *pharmacogenetics* and *pharmacogenomics*, and explain their clinical importance. 3.0
2. Explain genetic polymorphisms in terms of single nucleotide polymorphisms (SNPs), gene deletions, and gene amplifications that determine protein structure, configuration, and/or concentration. 3.0
3. Differentiate haplotype, genotype, and phenotype and discuss methods to determine phenotype and genotype. 2.0
4. Identify pharmacogenetic polymorphisms that affect drug response, as well as drug disposition and toxicity. 2.0
5. Explain the difference between pharmacogenetics on the effects of drugs, including NAT2 (isoniazid, procainamide); CYP2D6 (antidepressants, beta-blockers); CYP2C19 (omeprazole); CYP2C9 (warfarin); serum cholinesterase (succinylcholine), glucose-6-phosphate dehydrogenase (analgesics; antimalarials); thiopurine-S-methyltransferase (6-mercaptopurine); beta₂ adrenergic receptors, (albuterol); dopamine receptors (antipsychotics); malignant hyperthermia (inhalation anesthetics); UGT1A1 (irinotecan); and ABCB1 (corticosteroids). 3.0

J. Drug Interactions

1. Describe the pharmacokinetic and pharmacodynamic drug interactions. 4.0
2. Explain the concepts of summation, synergy, potentiation, and antagonism. 3.0
3. Identify and describe drug-food and drug-supplement interactions and drug interferences with diagnostic tests. 3.0

K. Loading Dose

1. Explain the reason for the use of a loading dose at the start of a drug regime. 4.0
2. Define the loading dose in relation to maintenance dose and accumulation factor. 3.0
3. Define the maintenance dose in terms of dosing rate, bioavailability (F) and dosing interval. 3.0

II. Autonomic Drugs

A. Drugs Acting at the Nerve Terminal

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. botulinum toxin 4.0
 - b. reserpine 1.0
 - c. cocaine 3.0
 - d. metyrosine 2.0
2. Describe the anatomical projections of the sympathetic and parasympathetic nervous system. 4.0
3. Explain homeostasis, “fight-or-flight”, “rest-and-digest”, with regards to the autonomic nervous system. 4.0
4. Explain the central control of the autonomic nervous system. 3.0
5. Explain the responses of end organs to activation of each division of the autonomic nervous system. 4.0
6. Explain the concept of *dominant tone*. 3.0
7. Identify drugs that inhibit reuptake of norepinephrine (NE) into adrenergic neurons. 3.0
8. Identify drugs that deplete NE by interfering with synthesis. 2.0

B. Direct-and-Indirect-Acting Cholinergic Agonists

1. Discuss the following with regard to objectives stated at the beginning of this section:
 - a. acetylcholine 4.0
 - b. carbachol 2.0
 - c. bethanechol 4.0
 - d. pilocarpine 4.0
 - e. cevimeline 3.0
 - f. neostigmine 4.0
 - g. physostigmine 3.0
 - h. pyridostigmine 2.0
 - i. echothiophate 3.0
 - j. edrophonium 4.0
 - k. malathion, parathion 2.0
 - l. pralidoxime (2-PAM) 4.0
 - m. sarin, soman, di-isofluorophosphate 3.0
 - n. nicotine 4.0
 - o. varenicline 3.0
2. Discuss the synthesis, storage, release, receptor action and inactivation of acetylcholine. 4.0
3. Identify drugs that affect the synthesis, storage, release, and inactivation of acetylcholine. 4.0
4. Differentiate nicotinic and muscarinic receptors with regard to their location and their physiological effects. 4.0
5. Explain the mechanism of action of nicotinic and muscarinic receptors with regard to their second messenger effects and signaling pathways. 4.0
6. Differentiate between reversible and irreversible anticholinesterase agents. 3.0
7. Explain the anionic and esteratic active site of AChE with regard to attraction, attachment, and rates of breakdown of substrates and inhibitors. 2.0

8. Identify and describe the mechanism by which pralidoxime (2-PAM) reactivates phosphorylated AChE. **4.0**
9. Describe the therapeutic uses of cholinergic agonists. **4.0**
10. Discuss the use of anticholinesterase agents as insecticides (malathion, parathion, organophosphates) and chemical warfare agents (sarin, soman) and the use of pralidoxime and atropine in treating organophosphate poisoning. **3.0**
11. Discuss the mechanism of action, therapeutic use and side effects of varenicline. **3.0**

C. Cholinergic Antagonist

1. Discuss the following with regard to the objectives stated at the beginning of this section:

Muscarinic Receptor Blocking Agents

- a. atropine **4.0**
- b. scopolamine **4.0**
- c. ipratropium, tiotropium **4.0**
- d. darifenacin, solifenacin **4.0**
- e. tolterodine, festoterodine **4.0**
- f. homatropine, tropicamide **3.0**
- g. oxybutynin, trospium **2.0**
- h. glycopyrrolate **3.0**
- i. dicyclomine **3.0**

Neuromuscular Blocking Agents

- j. nicotine **4.0**
 - k. succinylcholine **4.0**
 - l. d-Tubocurarine **3.0**
 - m. atracurium, cistracurium **4.0**
 - n. pancuronium, vecuronium, rocuronium **3.0**
2. Explain why muscarinic antagonists cause xerostomia, blurred vision, photophobia, tachycardia, difficulty in micturition, hyperthermia, glaucoma, and mental confusion in the elderly. **4.0**
 3. Explain the contraindication of muscarinic antagonists in glaucoma, obstructive disease of the gastrointestinal tract or urinary tract, and intestinal atony. **4.0**
 4. Discuss the therapeutic use of muscarinic receptor antagonists for mydriasis and cycloplegia. **3.0**
 5. Discuss the therapeutic uses of muscarinic receptor antagonists in bronchoconstriction, excessive salivation, and motion sickness. **4.0**
 6. Discuss the uses of muscarinic receptor antagonists in overactive bladder. **3.0**
 7. Compare and contrast the effects of the depolarizing and nondepolarizing neuromuscular junction (NMJ) blocking drugs. **4.0**
 8. Discuss the reversal and adverse side effects of non-depolarizing antagonists at the NMJ. **3.0**
 9. Identify the uses, side effects, and genetic differences associated with the use of succinylcholine. **3.0**

D. Adrenergic Agonists (Sympathomimetics)

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. epinephrine 4.0
 - b. norepinephrine 4.0
 - c. ephedrine 2.0
 - d. dopamine 3.0
 - e. fenoldopam 2.0
 - f. phenylephrine 4.0
 - g. pseudoephedrine 3.0
 - h. oxymetazoline, tetrahydrozoline 2.0
 - i. clonidine 4.0
 - j. brimonidine, apraclonidine 2.0
 - k. methyldopa 2.0
 - l. midodrine 2.0
 - m. amphetamine, methamphetamine 4.0
 - n. methylphenidate 3.0
 - o. tyramine 3.0
 - p. isoproterenol 4.0
 - q. albuterol 4.0
 - r. salmeterol, formoterol 4.0
 - s. dobutamine 3.0
 - t. mirabegron 2.0
2. Identify the steps in the synthesis, storage, release, and inactivation of norepinephrine and epinephrine. 4.0
3. Explain the types and subtypes of adrenergic receptors, and identify their locations and physiologic response to activation. 4.0
4. Discuss receptor selectivity of norepinephrine and epinephrine. 4.0
5. Differentiate between direct- and indirect-acting adrenergic drugs, in that direct agonists bind to receptors with intrinsic activity, indirect agonists release neurotransmitters from the neuron. 4.0
6. Differentiate the effects of high dose and low dose epinephrine. 4.0
7. Compare and contrast the pharmacology of epinephrine and isoproterenol. 4.0
8. ExCompare and contract the pharmacology of the beta selective adrenergic agonist isoproterenol, albuterol, salmeterol, and dobutamine. 4.0
9. Discuss the importance of α_1 adrenergic agonists in the treatment of nasal congestion, hypotension, and paroxysmal atrial tachycardia, as well their effects to cause mydriasis and vasoconstriction. 4.0
10. Describe the CNS effects of α_2 adrenergic agonists in the treatment of hypertension, and their different effects in the topical treatment of glaucoma. 4.0
11. Identify the adverse side effects of α_1 and α_2 agonists. 4.0
12. Explain the interactions of α_1 and α_2 agonists with oxytocic drugs and monoamine oxidase inhibitors. 2.0
13. Identify the contraindications for α_1 adrenergic agonists. 4.0
14. Differentiate the adverse side effects of nonselective alpha and selective alpha adrenergic antagonists. 4.0

E. Adrenergic Agonists

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. phenoxybenzamine 2.0
 - b. phentolamine 2.0
 - c. prazosin 4.0
 - d. terazosin, doxazosin 3.0
 - e. tamsulosin, alfuzosin 3.0
 - f. propranolol 4.0
 - g. timolol, nadolol, siltanol 4.0
 - h. metoprolol, atenolol 4.0
 - i. esmolol 4.0
 - j. nebivolol 3.0
 - k. carvedilol 3.0
 - l. labetalol 2.0
 - m. betaxolol 2.0
 - n. pindolol 2.0
2. Compare the effects of the non-selective alpha antagonists with those of the alpha₁ selective antagonists. 4.0
3. Know the major side effects and limitations of the alpha antagonists in treatment of hypertension. 3.0
4. Understand the use of selective alpha antagonists in the treatment of benign prostatic hyperplasia. 4.0
5. Understand the non-competitive nature of phenoxybenzamine and its use in the treatment of pheochromocytoma. 2.0
6. Compare and contrast the pharmacology of the non-selective beta antagonists with the beta₁ selective antagonists. 4.0
7. Discuss the unique mechanism of nebivolol contrasted with other beta₁ selective antagonists. 3.0
8. Compare and contrast the pharmacology of the alpha and beta blocking drugs carvedilol and labetalol with selective beta-blocking drugs. 4.0
9. Describe the adverse side effects of beta₂ adrenergic agonists. 4.0
10. Describe the adverse side effects of non-selective beta adrenergic antagonists and compare with those of beta₁ selective antagonists. 4.0
11. Explain the mechanism for the use of selective beta-adrenergic agonists in diseases such as cardiac decompensation, asthma, premature labor, bronchospasm, and emphysema. 4.0
12. Explain the use of alpha₁ adrenergic antagonists for hypertension and benign prostatic hypertrophy. 4.0

III. Cardiovascular and Respiratory Pharmacology

A. Introduction to Cardiovascular Drugs

1. Review the properties of the heart, including contractility (eg, excitation-contraction coupling) and electrical activity (eg, the action potential, automaticity, excitability, refractory period, conduction and the relationship to the electrocardiogram). 2.0
2. Explain the intrinsic and extrinsic regulation of the cardiovascular system. 4.0

B. Specific Drugs for Management of Cardiac Arrhythmias

1. Discuss the following with regard to the objectives at the beginning of this section :
 - a. Class I (A, B, C)
 - i. procainamide 3.0
 - ii. quinidine 3.0
 - iii. disopyramide 1.0
 - iv. lidocaine 4.0
 - v. mexiletine 2.0
 - vi. flecainide 2.0
 - b. Class II
 - i. propranolol 4.0
 - ii. esmolol 3.0
 - iii. acebutolol 3.0
 - c. Class III
 - i. sotalol 4.0
 - ii. amiodarone 4.0
 - iii. dronedarone 3.0
 - iv. dofetilide, ibutilide 3.0
 - d. Class IV
 - i. diltiazem 4.0
 - ii. verapamil 3.0
 - iii. adenosine 3.0
2. Explain the alteration of cardiac electrical activity in the production of cardiac arrhythmias. 2.0
3. Identify the pathophysiologic mechanisms of cardiac arrhythmias (abnormal automaticity, triggered rhythms, reentrant rhythms and abnormal impulse conduction). 3.0
4. Describe the alteration of slow (calcium-dependent) and fast (sodium-dependent) responses by antiarrhythmic drugs and explain how that relates to the use of specific agents in arrhythmias of different origins (ventricular versus supraventricular). 3.0
5. Explain the indirect autonomic actions of antiarrhythmic drugs. 3.0
6. Explain the impact of reduced cardiac output due to myocardial infarction and cardiomyopathy on drug half-life and pharmacodynamics. 2.0
7. Explain the influence of age on pharmacokinetic parameters, including liver Metabolism (lidocaine, procainamide, and propranolol) and elimination through kidney). 2.0
8. Describe the cardiac and extracardiac manifestations of toxicity from antiarrhythmic drugs. 3.0
9. Discuss the beneficial and adverse interactions among antiarrhythmic drugs and between antiarrhythmic drugs and digoxin. 3.0
10. Identify the possible contraindications of antiarrhythmic drugs in the presence of heart block or congestive heart failure, as well as the precautions and contraindications in other conditions. 3.0
11. Discuss the classes of drugs (both antiarrhythmic and non-antiarrhythmic) that can produce acquired long QT Syndrome (LQTS). 3.0
12. Explain the use of antiarrhythmic drugs in atrial, supraventricular, or ventricular arrhythmias. 4.0

C. Drugs for Management of Heart Failure

1. Discuss the following with regard to subsequent objectives:
 - a. ACE Inhibitors 4.0
 - b. Angiotensin receptor blockers 4.0
 - c. Loop diuretics 3.0
 - d. Thiazide diuretics 3.0
 - e. Beta Blockers 4.0
 - f. digoxin 4.0
 - g. dobutamine 2.0
 - h. dopamine 2.0
 - i. milrinone 2.0
 - j. hydralazine 2.0
 - k. nitroprusside 4.0
 - l. isosorbide Nitrate 2.0
 - m. nitroglycerin 4.0
2. Describe the basic pathophysiology of heart failure, and identify the cardiac and extracardiac compensatory mechanisms that are activated. 4.0
3. Discuss current recommendations for management of acute and chronic heart failure. 3.0
4. Explain the role of genetics and ethnicity in the physiology of heart failure and in the regulation of responsiveness to agents used in heart failure. 2.0
5. Explain the ionic basis for the mechanism of action of digoxin and the effects of digoxin on myocardial contractility. 4.0
6. Explain the significance of direct and indirect (autonomic) actions of digoxin as well as the consequence of cardiac output. 3.0
7. Discuss the positive inotropic effects of the β -adrenoceptor-agonists and phosphodiesterase inhibitors. 3.0
8. Discuss the effects of adrenoceptor antagonists and ACE-inhibitors on cardiac function and ventricular remodeling in the setting of heart failure. 4.0
9. Discuss the effects of vasodilators on preload and afterload. 3.0
10. Discuss the cardiac and extracardiac side effects and limitations of the antagonist agents, vasodilators, phosphodiesterase inhibitors, and ACE-inhibitors. 4.0
11. Explain the use of digoxin in congestive heart failure and in atrial arrhythmias. 2.0
12. Describe the role of adrenoceptor agonists, adrenoceptor antagonists, vasodilators, diuretics, and ACE-inhibitors in the treatment of acute and chronic heart failure. 4.0
13. Explain the use of atrial natriuretic peptide agonists, endothelial receptor antagonists, and metalloprotease inhibitors in the management of acute severe heart failure unresponsive to other agents. 2.0

D. Drugs for Management of Hypertension

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. ACE Inhibitors 4.0
 - i. captopril
 - ii. enalapril, etc
 - b. Angiotensin Receptor Blockers 4.0
 - i. losartan
 - ii. valsartan
 - iii. candesartan

c. Thiazide Diuretics	4.0
i. Hydrochlorothiazide	
d. Loop Diuretics	
i. Furosemide	4.0
e. Beta Blockers	4.0
i. metoprolol	
ii. bisoprolol	
iii. esmolol	
f. Alpha and Beta Blockers	2.0
i. labetalol	
ii. carvedilol	
g. Alpha ₁ Blockers	3.0
i. prazosin	
ii. terazosin, doxazosin	
h. Calcium Channel Blockers	3.0
i. diltiazem	
ii. verapamil	
i. Dihydropyridines	3.0
i. nifedipine, nicardipine	
ii. amlodipine	
J. Alpha ₂ Agonists	3.0
i. clonidine, methyldopa	
k. Nitrates/Nitroglycerin/ Nitroprusside	4.0
l. hydralazine	2.0
m. minoxidil	2.0
n. fenoldopam	1.0
2. Identify the determinants of systemic arterial blood pressure including the role of the autonomic nervous system, the regulation of fluid volume and the renin-angiotensin aldosterone system.	4.0
3. Explain the role of the central nervous system in the regulation of blood pressure.	3.0
4. Explain the role of nitric oxide in the maintenance of blood pressure.	4.0
5. Identify the types of hypertension and the relative prevalence of each.	3.0
6. Identify the mechanism of action of each of the several classes of agents used to manage hypertension of hypertension.	4.0
7. Discuss the end organ effects of untreated hypertension and the benefits achieved by therapeutic management of the disease.	3.0
8. Explain the actions of antihypertensive drugs on the heart, renal blood flow and renal function.	3.0
9. Describe the time-course of antihypertensive activity (onset and duration of action) for each class of agents.	2.0

- | | |
|---|------------|
| 10. Discuss the cardiac and extracardiac side effects of antihypertensive drugs, including reflex effects. | 3.0 |
| 11. Identify both beneficial and adverse interactions between antihypertensive drugs, as well as between antihypertensive drugs and other therapeutic agents. | 3.0 |
| 12. Explain the role of nonpharmacological treatment modalities in the management of hypertension. | 3.0 |
| 13. Explain the use of antihypertensive drugs in hypertensive emergencies and in pregnancy (e.g., eclampsia). | 3.0 |
| 14. Identify patient populations with special antihypertensive drug considerations. | 3.0 |

E. Drugs for the Management of Ischemic Heart Disease

- | | |
|--|------------|
| 1. Discuss the following with regard to subsequent objectives: | |
| a. Beta ₁ -Selective Blockers | |
| i. metoprolol | 4.0 |
| ii. atenolol | 4.0 |
| b. Calcium Channel Blockers | |
| i. diltiazem | 3.0 |
| ii. verapamil | 4.0 |
| iii. amlodipine | 3.0 |
| iv. nifedipine, nicardipine | 3.0 |
| c. Nitrates | |
| i. isorbide dinitrate | 3.0 |
| ii. amyl nitrate | 2.0 |
| iii. nitroglycerin | 3.0 |
| d. ranolazine | 3.0 |
| e. Phosphodiesterase Inhibitors | |
| i. sildenafil | 4.0 |
| ii. tadalafil | 4.0 |
| iii. vardenafil | 4.0 |
| f. aspirin, clopidogrel | 4.0 |
| 2. Explain the hemodynamic actions of antianginal drugs, including their coronary and peripheral vasodilator actions | 4.0 |
| 3. Discuss the effects of each antianginal drug or drug class on the determinants of myocardial oxygen consumption (heart rate, myocardial wall tension, etc.) and/or oxygen supply (coronary blood flow). | 4.0 |
| 4. Describe the actions of antianginal drugs on the peripheral circulation (arterial, venous), as well as their effects on ventricular preload and afterload. | 4.0 |
| 5. Explain the significance of a "first-pass effect" for orally administered antianginal drugs and the rationale underlying sublingual, intranasal and transdermal administration of nitrates. | 3.0 |
| 6. Explain the problem of dose intervals and tolerance development with the nitrates. | 3.0 |
| 7. Discuss the cardiac and extra-cardiac side effects of antianginal drugs with special reference to the interaction with drugs used to treat erectile dysfunction. | 3.0 |

- | | |
|---|------------|
| 8. Discuss the beneficial and adverse interactions between antianginal drugs, as well as between antianginal drugs and other cardiovascular drugs. | 3.0 |
| 9. Explain the use of antianginal drugs in classic (effort-related) angina pectoris and vasospastic angina pectoris. | 3.0 |
| 10. Explain the concept of "myocardial preservation" and discuss the use of antianginal drugs in the context of acute myocardial infarction with particular emphasis on adrenoceptor antagonists. | 3.0 |

F. Drugs for the Management of Hyperlipidemias

- | | |
|---|------------|
| 1. Discuss the following with regard to the objectives listed at the beginning of this section: | |
| a. Statins | 4.0 |
| i. lovastatin | 4.0 |
| ii. atorvastatin | 4.0 |
| iii. simvastatin | 4.0 |
| iv. rosuvastatin | 4.0 |
| v. fluvastatin | 4.0 |
| vi. pravastatin | 4.0 |
| b. Resins | 2.0 |
| i. cholestyramine | 2.0 |
| ii. colestevlam | 2.0 |
| iii. colestipol | 1.0 |
| c. emfibrozil, fenobibrate | 3.0 |
| d. ezetimibe | 3.0 |
| e. Omega-3 Fatty Acids | 2.0 |
| f. nicotinic Acid (niacin) | 3.0 |
| 2. Explain cholesterol synthesis, transport, export, excretion, and receptor mediated cellular uptake. | 3.0 |
| 3. Discuss treatment goals for achieving specific lipid levels. | 4.0 |
| 4. Discuss the use of drugs in different types of hyperlipidemias (I, II, III, IV, and V), as well as the alterations in serum lipids in each type (triglycerides, cholesterol, LDL, HDL, LDL, lipoproteins) produced by the drugs. | 3.0 |
| 5. Identify the lipid profile characteristic of Type-2 diabetes. | 3.0 |
| 6. Understand the actions of each drug class on serum lipids, and compare and contrast the mechanism of each of these actions know the advantages and uses of combinations of these agents in the management of hyperlipidemia. | 4.0 |
| 7. Describe alterations in plasma lipids due to other drugs (e.g., protease inhibitor-induced hyperlipidemia; estrogen-induced hypolipidemia). | 2.0 |
| 8. Explain the role of the HMG CoA reductase inhibitors in preventing acute coronary events and stroke and as adjuncts in the management of dementia. | 3.0 |
| 9. Describe how the interactions of statins with other drugs can increase the risk of myopathy. | 3.0 |
| 10. Be able to recommend nonpharmacological management of hyperlipidemia (i.e., life style modifications). | 1.0 |

G. Renal Drugs

A. Drugs Affecting Renal Function, Water and Electrolyte Metabolism

1. Discuss the following with regard to the objectives listed at the beginning of this section:
 - a. desmopressin (dDAVP) **2.0**
 - b. vasopressin **3.0**
 - c. demeclocycline **1.0**
2. Explain the mechanisms through which the kidney makes concentrated or dilute urine. **4.0**
3. Describe the roles of vasopressin, aquaporins, V1 and V2 receptors, cyclic AMP, and prostaglandins in regulating renal epithelial water permeability. **3.0**
4. Explain how NSAIDs and clonidine can alter water reabsorption by the kidney. **4.0**
5. Outline the signs, symptoms and treatment of the syndrome of inappropriate ADH secretion (SIADH) and discuss the toxicity of correcting dilutional hyponatremia with demeclocycline. **2.0**
6. Explain how drugs such as clonidine, chlorpropamide, demeclocycline, lithium, and NSAIDs can modify the action of vasopressin. **2.0**
7. Explain the alteration of ACTH secretion by blocking the V1 receptor. **2.0**
8. Describe the therapy of central and nephrogenic diabetes insipidus. **3.0**
9. Explain the mechanisms of lithium carbonate interference with renal water reabsorption. **3.0**

B. Diuretic Drugs

1. Discuss the following with regard to the objectives listed at the beginning of this section:
 - a. acetazolamide, dorsolamide, brinzolamide **2.0**
 - b. Bumetanide **3.0**
 - c. ethacrynic acid **3.0**
 - d. eplerenone **2.0**
 - e. amiloride **3.0**
 - f. mannitol **1.0**
 - g. furosemide **4.0**
 - h. thiazides **4.0**
 - i. spironolactone **3.0**
 - j. triamterine **3.0**
2. Describe the location and function of major ion transporters and channels on renal epithelial membranes. **3.0**
3. Explain the influence of sodium transport on the reabsorption of other ions and water in the kidney. **3.0**
4. Explain hypertension or edema caused by abnormal renal function. **3.0**
5. Outline the changes that occur with electrolyte transport, water reabsorption and hemodynamics when specific diuretics inhibit kidney function. **4.0**
6. Distinguish the effects of K⁺- sparing diuretics. **4.0**
7. Identify the hypokalemic action of some diuretics and use of supplemental therapeutics to prevent hypokalemia. **4.0**
8. Explain the hemodynamic, ion transport, and excretory effects of different classes of diuretic drugs. **4.0**

9. Explain the importance of the organic anion transporters for the renal action of diuretics. 3.0
10. Describe how other drugs or diseases can interfere with the effects of diuretics. 3.0
11. Explain how thiazides and loop diuretics can cause a metabolic alkalosis. 4.0
12. Relate hyponatremia to diuretic therapy. 3.0
13. Explain the underlying mechanisms involved in metabolic imbalances with diuretic therapy, especially in relation to glucose, uric acid, lipids, calcium, magnesium, and potassium. 4.0
14. Identify the clinical consequences of interactions between diuretics and drugs such as cardiac glycosides, oral hypoglycemics, uricosurics, aminoglycosides, amphotericin B, NSAIDs, and angiotensin inhibitors. 4.0
15. Discuss the lack of efficacy of thiazide diuretics in reduced renal perfusion. 3.0
16. Contrast the effects of loop thiazide diuretics on calcium homeostasis. 3.0

H. Pulmonary Drugs

A. Drugs for Management of Respiratory Diseases

1. Discuss the following with regard to the objectives listed at the beginning of this section:
 - a. Inhaled Corticosteroids, e.g. 4.0
 - i. beclomethasone, fluticasone, budesonide
 - b. cromolyn 1.0
 - c. omalizumab 2.0
 - d. Leukotriene Inhibitors 4.0
 - i. zafirlukast, montelukast
 - ii. zileuton
 - e. Beta-2 Agonists 4.0
 - i. Albuterol, levalbuterol
 - ii. Pirbuterol, terbutaline
 - iii. Salmeterol, formoterol
 - f. ipratropium, tiotropium 3.0
 - g. theophylline 2.0
2. Identify the endogenous chemical mediators and receptors that regulate bronchial smooth muscle tone. 3.0
3. Relate bronchial smooth muscle reactivity to the pathogenesis of asthma. 4.0
4. Explain the role of the inflammatory process in the pathogenesis of asthma and chronic obstructive pulmonary disease (COPD). 4.0
5. Identify the mechanism of action of each of the major classes of agents relative to the component of pathogenesis to distinguish between agents that modify the disease process versus those that relieve symptoms. 4.0
6. Distinguish the use of drugs to treat acute episodes of asthma from those used for long-term treatment and prevention. 4.0
7. Discuss the use of drugs in the treatment of COPD. 3.0
8. Identify the factors that influence the plasma levels of theophylline. 2.0
9. Explain the potential for allergic reactions to ipratropium in patients allergic to soy or peanut products. 1.0

I. Antihistamines

1. Discuss the following with regard to the objective stated at the beginning of this section:

First generation

- | | |
|---------------------|-----|
| a. diphenhydramine | 4.0 |
| b. chlorpheniramine | 2.0 |
| c. brompheniramine | 2.0 |
| d. clemastine | 2.0 |
| e. cyclizine | 2.0 |
| f. cyproheptadine | 2.0 |
| g. dimenhydrinate | 3.0 |
| h. hydroxyzine | 3.0 |
| i. meclizine | 2.0 |
| j. promethazine | 3.0 |

Second generation

- | | |
|------------------------------|-----|
| k. certirizine | 4.0 |
| l. loratadine, desloratadine | 4.0 |
| m. fexofenadine | 4.0 |
| n. azelastine | 3.0 |
2. Describe the actions of histamine on the nervous system, cardiovascular system Bronchiolar smooth muscle, gastrointestinal tract smooth muscle, and secretory tissues. 4.0
3. Describe and explain the mechanism behind the “triple response” following the subcutaneous injection of histamine. 3.0
4. Identify and explain the mechanism of action of the binding of antihistamines to H1 histamine receptors. 2.0
5. Discuss the pharmacologic effects and sites of actions of diphenhydramine and its ability to relieve the symptoms of allergic rhinitis. 4.0
6. Distinguish between the first and second generation antihistamines 4.0

J. Gastrointestinal Drugs

A. Drugs Used for Treatment of Peptic Ulcer Disease

1. Discuss the following with regard to the objective stated at the beginning of this section:

- | | |
|------------------------|-----|
| a. cimetidine | 4.0 |
| b. ranitidine | 4.0 |
| c. famotidine | 4.0 |
| d. nizatidine | 4.0 |
| e. omeprazole | 4.0 |
| f. esomeprazole | 4.0 |
| g. lansoprazole | 3.0 |
| h. rabeprazole | 3.0 |
| i. pantoprazole | 3.0 |
| j. calcium carbonate | 3.0 |
| k. magnesium hydroxide | 3.0 |
| l. aluminum hydroxide | 3.0 |

- | | |
|--------------------------|-----|
| m. sodium bicarbonate | 2.0 |
| n. misoprostol | 4.0 |
| o. sucralfate | 2.0 |
| p. clarithromycin | 4.0 |
| q. metronidazole | 4.0 |
| r. amoxicillin | 4.0 |
| s. tetracycline | 2.0 |
| t. bismuth subsalicylate | 3.0 |
2. Explain the neurohumoral control of H⁺ secretion by gastric parietal cells and the mechanism of H⁺ production by the parietal cell H⁺/K⁺ ATPase 4.0
 3. Explain the role of histamine in the different phases H⁺ secretion. 4.0
 4. Identify the causes of H⁺ hypersecretion. 4.0
 5. Describe the mechanism of action of proton pump inhibitors and why they are selective for the parietal cell proton pump. 4.0
 6. Identify and explain causes for disruption of the cytoprotective barrier. 4.0
 7. Explain the role of *H. pylori* in peptic ulcer disease. 4.0
 8. Describe tests for evaluating *H. pylori* infection. 2.0
 9. Discuss the use of triple and quadruple therapy regimens used for *H. pylori* eradication. 4.0
 10. Explain the contribution of each agent in triple or quadruple therapy regimens in *H. pylori* eradication. 3.0
 11. Discuss the potential for antibiotic resistant strains of *H. pylori*. 3.0

B. Prokinetic Drugs and Laxatives

1. Discuss the following with regard to the objectives stated at the beginning of this section:

a. erythromycin	3.0
b. metoclopramide	3.0
c. lubiprostone	4.0
d. bethanechol	2.0
e. psyllium	2.0
f. methylcellulose	3.0
g. sodium phosphate/sodium citrate	3.0
h. lactulose	3.0
i. castor oil	1.0
j. bisacodyl	2.0
k. senna	2.0
l. mineral oil	1.0
m. docusate	3.0
n. glycerin	2.0
o. magnesium hydroxide	3.0
p. sorbitol	2.0
q. polyethylene glycol	4.0
r. lubiprostone	3.0
2. Describe the neural and hormonal mechanisms controlling gastric and intestinal motility. 3.0
3. Explain the changes in neural and hormonal control of stomach and intestinal motility that lead to delayed gastric emptying or accommodation. 3.0

4. Discuss why some drugs are selective for upper GI motility disorders and why others are selective for lower GI motility disorders. **2.0**
- C. Anti-diarrheal Drugs**
1. Discuss the following with regard to the objectives stated at the beginning of this section:
- a. loperamide **4.0**
 - b. diphenoxylate **3.0**
 - c. octreotide **3.0**
2. Discuss the neural mechanisms controlling colonic motility, water and electrolyte absorption, and fluid secretion. **3.0**
3. Identify and describe the conditions under which neural mechanisms controlling colonic motility, as well as water and electrolyte absorption and secretion are impaired. **3.0**
4. Discuss the neural mechanisms of visceral sensation and visceral pain. **2.0**
5. Discuss the importance of maintaining normal gut microbiota and how disruption can lead to altered motility, absorption and secretion in the colon. **3.0**
- D. Drugs Used for Treatment of Inflammatory Bowel Disease**
1. Discuss the following with regard to the objectives stated at the beginning of this section:
- a. sulfapyridine **4.0**
 - b. sulfasalazine **4.0**
 - c. olsalazine, mesalamine **3.0**
 - d. hydrocortisone **4.0**
 - e. prednisone, prednisolone **4.0**
 - f. budesonide **4.0**
 - g. methotrexate **4.0**
 - h. 6-mercaptopurine **3.0**
 - i. azathioprine **3.0**
 - j. infliximab **4.0**
 - k. adalimumab **3.0**
 - l. lactobacillus **2.0**
 - m. natalizumab **2.0**
2. Identify the mechanisms responsible of intestinal and extra-intestinal symptoms of inflammatory bowel disease. **2.0**
3. Discuss the contribution of intestinal bacteria to the pathophysiology of inflammatory bowel disease. **2.0**
4. Explain the routes of administration of drugs in each class used to treat inflammatory bowel disease.
5. Discuss the absorption and distribution of each class of drug used to treat inflammatory bowel disease and identify the impact on the choice of the route of administration. **3.0**
6. Describe the mechanisms for bioactivation of the 5-aminosalicylic acid agents and identify the impact treatment of inflammatory bowel disease. **3.0**

E. Drugs Used to Induce or Treat Nausea and Vomiting

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. apomorphine 2.0
 - b. syrup of ipecac 2.0
 - c. prochlorperazine 2.0
 - d. promethazine 3.0
 - e. ondansetron 3.0
 - f. granisetron, palonosetron, dolasetron 3.0
 - g. dronabinol 3.0
 - h. diphenhydramine, dimenhydrinate 3.0
 - i. meclizine, cyclizine, hydroxyzine 3.0
 - j. aprepitant 3.0
 - k. scopolamine 3.0
2. Discuss the central and peripheral nervous system mechanisms responsible for nausea and vomiting. 3.0
3. Explain the use of multi-drug treatment of nausea and vomiting. 3.0
4. Discuss the use of anti-emetic drugs in the treatment of chemotherapy-induced nausea and vomiting versus those used for motion sickness. 4.0
5. Distinguish H1 antihistamine agents that have anticholinergic actions from those that do not have anticholinergic properties. 3.0

F. Drugs Used to Treatment Irritable Bowel Syndrome (IBS)

1. Discuss the following with regard to the objectives listed at the beginning of this section:
 - a. loperamide 3.0
 - b. amitriptyline, desipramine 3.0
 - c. dicyclomine 3.0
 - d. lubiprostone 4.0
 - e. linaclotide 4.0
2. Describe the characteristics of IBS and how each of the agents above are used to provide symptomatic relief. 4.0
3. Distinguish between the agents used to treat diarrhea-predominant IBS and constipation-predominant IBS. 4.0
4. Describe the difference in efficacy between males and females for alosetron and lubiprostone. 4.0

IV. Drugs Acting on the Central Nervous System

A. Endogenous Compounds

1. Discuss the following with regard to the objectives stated at the beginning of this section:
Define the following:
 - a. Dopamine (DA) 4.0
 - b. Gamma-Aminobutyric Acid (GABA) 3.0
 - c. Norepinephrine (NE) 2.0
 - d. Dynorphins 3.0

- | | |
|-------------------------------|-----|
| e. Glycine | 3.0 |
| f. Acetylcholine (ACh) | 4.0 |
| g. 5-Hydroxytryptamine (5-HT) | 4.0 |
| h. Glutamate | 4.0 |
| i. Substance P | 2.0 |
| j. Beta-Endorphin | 3.0 |
| k. Enkephalins | 3.0 |
| l. Histamine | 3.0 |
| m. NMDA receptors | 3.0 |
2. Identify the major neurotransmitters in the brain, their predominant anatomical pathways, and their associated relevant disorders. 4.0
 3. Compare and contrast G protein coupled receptors and ligand-gated ion channels, and describe the major effector systems coupled to various G-proteins. 4.0
 4. Explain how synaptic function changes in response to chronic administration of agonists, antagonists, and uptake blockers. 4.0
 5. Describe the processes of receptor sensitization and desensitization and provide examples of how these processes may be induced. 4.0
 6. Identify the molecular, cellular, and biochemical sites where drugs can act to affect neuronal function. 4.0
 7. Describe the blood brain barrier and list the considerations that determine whether a drug will gain access to the central nervous system. 4.0

B. Antidepressants

1. Discuss the following with regard to the objectives stated at the beginning of this section:

a. Amitriptyline, nortriptyline	4.0
b. imipramine, despiramine	2.0
c. clomipramine	3.0
d. fluoxetine	4.0
e. sertraline	3.0
f. paroxetine	3.0
g. citalopram	4.0
h. escitalopram	4.0
i. fluvoxamine	2.0
j. phenelzine	3.0
k. venlafaxine/desvenlafaxine	4.0
l. duloxetine	4.0
m. mirtazapine	4.0
n. bupropion	4.0
o. trazodone	3.0
p. St. John's Wort	2.0
2. Identify the major classes of antidepressant drugs and their primary cellular targets (TCAs, SSRIs, SNRIs, atypical antidepressants, and MAO inhibitors). 4.0
3. Identify the mechanisms that could account for the delay in therapeutic actions of antidepressants. 3.0
4. Discuss the pharmacokinetics of the different classes of antidepressant drugs, and explain the importance of active metabolite formation, as well as how

- pharmacokinetics is relevant when switching from one medication to another. 3.0
5. Explain the use of antidepressants for other indications, in particular neuropathic and chronic pain. 4.0
 6. Identify the drug interactions associated with use of *St. John's Wort*. 3.0
 7. Describe major drug and food interactions for the antidepressants. 4.0

C. Antipsychotic Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. chlorpromazine 4.0
 - b. fluphenazine 2.0
 - c. haloperidol 4.0
 - d. clozapine 3.0
 - e. olanzapine 4.0
 - f. risperidone 4.0
 - g. quetiapine 4.0
 - h. ziprasidone 2.0
 - i. aripiprazole 4.0
2. Contrast the actions of phenothiazines and haloperidol with those of atypical antipsychotics, and explain the implications for theories of the mechanisms of antipsychotic actions. 4.0
3. Discuss current theories regarding the therapeutic mechanism of action of antipsychotic drugs, including acute and chronic effects on major dopaminergic and serotonergic systems in the CNS. 4.0
4. Explain uses of antipsychotic drugs for indications other than schizophrenia. 3.0
5. Explain the use of dopamine antagonists in Tourette's syndrome. 2.0
6. Discuss the adverse effect profile of low-potency classical antipsychotics, high-potency classical antipsychotics, and atypical antipsychotics. 4.0
7. Identify the time course, signs, and symptoms of antipsychotic drug-induced dyskinesias (dystonia, akathisia, Parkinson-like symptoms, tardive dyskinesia), and discuss their management and treatment. 3.0
8. Define *neuroleptic malignant syndrome* and discuss its management and treatment. 4.0

D. Drugs for Bipolar Disorder

1. Discuss the following with regard to the objectives at the beginning of this section:
 - a. lithium 4.0
 - b. valproic acid 4.0
 - c. carbamazepine 3.0
 - d. olanzapine 4.0
 - e. risperidone 3.0
 - f. quetiapine 4.0
 - g. aripiprazole 3.0
 - h. clonazepam 2.0

2. Describe the signs and symptoms of bipolar disorder, including subtypes and natural history, including manic episodes. 4.0
3. Explain the major theories explaining the presumed mechanisms of action of drugs useful for treating bipolar disorder (lithium, anticonvulsants, antipsychotics). 3.0
4. Discuss the pharmacokinetics of lithium, and explain its relationship to alteration in dietary sodium, effects of exercise, use of diuretics, monitoring of plasma lithium levels, and treatment of lithium overdose. 4.0
5. Discuss the use of antiseizure drugs for treatment of bipolar disorder; compare and contrast their advantages and disadvantages compared to lithium. 4.0
6. Differentiate between adverse side effects of lithium from signs and symptoms of lithium overdose, and explain why lithium is contraindicated in patients with impaired renal function or cardiovascular disease. 4.0

E. Drugs for Seizure Disorders

1. Discuss the following with regard to the objectives stated in the beginning of this section:
 - a. phenytoin, fosphenytoin 4.0
 - b. carbamazepine 4.0
 - c. phenobarbital, primidone 2.0
 - d. topiramate 3.0
 - e. diazepam, lorazepam 4.0
 - f. lamotrigine 3.0
 - g. valproic acid 3.0
 - h. ethosuximide 4.0
 - i. tiagabine 2.0
 - j. clonazepam 3.0
2. Identify the drugs of choice for the major seizure types and understand their mechanism of action. 4.0
3. Identify the pharmacokinetic factors relevant to appropriate therapy with antiseizure drugs, in particular why the clearance of phenytoin changes with dose. 3.0
4. Identify the antiseizure medications that induce hepatic enzymes and know the likely interactions with drugs used for other conditions. 4.0
5. Identify the adverse and teratogenic effects of the major antiseizure drugs. 4.0
6. Be familiar with uses of antiseizure drugs for other conditions. 4.0

F. Sedative Hypnotics and Anxiolytics

1. Discuss the following with regard to the objectives stated in the beginning of this section:
 - a. diazepam 4.0
 - b. chlordiazepoxide 3.0
 - c. lorazepam 4.0
 - d. alprazolam 4.0
 - e. oxazepam 3.0
 - f. midazolam 4.0
 - g. triazolam 2.0
 - h. temazepam 2.0
 - i. flurazepam 2.0
 - j. zolpidem 4.0

- | | |
|--|-----|
| k. zaleplon | 3.0 |
| l. eszopiclone | 3.0 |
| m. ramelteon | 3.0 |
| n. pentobarbital | 2.0 |
| o. diphenhydramine | 2.0 |
| p. buspirone | 4.0 |
| q. lumazenil (antagonist) | 4.0 |
| 2. Explain the GABA _A receptor channel complex, the heterogeneity of its subunits, and the physiological and therapeutic implications. | 4.0 |
| 3. Discuss the effects of various sedative/hypnotic/anxiolytic drugs on GABA _A function and their selectivity for different receptors with different subunit subtypes, as well as differences in their sites of action on the GABA _A receptor channel complex. | 4.0 |
| 4. Identify the signs and symptoms of barbiturate and benzodiazepine overdose and its treatment. | 4.0 |
| 5. Explain the interactions of the various classes of drugs used as hypnotics, sedative, and anxiolytics with other CNS depressants. | 4.0 |
| 6. Explain the dependence liability and withdrawal syndromes of the various classes of drugs used as hypnotics, sedative, and anxiolytics. | 4.0 |
| 7. Discuss the adverse effects of benzodiazepines, nonbenzodiazepines, and barbiturates, as well as why drugs acting at the benzodiazepine receptor have virtually totally replaced barbiturates as hypnotics. | 4.0 |
| 8. Explain how pharmacokinetics of various benzodiazepines relates to their therapeutic utility. | 4.0 |
| 9. Identify and describe other groups of drugs with sedative/hypnotic and anxiolytic actions, including ramelteon, buspirone and diphenhydramine. | 4.0 |
| 10. Discuss the potential for abuse of <u>benzodiazepines</u> and barbiturates. | 4.0 |

G. Centrally Acting Muscle Relaxants

- | | |
|--|-----|
| 1. Discuss the following with regard to the objectives stated at the beginning of this section: | |
| a. baclofen | 3.0 |
| b. dantrolene | 4.0 |
| c. diazepam | 4.0 |
| d. lorazepam | 3.0 |
| e. tizanidine | 4.0 |
| f. cyclobenzaprine | 2.0 |
| g. carisoprodol | 2.0 |
| 2. Identify drugs useful for treatment of spasticity, and compare and contrast the mechanisms of action and adverse effects of benzodiazepines, baclofen, cyclobenzaprine, and dantrolene. | 4.0 |
| 3. Describe the pathophysiological basis of rigidity, spasticity, and muscle spasm, and identify the classes of agents that are used to promote skeletal muscle relaxation. | 4.0 |
| 4. Identify the molecular mechanism of action of each primary drug. | 4.0 |

H. Ethanol and Drugs for Treatment of Alcoholism

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. ethanol 4.0
 - b. acamprosate 4.0
 - c. fomepizole 3.0
 - d. methanol, ethylene glycol 2.0
 - e. naltrexone 3.0
 - f. disulfiram 2.0
 - g. topiramate 3.0
2. Discuss current theories about the mechanism of action of alcohol in the CNS. 4.0
3. Describe the pharmacokinetics, absorption, distribution, metabolism, and excretion of ethanol. 4.0
4. Describe the acute and chronic organ toxicities of ethanol. 4.0
5. Identify the drugs with which ethanol shows cross-tolerance and cross-dependence. 4.0
6. Identify drugs, both prescription and over the counter that should not be combined with alcohol. 3.0
7. Explain the management of methanol and ethylene glycol toxicity. 4.0
8. Identify the signs and symptoms of chronic alcoholism and the ethanol abstinence syndrome; and compare and contrast the latter with abstinence syndromes following chronic use of barbiturates, benzodiazepines, or opioids. 4.0
9. Discuss the use of benzodiazepines to prevent symptoms of acute alcohol withdrawal. 4.0
10. Explain the effects and the mechanistic rationale for the use of disulfiram, naltrexone, and acamprosate in the treatment of chronic alcoholism. 3.0

I. Opioids

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. Agonists
 - i. morphine 4.0
 - ii. hydromorphone 4.0
 - iii. hydrocodone 4.0
 - iv. oxycodone 4.0
 - v. methadone 4.0
 - vi. meperidine 4.0
 - vii. fentanyl 4.0
 - viii. alfentanil 4.0
 - ix. codeine 4.0
 - x. diphenoxylate 4.0
 - xi. loperamide 4.0
 - xii. heroin 4.0
 - b. Mixed Agonists/Antagonists
 - i. buprenorphine 4.0
 - ii. butorphanol 3.0
 - iii. tramadol 4.0
 - iv. pentazocine 2.0
 - v. buprenorphine-naloxone 3.0

c. <u>Antagonists</u>	
i. naloxone	4.0
ii. naltrexone	4.0
d. <u>Antitussives</u>	
i. codeine	3.0
ii. dextromethorphan	2.0
2. Discuss the pharmacological effects and sites of action of the prototype opioid agonist morphine, and its utility in relieving different types of pain.	4.0
3. Identify potential therapeutic actions of opioids aside from analgesia in CNS and other organ systems including cardiovascular, respiratory, and GI.	4.0
4. Explain the salient differences in pharmacology between morphine and meperidine, fentanyl, methadone, and oxycodone.	3.0
5. Identify the molecular mechanism of action of each drug in each drug class.	4.0
6. Explain how the pharmacokinetic processes affecting morphine, absorption, distribution, metabolism, and excretion are relevant to its therapeutic use.	3.0
7. Identify the opioid agonists that are metabolized to morphine and indicate the salient differences in their pharmacology from that of morphine.	3.0
8. Identify adverse effects of morphine on CNS, cardiovascular, GI-biliary, respiratory and genitourinary systems.	4.0
9. Identify the major drug interactions of morphine.	4.0
10. Identify the contraindications for morphine and its surrogates.	4.0
11. Identify the characteristics of opioid tolerance and dependence, and explain opioid abstinence syndrome and how it differs from that for sedative-hypnotics.	4.0
12. Discuss abuse liability for opioids and how it differs among the various drugs.	3.0
13. Identify the signs and symptoms of morphine and heroin overdose and how they are managed.	4.0
14. Explain precipitated abstinence and indicate under what circumstances it might occur following the clinical use of opioid analgesics or antagonists.	4.0
15. Discuss the advantages and disadvantages of combining moderate opioids with acetaminophen or aspirin.	3.0
16. Identify the clinical indications for the opioids and opioid antagonists and the basis for their use.	4.0
17. Contrast the analgesic effects of morphine with those of the nonsteroidal anti-inflammatory drugs; with those of antidepressants; and with those of carbamazepine and gabapentin, particularly in relation to the treatment of neuropathic pain conditions.	4.0
18. Discuss the rationale for using mixtures of opioid analgesics and NSAIDs.	4.0
19. Explain how agonist-antagonists and partial agonists differ in their utility and adverse effect profile when compared to morphine.	4.0
20. Explain the salient differences between naloxone and naltrexone and how these are reflected in clinical use of these drugs.	3.0
21. Explain how the combination of naloxone with opiate analgesics in oral and sublingual preparations permits opiate action, yet decreases abuse liability.	3.0
22. Rationalize using methadone to treat heroin abusers, and identify aspects of methadone's pharmacokinetics and pharmacodynamics that make it useful for this purpose.	3.0
23. Differentiate between maintenance therapy with methadone and buprenorphine.	3.0
24. Rationalize using methadone for treatment of chronic pain.	3.0

J. Drugs of Abuse

I. Stimulants

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. methamphetamine 4.0
 - b. cocaine 4.0
 - c. methylphenidate 3.0
 - d. caffeine 3.0
 - e. ephedrine 2.0
 - f. nicotine 4.0
 - g. varenicline 3.0
2. Discuss the mechanism of action and abuse potentials of the stimulants listed above. 3.0
3. Explain therapeutic uses of stimulants and related drugs as appetite suppressants, in attention deficit hyperactivity disorder, in narcolepsy, and for promoting wakefulness. 4.0
4. Describe the addictive properties of nicotine and uses and side effects of varenicline. 4.0
5. Describe other therapies to treat nicotine dependence, including nicotine patches and chewing gum and bupropion. 4.0

II. Hallucinogens

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. mdma (ecstasy) 4.0
 - b. ketamine 3.0
 - c. phencyclidine (pcp) 1.0
 - d. lysergic acid diethylamide (lsd) 2.0
 - e. mescaline 2.0
2. Discuss the mechanism of action and abuse potentials of the stimulants listed above. 3.0

III. Cannabinoids

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. marijuana/delta-9 tetrahydrocannabinol (thc) 4.0
 - b. dronabinol 2.0
 - c. synthetic cannabinoids 2.0
2. Explain the psychological, physiological and pharmacologic effects of smoking marijuana and understand the rationale for using dronabinol. 3.0
3. Discuss possible medical uses of marijuana. 2.0
4. Discuss the effects of synthetic cannabinoids and how they may differ from those of marijuana. 2.0

IV. Inhalants

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. carbon tetrachloride 1.0
 - b. glue 1.0
 - c. toluene 1.0
 - d. gasoline 1.0
 - e. nitrous oxide 1.0
2. Describe the epidemiology of abuse of inhalants. 2.0
3. Discuss the effects of organic solvents and their toxicities. 2.0

K. Drugs for Treatment of Parkinson's Disease

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. L-dopa/carbidopa 4.0
 - b. selegiline (deprenyl) 4.0
 - c. pramipexole 4.0
 - d. ropinirole 4.0
 - e. bromocriptine 4.0
 - f. benztropine 1.0
 - g. entacapone 1.0
2. Understand the role of dopamine loss and cholinergic/dopaminergic interactions in Parkinson's Disease. 4.0
3. Identify the adverse effect profile of levodopa and how it is altered by combination with carbidopa. 4.0
4. Understand the use and effects of selegiline and other MAO inhibitors in Parkinson's Disease. 4.0
5. Differentiate between the two major classes of direct DA receptor agonists used for chronic control of Parkinson's disease, and how their therapeutic actions compare to that of levodopa. 3.0
6. Explain the use of anticholinergics in treating Parkinson's disease. 3.0

L. Drugs for Treatment of Alzheimer's Disease

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. donepezil 4.0
 - b. galantamine 4.0
 - c. rivastigmine 4.0
 - d. memantine 4.0
2. Identify drugs used for the treatment of Alzheimer's disease, their mechanisms of action, their efficacy, and their adverse effects. 4.0

M. General Anesthetics

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. desflurane 4.0
 - b. nitrous oxide (N₂O) 4.0
 - c. halothane 1.0
 - d. fentanyl 4.0
 - e. midazolam 4.0
 - f. alfentanil 2.0
 - g. remifentanil 1.0
 - h. isoflurane 4.0
 - i. sevoflurane 3.0
 - j. etomidate 1.0
 - k. ketamine 4.0
 - l. morphine 4.0
2. Define general anesthesia and dissociative anesthesia. 3.0

3. Discuss the objectives of general anesthesia and characteristics of an ideal anesthetic, and identify the stages of general anesthesia. 3.0
4. Explain the current theories of the mechanisms of action of inhalation anesthetics and of intravenous anesthetics. 3.0
5. Explain the concept of the blood gas dissociation constant and how it affects rate of induction of anesthetic. 4.0
6. Explain how the physical properties of inhalation anesthetics influence the rate of Equilibration of anesthetic in the inspired air to anesthetic in alveoli, blood, brain, muscle and fat; and how this information is related to onset and recovery from inhalation anesthesia. 4.0
7. Compare and contrast commonly used intravenous induction agents. 3.0
8. Describe relative roles of distribution and metabolism in determining duration of action in, and how duration of action may change with repeated administration of intravenous induction agents. 3.0
9. Describe the complications that may ensue with the use of nitrous oxide as a direct result of the high concentrations at which it is administered and its solubility in blood relative to that of nitrogen. 4.0
10. Define *malignant hyperthermia*, list some common triggering agents, and discuss its prevention and treatment. 4.0
11. Explain the utility and adverse effects of drugs commonly used as pre-anesthetic agents. 4.0
12. Explain the pharmacological effects of the drugs in each class on pulmonary, cardiovascular, and renal function. 3.0
13. Compare and contrast commonly used intravenous induction agents, in terms of their speed of onset and duration of action. 4.0
14. Explain the relative roles of distribution and metabolism in determining duration of action and how duration of action may change with repeated administration of an intravenous anesthetic. 4.0
15. Define MAC (minimal alveolar concentration), name the physical property of an inhalation anesthetic that correlates best with its MAC, and explain how the concept of MAC is used in anesthesiology. 4.0

N. Local Anesthetics

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. Esters
 - i. procaine 3.0
 - ii. benzocaine 3.0
 - iii. cocaine 3.0
 - iv. tetracaine 3.0
 - b. Amides
 - v. lidocaine 4.0
 - vi. bupivacaine 4.0
 - vii. ropivacaine 3.0
 - viii. prilocaine 1.0
2. Explain how the actions of clinically used local anesthetics might be influenced by the frequency of impulse transmission in peripheral nerves, size and class of the peripheral axons, pH, and by vascularity of the injected area. 4.0

- | | |
|--|------------|
| 3. Explain the ionic basis of the action potential and the mechanism of action of local anesthetics. | 3.0 |
| 4. Identify the common adverse effects of local anesthetics and indicate appropriate treatments should they occur. | 4.0 |
| 5. Identify the significant differences between amide and ester-type local anesthetics. | 4.0 |
| 6. Identify the common routes of administration of local anesthetics. | 4.0 |
| 7. Identify the anesthetics that cannot be used topically or for infiltration, and why. | 4.0 |
| 8. Explain the methods used to restrict local anesthetics to a desired site of action and indicate how these methods reduce adverse effects. | 4.0 |
| 9. Explain epidural and intrathecal administration of selected opioids and local anesthetics. | 3.0 |

X. Autacoids and Drugs Used to Treat Inflammation

1. Discuss the following with regard to the objectives stated at the beginning of this section:

A. Non-Steroidal Anti-inflammatories

Non Selective

- | | |
|---------------------------------|------------|
| a. indomethacin | 3.0 |
| b. sulindac | 2.0 |
| c. meclofenamate | 1.0 |
| d. diclofenac | 3.0 |
| e. ketorolac | 1.0 |
| f. ibuprofen | 3.0 |
| g. naproxen (Anaprox, Naprosyn) | 3.0 |
| h. fenoprofen (Ansaid) | 1.0 |
| i. ketoprofen (Orudis) | 3.0 |
| j. piroxicam (Feldene) | 1.0 |

B. COX-2 Selective

- | | |
|--------------|------------|
| a. celecoxib | 4.0 |
| b. meloxicam | 3.0 |

2. Describe the formation of inflammatory product formation from the arachidonic cascade and the enzymes involved. **3.0**
3. Describe the effects of prostaglandins, leukotrienes, thromboxane A1 and prostacyclin on various organ systems. **3.0**
4. Understand the role of tumor necrosis alpha (TNF alpha) in inflammation. **3.0**
5. Describe the action of COX-1 and COX-2 inhibitor drugs to decrease the formation of prostaglandins. **4.0**
6. Describe the differences between acetaminophen and the non-steroidal anti-inflammatory drugs (NSAIDs). **4.0**
7. Describe the differences in the actions between the NSAIDs and the COX-2 selective drugs on the platelet system, blood vessels, and the GI system. **3.0**
8. Describe the general pharmacokinetic properties of the NSAIDs with regard to bioavailability, CYP biotransformation, protein binding and renal and biliary excretion. **2.0**
9. Describe the possible adverse drug effects (ADRs) associated with the NSAIDs including on the CNS, cardiovascular, gastrointestinal, and renal systems **2.0**

- | | |
|--|-----|
| 10. Compare and contrast the actions of the NSAIDs and the glucocorticoids in the treatment of inflammation. | 2.0 |
| 11. Explain the effects and time course of aspirin on platelet function. | 2.0 |
| 12. Describe the clinical uses of acetaminophen. | 3.0 |
| 13. Describe the dose and mechanism for toxicity of acetaminophen. | 3.0 |
| 14. Explain why the treatment for acetaminophen includes the use of N-acetylcysteine. | 3.0 |

C. Disease-Modifying Antiheumatic Drugs (DMARDs)

1. Discuss the following with regard to the objectives stated at the beginning of this section:

Nonbiologic DMARDs

- | | |
|-------------------------------|-----|
| a. azathioprine | 3.0 |
| b. cyclophosphamide | 1.0 |
| c. methotrexate | 2.0 |
| d. tofacitinib | 3.0 |
| e. micophenolate mofetil | 3.0 |
| f. leflunomide | 3.0 |
| g. sulfasalazine | 3.0 |
| h. hydroxychloroquine sulfate | 3.0 |
| i. penicillamine | 3.0 |
| j. gold sodium thiomalate | 3.0 |
| k. auranofin | 3.0 |
| l. aurothioglucose | 3.0 |

TNF-alpha-blocking agents

- | | |
|--------------------------------|-----|
| a. adalimumab (humira) | 4.0 |
| b. certolizumab pegol (cimiza) | 4.0 |
| c. etanercept (enbrel) | 4.0 |
| d. golimumab (simponi) | 4.0 |
| e. infliximab (remicade) | 4.0 |

- | | |
|---|-----|
| 2. Describe the pathophysiology of rheumatoid arthritis (RA) | 2.0 |
| 3. For each of the following DMARDs listed above mechanism of action and major adverse reactions. | 4.0 |
| 4. Contrast the use and side effects of biologic vs. non-biologic DMARDs. | 3.0 |

XI. Endocrine Pharmacology

A. Drugs and Hormones from Hypothalamus and Anterior Pituitary

1. Discuss the following with regard to subsequent objectives stated at the beginning of this section:
- | | |
|-------------------------|-----|
| a. somatropin (rhgh) | 3.0 |
| b. mecasermin (rhigf-1) | 3.0 |
| c. octreotide | 3.0 |
| d. lanreotide | 2.0 |
| e. pegvisomant | 3.0 |
| f. bromocriptine | 3.0 |
| g. cabergoline | 4.0 |
| h. prolactin | 2.0 |

i. human chorionic gonadotropin (hcg and rhcg)	2.0
j. human menopausal gonadotropin (hmg; menotropin)	2.0
k. recombinant human fsh (rfsh)	2.0
l. urofollitropin (ufsh)	2.0
m. nafarelin acetate	1.0
n. goserelin acetate	1.0
o. ganirelix acetate	1.0
p. cetorelix acetate	1.0
2. Identify and describe the general functions of hormones and their target organs (location and type of receptors).	3.0
3. Explain the etiology of endocrine syndromes including those due to hormone deficiency/excess, receptor defects, hormone resistance, abnormal hormone dynamics, and hormone binding proteins.	3.0
4. Identify the mechanisms of hormone action including receptors and signal transduction pathways for hormones.	3.0
5. Explain the regulation of hormone synthesis/release/disposition, the role of circadian rhythms, patterns of release, binding proteins, and modulating factors.	1.0
6. Explain the regulation of growth hormone (GH) biosynthesis and secretion, including the roles of growth hormone releasing hormone (GH-RH) and GH-releasing peptides; glucose levels, somatotatin, and dopamine; and age and body composition.	4.0
7. Identify the physiological conditions that elicit growth hormone secretion, and outline how specific diagnostic maneuvers can elicit GH secretion.	3.0
8. Explain the regulation of prolactin biosynthesis secretion and release by suckling, as well as the effect of dopaminergic and serotonergic agonists and antagonists.	3.0
9. Identify pharmacological agents that can induce hyperprolactinemia.	3.0
10. Describe medical problems related to hypersecretion of prolactin in the female (galactorrhea, amenorrhea, infertility) and in the male (hypogonadism, infertility).	3.0
11. Describe the roles of corticotropin releasing hormone (CRH) and corticotropin (ACTH, adrenocorticotropic hormone) in the regulation of the secretion of the corticosteroids.	3.0
12. Explain the kinetics of secretion for GnRH and the relationship to the therapeutic uses of synthetic analogs, the mode of administration, and therapeutic considerations.	4.0
13. Identify the molecular mechanism of action of each drug in each drug class.	4.0
14. Explain the biological actions of growth hormone on peripheral tissues.	2.0
15. Explain the role(s) of IGFs (somatomedins).	2.0
16. Describe the biological actions of prolactin on breast development and lactation and explain the relationship of the hormones that are involved in breast development and lactation, including growth hormone, estrogen, progesterone, glucocorticoids, TRH, prolactin, oxytocin, and insulin.	2.0
17. Explain the structure-activity relationships of gonadotropin releasing hormone (GnRH) and synthetic analogs.	3.0
18. Identify the route(s) by which each of the listed factors is administered.	4.0
19. Identify and describe the adverse effects of GH therapy in children and adults.	4.0
20. Identify and describe the adverse effects of agents used to treat hypersecretion of GH and prolactin in children and adults.	4.0
21. Identify and describe the adverse effects of cortecorelin and cosyntropin when used in stimulation tests.	1.0

- | | |
|---|-----|
| 22. Identify and describe the adverse effects of GnRH and analogs and antagonists as therapeutic agents when used to treat infertility, prostatic carcinoma, endometriosis, and central precocious puberty. | 1.0 |
| 23. Identify and describe the medical problems related to hypo- or hyper- secretion of GH and the role of releasing/replacement therapy and release-inhibiting drugs in the management of these states. | 4.0 |
| 24. Explain the mode of administration of corticotropin and cosyntropin when used in the diagnosis of disorders of the adrenal axis. | 1.0 |
| 25. Discuss the rapid ACTH stimulation test in diagnosing pituitary-adrenal disorders and identify what endpoint is measured. | 1.0 |
| 26. Explain the mode of administration and therapeutic considerations for the use of gonatotropins and GnRH agonists and antagonists in the treatment of infertility, endometriosis, uterine fibroids, prostate cancer, and precocious puberty. | 4.0 |

B. Posterior Pituitary Agents

- | | |
|---|-----|
| 1. Discuss the following with regard to the objectives listed at the beginning of this section: | |
| a. vasopressin (arginine vasopressin) | 4.0 |
| b. desmopressin | 4.0 |
| c. tolvaptan (v ₂ selective) | 3.0 |
| d. demeclocycline | 2.0 |
| e. oxytocin | 2.0 |
| 2. Describe the effects of vasopressin on receptor subtypes and signal transduction systems in vascular smooth muscle and the kidney. | 4.0 |
| 3. Identify the drugs that affect vasopressin release/action and explain their relationship to the therapy of diabetes insipidus and SIADH. | 4.0 |
| 4. Identify the drugs that can cause diabetes insipidus (nephrogenic and neurogenic) and SIADH. | 4.0 |
| 5. Explain the actions of oxytocin and their roles in parturition and lactation. | 4.0 |
| 6. Identify the molecular mechanism of action of vasopressin and related hormones. | 4.0 |
| 7. Explain the actions of vasopressin and analogs, such as desmopressin, on organ systems. | 4.0 |
| 8. Identify the route(s) by which each of the listed agents is administered. | 4.0 |
| 9. Outline the toxicities and contraindications for vasopressin agents and oxytocin. | 1.0 |
| 10. Discuss the rapid ACTH stimulation test in diagnosing pituitary-adrenal disorders and identify what endpoint is measured. | 1.0 |
| 11. Discuss preparations and routes administration of vasopressin analogs available for treating neurogenic and partial diabetes insipidus, bleeding of esophageal varices, and deficient blood clotting factors in hemophilia. | 2.0 |
| 12. Describe the diagnostic and therapeutic uses of oxytocin. | 1.0 |

C. Adrenal Cortical Drugs and Hormones

- | | |
|---|-----|
| 1. Discuss the following with regard to the objectives listed at the beginning of this section: | |
| a. cortisol (hydrocortisone) | 4.0 |
| b. dexamethasone | 4.0 |
| c. prednisone | 4.0 |

- | | |
|--|-----|
| d. prednisolone | 4.0 |
| e. triamcinolone | 4.0 |
| f. fluticasone | 4.0 |
| g. beclomethasone | 4.0 |
| h. aldosterone | 4.0 |
| i. fludrocortisone | 4.0 |
| j. mifepristone | 3.0 |
| k. metyrapone | 3.0 |
| l. ketoconazole | 3.0 |
| m. spironolactone | 4.0 |
| n. drospirenone | 2.0 |
|
 | |
| 2. Outline the major steps in the biosynthesis of steroids. | 3.0 |
| 3. Explain the regulation of corticosteroid synthesis by ACTH and angiotensin. | 4.0 |
| 4. Explain the regulation of aldosterone secretion by angiotensin (I, II, and III). | 4.0 |
| 5. Identify the molecular mechanism of action of the corticosteroids. | 4.0 |
| 6. Explain the actions of corticosteroids on intermediary metabolism, growth and development, electrolyte homeostasis, immune, and inflammatory responses. | 4.0 |
| 7. Describe the cellular mechanism of action of corticosteroids. | 4.0 |
| 8. Discuss the structure-activity relationship of synthetic glucocorticoids, especially those modifications that enhance pharmacodynamics activity and/or determine activity based on route of administration. | 4.0 |
| 9. Explain the significance of corticosteroid disposition (protein binding, biotransformation, enzyme induction) that may necessitate changes in dosage regimens. | 4.0 |
| 10. Outline the adverse effects/contraindications related to corticosteroid use. | 4.0 |
| 11. Outline the adverse effects of excessive mineralocorticoid activity. | 4.0 |
| 12. Explain the rationale for corticosteroid use in replacement therapy, as antiinflammatory and immunosuppressive agents and as diagnostic agents in hypothalmo-pituitary adrenocortical disease/dysfunction. | 4.0 |
| 13. Explain the rationale for alternate day therapy and the necessity for slow withdrawal following chronic therapy with glucocorticoids. | 4.0 |
| 14. Explain the rationale for spironolactone in treating primary hyperaldosteronism. | 4.0 |

D. Drugs for the Treatment of Thyroid Diseases

- | | |
|---|-----|
| 1. Discuss the following with regard to the objectives listed at the beginning of this section: | |
| a. levothyroxine | 4.0 |
| b. triiodothyronine | 3.0 |
| c. radioactive iodine (i^{131}) | 4.0 |
| d. methimazole | 4.0 |
| e. propylthiouraci | 4.0 |
| f. propranolol | 4.0 |
| g. lithium | 2.0 |
| h. iodide salts | 3.0 |
| i. potassium iodide | 4.0 |
|
 | |
| 2. Explain the regulation and the key steps in thyroid hormone synthesis and peripheral conversion. | 3.0 |
| 3. Identify the mechanisms by which thyroid hormones regulate cellular function. | 4.0 |

4. Identify the signs and symptoms of hypothyroidism (myxedema) and the consequences of the disease that can alter drug therapy for other concurrent diseases. **4.0**
5. Identify the molecular mechanism of action of each drug in each drug class. **4.0**
6. Explain the relationship between thyroid hormones and the actions of catecholamines and the rationale for the use of propranolol in the treatment of hyperthyroidism. **4.0**
7. Explain the pharmacokinetic rationale for selecting the most appropriate form of thyroid hormone as replacement therapy. **4.0**
8. Identify the best index of adequate replacement therapy with thyroid hormone. **4.0**
9. Explain the rationale for selecting the most appropriate antithyroid drug for treating hyperthyroidism (diffuse toxic goiter) in a non-pregnant versus a pregnant female. **3.0**
10. Describe potential adverse effects of replacement therapy with levothyroxine. **4.0**
11. Outline the adverse effects of antithyroid medications and identify those that are potentially life threatening. **4.0**
12. Explain the necessary cautions when replacing thyroid hormone in a patient with a history of coronary artery disease. **4.0**
13. Explain the rationale and order of administration of drugs given to treat thyroid storm. **4.0**
14. Explain the rationale for the uses of drugs/radioiodine in treating hyperthyroidism; explain their mechanism(s) of action; consequences of radioactive iodine use. **4.0**

E. Drugs for the Treatment of Osteoporosis and Disorders of Calcium Homeostasis

1. Discuss the following with regard the objectives listed at the beginning of this section:
 - a. teriparatide acetate **4.0**
 - b. vitamin d **4.0**
 - c. calcitriol **4.0**
 - d. calcium gluconate **4.0**
 - e. cinacalcet **3.0**
 - f. calcitonin **3.0**
 - g. raloxifene **3.0**
 - h. Bisphosphonates **3.0**
 - i. alendronate
 - ii. etidronate
 - iii. ibandronate
 - iv. risedronate
 - v. zoledronate
 - i. denosumab **3.0**
2. Describe the regulation of calcium homeostasis and the physiological actions of parathyroid hormone (PTH), calcitonin (CT) and 1,25dihydroxyvitamin D₃ [1,25-(OH)₂D₃]; understand the role(s) of kidney, liver, and GI tract in vitamin D homeostasis. **4.0**
3. Identify the mechanisms regulating synthesis, secretion of PTH and actions and CT their mechanism(s) of action on bone, kidney and intestine. **4.0**
4. Identify the molecular mechanism of action of each drug in each drug class. **4.0**
5. Explain the possible adverse effects of CT, 1,25-(OH)₂D and calcium supplements. **4.0**
6. Discuss common and possible serious side effects of bisphosphonates. **4.0**
7. Identify the available preparations of CT, 1,25-(OH)₂D, and calcium supplements and their clinical uses; compare and contrast the treatment of hypo- and hyper-parathyroidism. **4.0**
8. Identify the available preparations of CT and 1,25-(OH)₂D and calcium supplements. **4.0**

9. Explain the clinical value of bisphosphonates and CT in the treatment of: hypercalcemia, Paget's disease, osteoporosis (postmenopausal and glucocorticoid-induced). **4.0**

F. Drugs for Treatment of Diabetes Mellitus

1. Discuss the following with regard to the objectives listed at the beginning of this section: **4.0**
- a. Insulins **4.0**
 - i. regular
 - ii. lispro
 - iii. aspart
 - iv. glulisine
 - v. nph
 - vi. glargine
 - vii. detemir
 - b. pramlintide **4.0**
 - c. exenatide **4.0**
 - d. dulaglutide **3.0**
 - e. metformin **4.0**
 - f. tolbutamide **2.0**
 - g. glipizide **4.0**
 - h. glyburide **4.0**
 - i. glimeperide **3.0**
 - j. repaglinide **4.0**
 - k. nateglinide **4.0**
 - l. acarbose **4.0**
 - m. miglitol **3.0**
 - n. pioglitazone **4.0**
 - o. rosiglitazone **3.0**
 - p. sitagliptin **4.0**
 - q. saxagliptin **3.0**
 - r. canagliflozin **4.0**
 - s. dapagliflozin **2.0**
 - t. glucagon **4.0**
 - u. diazoxide **2.0**
2. Describe the normal daily patterns of insulin secretion and changes that occur in different types of diabetes mellitus. **4.0**
3. Explain the effects of insulin and glucagon on intermediary metabolism and ion transport. **4.0**
4. Explain the effects of incretin hormones, esp. GLP-1 on insulin and glucagon secretion. **3.0**
5. Explain the effects of amylin protein on glucagon secretion. **4.0**
6. Describe the pathophysiology of the primary types of diabetes mellitus and their sequelae: diabetic ketoacidosis and nonketotic hyperosmolar coma, and chronic complications. **4.0**
7. Describe the role of 5' AMP-activated protein kinase (AMPK) and peroxisome proliferator-activated receptors (PPARs) in the regulation of glucose metabolism. **4.0**
8. Identify the molecular mechanism of action of each drug in each class. **4.0**
9. Explain the pharmacokinetic (onset and duration of action) rationale for the use of insulin preparations in 'split-mixed' or continuous SC infusion. **4.0**

10. Discuss commonly used drugs with which sulfonylurea compounds are known to interact and the postulated mechanisms for these interactions (first versus second generation). **4.0**
11. Explain the clinical manifestations and management of overdose with insulin and oral hypoglycemic agents, respectively. **4.0**
12. Discuss cardiovascular concerns with the use of the thiazolidinediones **4.0**
13. Discuss the risk of severe joint pain associated with the dipeptidyl peptidase IV (DPP-IV) inhibitors. **3.0**
14. Discuss risks associated with the Sodium-glucose Co-transporter 2 (SGLT2) Inhibitors. **4.0**
15. Identify the relative roles of insulin and oral hypoglycemics in the treatment of type 1 and type 2 diabetes mellitus. **4.0**
16. Explain the mechanisms by which oral anti-diabetic agents act and describe the influence these mechanisms have on selection for therapy in individual patients (eg, obese). **4.0**
17. Explain the potential for metformin to cause metabolic acidosis, and identify in which patients it is contraindicated. **4.0**
18. Describe the regulation of calcium homeostasis and the physiological actions of parathyroid hormone (PTH), calcitonin (CT) and 1,25-dihydroxyvitamin D₃ [1,25-(OH)₂D₃]; understand the role(s) of kidney, liver, and GI tract in vitamin D homeostasis. **4.0**
19. Identify the mechanisms regulating synthesis, secretion of PTH and actions and CT their Mechanism(s) of action on bone, kidney and intestine. **4.0**
20. Identify the molecular mechanism of action of each drug in each drug class. **4.0**
21. Explain the possible adverse effects of CT, 1,25-(OH)₂D and calcium supplements. **4.0**
22. Discuss the chronic toxicity associated with long-term use of sodium fluoride. **1.0**
23. Identify the available preparations of CT, 1,25-(OH)₂D, and calcium supplements and their clinical uses; compare and contrast the treatment of hypo- and hyper-parathyroidism. **4.0**
24. Identify the available preparations of CT and 1,25-(OH)₂D and calcium supplements. **4.0**
25. Explain the clinical value of bisphosphonates and CT in the treatment of: hypercalcemia, Paget's disease, osteoporosis (postmenopausal and glucocorticoid-induced). **4.0**

G. Gonadal Hormones and Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. Estrogens **4.0**
 - i. estradiol (17 β-estradiol, e₂)
 - ii. ethinyl estradiol
 - iii. mestranol
 - b. Selective Estrogen Receptor Modulators (SERMs) **4.0**
 - i. tamoxifen
 - ii. raloxifene
 - iii. toremifene
 - c. Anti-estrogens **4.0**
 - i. clomiphene
 - ii. fulvestrant
 - d. Aromatase Inhibitors **4.0**
 - i. exemestane
 - ii. anastrozole
 - e. Progestins **4.0**
 - i. progesterone
 - ii. medroxyprogesterone

iii. norethindrone	
iv. levonorgestrel	
v. drospirinone	
f. mifepristone	3.0
g. Androgens	4.0
i. testosterone	
ii. methyltestosterone	
iii. nandrolone	
iv. oxandrolone	
v. Danazol	
h. Androgen Receptor Antagonists	4.0
i. flutamide	
ii. bicalutamide	
iii. spironolactone	
i. Androgen Synthesis Inhibitors	4.0
i. Finasteride	
2. Explain the gametogenic and steroidogenic functions of the ovary and their regulation by the gonadotropins.	1.0
3. Identify the sources of androgens (ovary, testes, adrenal) and understand their regulation by the gonadotropins.	1.0
4. Explain the importance of the gonadal steroids for sexual differentiation and puberty.	3.0
5. Describe medical problems associated with hypo- (hypogonadism) and hyperfunction and explain rationales for therapy.	4.0
6. Identify the molecular mechanism of action of each drug in each drug class.	4.0
7. Discuss the effects of estrogen on cardiovascular function, intermediary metabolism, electrolyte and water balance, cognition, reproductive function, skin, plasma proteins, and blood lipids hepatic function.	4.0
8. Discuss the effects of estrogens on laboratory tests, including liver function, clotting factors, thyroid hormone disposition, and adrenocortical function.	4.0
9. Discuss the effects of androgens on growth and development (anabolic actions versus androgenic actions).	4.0
10. Explain androgen action in tissues that express 5 α reductase and aromatase.	4.0
11. Differentiate between absorption, distribution, and elimination of synthetic and natural estrogens.	4.0
12. Identify the routes of administration, absorption, and relative duration of action of synthetic androgens and testosterone.	4.0
13. Describe major adverse effects/contraindications for estrogens and progestins alone and in combination.	4.0
14. Describe the most common drug interactions with estrogens and progestins.	4.0
15. Describe the adverse effects of androgens/anabolic steroids in males and females.	4.0
16. Correlate the hepatotoxicity of androgens/anabolic steroids with their chemical structure.	4.0
17. Discuss uses of estrogens, progestins, and androgens in replacement therapy for primary hypogonadism.	4.0
18. Describe the uses of estrogens and progestins for postmenopausal replacement therapy and compare risks and benefits, including those related to osteoporosis, cognitive disorders, cardiovascular disease, and cancer.	4.0
19. Explain the rationale for the various dosage schedules (eg, biphasics, triphasics), for oral contraception when combination (estrogen-progestin) therapy is used.	3.0

- | | |
|--|------------|
| 20. Outline other types of hormonal contraceptive preparations, including progestin only and postcoital agents, and identify their routes of administration. | 3.0 |
| 21. Describe the use of long-acting progestins for long-term suppression of ovulation. | 3.0 |
| 22. Explain the use of estrogen receptor antagonists and aromatase inhibitors in the treatment of breast cancer. | 3.0 |
| 23. Explain the activity of SERMs and describe their therapeutic utility. | 4.0 |
| 24. Explain the use of clomiphene for the treatment of infertility. | 2.0 |
| 25. Identify the mechanism of action of mifepristone and other abortifacients. | 3.0 |
| 26. Explain the clinical uses of androgens in hereditary angioedema, anemia, and catabolic states. | 4.0 |
| 27. Describe the uses of androgen receptor antagonists and androgen synthesis inhibitors. | 4.0 |

H. Drugs Affecting the Female Urogenital System

- | | |
|---|------------|
| 1. Discuss the following with regard to the objectives stated at the beginning of this section: | |
| a. anastrozole | 4.0 |
| b. drospirinone | 3.0 |
| c. exemestane | 4.0 |
| d. medroxyprogesterone | 4.0 |
| e. raloxifene | 4.0 |
| f. finasteride | 4.0 |
| g. testosterone | 4.0 |
| h. clomiphene | 4.0 |
| i. estradiol 17 β | 4.0 |
| j. levonogestrel | 4.0 |
| k. norethindrone | 4.0 |
| l. tamoxifen | 4.0 |
| m. flutamide | 4.0 |
| n. Conjugated/Esterified Estrogens | 4.0 |
| o. mestranol | 4.0 |
| p. bicalutamide | 4.0 |
| q. leuprolide | 4.0 |
| r. diethylstilbestrol | 4.0 |
| s. ethinyl estradiol | 4.0 |
| t. mifepristone | 4.0 |
| u. progesterone | 4.0 |
| v. danazol | 4.0 |
| w. oxandrolone | 4.0 |
| 2. Identify the molecular mechanism of action of drugs used for uterine stimulation or relaxation. | 2.0 |
| 3. Identify the receptors targeted by the oxytocics and the sensitivity of the uterus during the three trimesters of pregnancy. | 2.0 |
| 4. Describe the usual route(s) of administration, onset and duration of action of the various agents used for uterine stimulation or relaxation | 1.0 |
| 5. Identify the potential adverse effects of the oxytocic agents in the mother (uterine, extrauterine) and in the infant. | 1.0 |
| 6. Describe the clinical use of the individual oxytocics. | 2.0 |

7. Compare the utilization of mifepristone versus prostaglandins and oxytocics in therapeutic abortion. 2.0
8. Explain the limitation of tocolytic use to decreasing the incidence of respiratory distress syndrome. 2.0

I. Drugs Affecting the Female Urogenital System

1. Discuss the following with regard to the objectives:
 - a. methylergonovine 2.0
 - b. carbopros 2.0
 - c. dinoprostone (pge2) 2.0
 - d. magnesium sulfate 2.0
 - e. indomethacin 2.0
 - f. mifepristone 2.0
2. Identify the molecular mechanism of action of drugs used for uterine stimulation or relaxation. 2.0
3. Identify the receptors targeted by the oxytocics and the sensitivity of the uterus during the three trimesters of pregnancy. 2.0
4. Describe the usual route(s) of administration as well as onset and duration of action of the various agents used for uterine stimulation or relaxation. 1.0
5. Identify the potential adverse effects of the oxytocic agents in the mother (uterine, extrauterine) and in the infant. 1.0
6. Explain the clinical use of the individual oxytocics. 2.0
7. Compare the utilization of mifepristone versus prostaglandins and oxytocics in therapeutic abortion. 2.0
8. Explain the limitation of tocolytic use to decreasing the incidence of respiratory distress syndrome. 2.0

J. Drugs Affecting the Male Urogenital System

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. alprostadil 2.0
 - b. sildenafil 2.0
 - c. doxazosin 2.0
 - d. tamsulosin 2.0
 - e. alfusosin 2.0
 - f. saw palmetto 2.0
 - g. terazosin 2.0
2. List the neuroendocrine factors that regulate functions of the male urogenital tract. 4.0
3. Identify the molecular mechanism of action of the drugs used for benign prostatic hyperplasia and erectile dysfunction. 3.0
4. Describe the adverse effects and contraindications of the agents in each class. 3.0
5. Identify drugs that can be used to treat benign prostatic hyperplasia and erectile dysfunction. 4.0
6. Explain the relationship between the mechanism of action of the drugs listed above and relate the resulting pharmacological effects to their clinical use. 3.0

XII. Hemostasis and Blood Forming Organs

A. Drugs for Treatment of Anemia and Neutropenia

1. Discuss the following with regard to the objectives listed at the beginning of this section:
 - a. iron products 3.0
 - b. erythropoetin alfa 4.0
 - c. folic acid 4.0
 - d. filgrastim (granulocyte colony stimulating factor) 3.0
 - e. interleukin-11 2.0
 - f. deferoxamine 1.0
 - g. darbepoetin 3.0
 - h. vitamin b12/ cyanocobalamin 4.0
 - i. sargramostim 2.0
 - j. thrombopoietin 2.0
2. Describe the normal physiological control of hematopoietic growth factors and the effect of kidney failure on erythropoiesis. 4.0
3. Relate factors leading to abnormal iron balance, including genetic hemochromatosis, to the iron absorption and transport pathways. 3.0
4. Identify the biochemical systems that are impaired in B-12 and folic acid deficiency, and the role of cyanocobalamin and folic acid in correcting the metabolic defect in DNA thymine and methionine synthesis. 3.0
5. Identify the molecular mechanism of action pharmacological effects of the drugs in each class on the hematopoietic system. 3.0
6. Describe the approved therapeutic indications and contraindications and pharmacokinetics for recombinant erythropoietin and the erythropoietin-like drug darbepoetin. 3.0
7. Identify the criteria used for the diagnosis of iron deficiency anemia and criteria for oral therapy versus parenteral iron therapy. 2.0
8. Explain the appropriate management of the patient with a megaloblastic anemia in regards to both acute and chronic management, route of administration, vitamin dosage, and expected response. 3.0
9. Compare the therapeutic applications for myeloid growth factors with those for thrombopoietic growth factors. 3.0

B. Anticoagulant Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. heparin 4.0
 - b. enoxaparin 4.0
 - c. protamine sulfate 4.0
 - d. vitamin k 2.0
 - e. bivalirudin 2.0
 - f. warfarin sodium (coumarin) 4.0
 - g. argatroban 2.0
 - h. rivaroxaban 4.0
2. Explain the importance of clotting factors and regulation of hemostasis. 3.0
3. Describe the pathogenesis of thrombosis. 4.0
4. Describe the molecular mechanism of action of each drug in each drug class. 4.0

- | | |
|---|-----|
| 5. Identify the sites of action of heparin and direct thrombin inhibitors in the coagulation process. | 4.0 |
| 6. Explain the relationship between the chemical structure of the oral anti-coagulants and vitamin K, and discuss its importance in determining the mechanism of action of the oral anticoagulants. | 4.0 |
| 7. Describe the mechanism of action and pharmacokinetics of the following antithrombin agents: heparin, low molecular weight heparin (eg, enoxaparin), bivalirudin. | 4.0 |
| 8. Explain the effects of heparin on lipolysis and its role as a growth factor. | 2.0 |
| 9. Describe the onset of action and duration of action of warfarin effect in relationship to half-life of clotting factors and their production in the human. | 4.0 |
| 10. Explain the role of Vitamin K for the synthesis of coagulation factors (II, VII, IX and X) and Proteins C and S. | 4.0 |
| 11. Identify the appropriate routes of administration of heparin and warfarin. | 4.0 |
| 12. Describe the mechanism of action and onset of action of heparin with that of the oral anticoagulants. | 4.0 |
| 13. Understand the monitoring of warfarin therapy using PT, INR and the indications for measuring warfarin levels. | 4.0 |
| 14. Understand how pharmacogenomics can be used to predict the dose of warfarin in individual patients. | 3.0 |
| 14. Describe the principal adverse effects and contraindications of the drugs in each class. | 4.0 |
| 15. Know the complications associated with heparin therapy (eg, excessive bleeding) and heparin-induced thrombocytopenia with associated thrombosis. | 4.0 |
| 16. Understand how protamine and vitamin K are used as antidotes to excessive bleeding caused by heparin and warfarin, respectively. | 4.0 |
| 17. Explain the adverse effects, contraindications and toxicities of warfarin, including embryo and fetal toxicities. | 4.0 |
| 18. Describe drug-drug, drug-food, and drug-disease interactions with warfarin. | 4.0 |
| 19. Contrast the use and monitoring of standard versus low-molecular-weight heparin preparations. | 4.0 |
| 20. Explain how antithrombin agents are used clinically for anticoagulation in patients with heparin-induced thrombocytopenia. | 4.0 |
| 21. Identify clinical uses and goals of warfarin therapy including its use in venous thromboembolic diseases, atrial fibrillation, myocardial infarction, and strokes. | 4.0 |
| 22. Discuss the approach to the management of the patient on short term and long term oral anticoagulation. | 4.0 |
| C. <u>Antiplatelet Drugs</u> | |
| 1. Discuss the following with regard to the objectives stated at the beginning of this section : | |
| a. aspirin (acetylsalicylic acid) | 4.0 |
| b. eptifibatide | 2.0 |
| c. tirofiban | 2.0 |
| d. clopidogrel | 4.0 |
| e. abciximab | 2.0 |
| f. ticlopidine | 2.0 |
| 2. Explain the role of platelet aggregation in the regulation of hemostasis. | 4.0 |
| 3. Describe the pathogenesis of thrombosis with respect to the platelet release reaction. | 4.0 |
| 4. Identify the molecular mechanism of action of each drug in each drug class. | 3.0 |
| 5. Understand how inhibition of prostaglandin synthesis affects platelet aggregation, specifically the role of COX-1 and COX-2. | 4.0 |

6. Compare and contrast the mechanism of action for aspirin, dipyridamole, ticlopidine, clopidogrel, and abciximab. 4.0
7. Identify the site of action of each drug in the platelet aggregation process. 3.0
8. Compare the effects and time course of aspirin with standard nonsteroidal anti-inflammatory agents (NSAIDs) and cyclooxygenase 2 (COX2) inhibitors on platelet function. 4.0
8. Identify the principal adverse effects and contraindications of the drugs in each class. 4.0
9. Identify and describe the drug-drug, drug-food, and drug-disease interactions of each drug. 4.0
10. Explain how concomitant use of NSAIDs can interfere with the antiplatelet actions of aspirin. 4.0
11. Explain management of the patient on short-term and long-term antiplatelet therapy. 2.0
12. Explain the role of the platelet glycoprotein IIb/ IIIa inhibitors in the management of coronary disease. 3.0
13. Compare the effects of aspirin, ibuprofen, and propranolol for primary post MI prophylaxis. 3.0

D. Fibrolytic/Antifibrolytic Drugs

1. Discuss the following with regard to the objectives at the beginning of this section:
 - a. urplomase 3.0
 - b. tissue plasminogen activator (alteplase) 4.0
 - c. aminocaproic acid 3.0
 - d. tenetelase 2.0
2. Explain the role of plasminogen in thrombolysis. 4.0
3. Explain the role of thrombolysis in the physiology of hemostasis. 4.0
4. Compare the molecular mechanism and site of action of alteplase to that of aminocaproic acid. 2.0
5. Explain the differences between streptokinase and alteplase in the activation of plasminogen. 3.0
6. Explain the degradation of clotting factors from streptokinase. 3.0
7. Compare the pharmacokinetic differences of alteplase and streptokinase. 2.0
8. Relate the major adverse effects of thrombolytic drugs to their mechanism of action. 3.0
9. Identify primary contraindications for thrombolytic drugs. 3.0
10. Identify the major indications for thrombolytic drug therapy. 4.0
11. Explain why aminocaproic acid (EACA) is used routinely along with desmopressin and factor replacement in dental procedures in patients with hemophilia and von Willebrand's disease and for non-dental bleeding episodes in both diseases. 2.0

XIII. Chemotherapy

A. Basic Principles of Antimicrobial Therapy

1. Define antibiotics, selective toxicity, therapeutic index, bacteriostatic, and bactericidal. 4.0
2. Identify MIC and MBC values. 3.0
3. Differentiate between synergism and antagonism. 3.0
4. Explain the modes of action of antimicrobial drugs. 4.0
5. Explain bacterial resistance and the mechanisms involved in acquiring bacterial resistance. 4.0
6. Understand the basic principles of combination therapy with antimicrobial drugs. 4.0

B. Cell Wall Synthesis Inhibitors

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. amoxicillin 4.0
 - b. ampicillin 4.0
 - c. clavulanic acid 4.0
 - d. cloxacillin 3.0
 - e. imipenem 4.0
 - f. meropenem 2.0
 - g. methicillin 3.0
 - h. nafcillin 2.0
 - i. oxacillin 2.0
 - j. penicillin g 4.0
 - k. penicillin u 4.0
 - l. piperacillin 4.0
 - m. sulbactam 3.0
 - n. tazobactam 3.0
 - o. ticarcillin 3.0
 - p. cefaclor 3.0
 - q. cefazolin 3.0
 - r. cefepime 3.0
 - s. cefotaxime 3.0
 - t. ceftaxime 3.0
 - u. ceftazidime 3.0
 - v. ceftazidime 3.0
 - w. ceftriaxone 4.0
 - x. cefuroxime 3.0
 - y. cephalixin 4.0
 - z. vancomycin 4.0
2. Discuss the structural relationship of the penicillin molecule to antimicrobial activity. 3.0
3. Identify the mechanism of action of β -lactam antibiotics. 4.0
4. Discuss the principle of combination of inhibitors of β -lactamase with penicillins. 4.0
5. Explain the pharmacological basis for combining imipenem with cilastatin. 3.0
6. Describe the structural differences between penicillins and cephalosporins. 3.0
7. Identify the mechanism of action of cephalosporins. 4.0
8. Identify the mechanism of action and clinical use of vancomycin. 4.0
9. Describe the pharmacokinetic properties of penicillins. 4.0
10. Discuss the repository penicillins. 4.0
11. Discuss the penicillinase-resistant penicillins. 4.0
12. Discuss the four generations of cephalosporins with respect to the differences in their antimicrobial spectrum and pharmacokinetic properties. 4.0
13. Discuss the pharmacokinetic properties of vancomycin with regard to IV and oral administration. 4.0
14. Discuss *superinfection* and *cross-hypersensitivity*. 4.0
15. Identify primary therapeutic indications for B-lactam antibiotics penicillin G and broad spectrum penicillins. 4.0
16. Describe the antimicrobial spectrum activity of monobactams and carbapenems. 4.0
17. Identify the main therapeutic indications of and vancomycin. 4.0

C. Protein Synthesis Inhibitors

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. amikacin 2.0
 - b. gentamicin 3.0
 - c. neomycin 4.0
 - d. streptomycin 2.0
 - e. tobramycin 2.0
 - f. clindamycin 4.0
 - g. azithromycin 4.0
 - h. clarithromycin 4.0
 - i. erythromycin 4.0
 - j. linezolid 4.0
 - k. quinupristin/dalfopristin 4.0
 - l. doxycycline 4.0
 - m. minocycline 3.0
 - n. tetracycline 4.0
 - o. chloramphenicol 4.0
2. Identify the mechanism of action of each class of protein synthesis inhibitors. 4.0
3. Identify the mechanism of acquired drug resistance. 4.0
4. Discuss the basis for combination therapy with an aminoglycoside and a penicillin, cephalosporin, or vancomycin. 4.0
5. Discuss the pharmacokinetic properties of each class of protein synthesis inhibitors. 4.0
6. Discuss the importance of peak and trough levels of aminoglycosides. 4.0
7. Discuss the need for and the method of dose adjustment for aminoglycosides in patients with compromised renal function. 4.0
8. Identify the main toxicities of each class of protein synthesis inhibitors. 4.0
9. Identify the major drug interactions of macrolides due to inhibition of cytochrome P450 enzymes. 4.0
10. Identify the primary therapeutic indications for each class of protein synthesis inhibitors. 4.0

D. Inhibitors of Nucleic Acid Metabolism and Drugs Interfering with Intermediary Metabolism

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. ciprofloxacin 4.0
 - b. levofloxacin 4.0
 - c. metronidazole 4.0
 - d. rifampin 4.0
 - e. trimethoprim-sulfamethoxazole (cotrimoxazole) 4.0
2. Identify the mechanism of action of the antibiotics that affect metabolism. 4.0
3. Explain the synergistic inhibition due to sequential blockade with cotrimoxazole. 3.0
4. Identify the adverse effects of ciprofloxacin, including contraindications in children and pregnant women. 4.0
5. Discuss the pharmacokinetic properties of each class of antibiotics. 3.0
6. Identify the major toxicities of each class of drugs. 4.0
7. Identify the therapeutic indications of each class of antimicrobial drugs that affect metabolism. 4.0
8. Discuss the advantages of newer fluoroquinolones over ciprofloxacin. 4.0

9. Identify the major therapeutic indications of sulfonamides alone, and in combination with trimethoprim (cotrimoxazole). **4.0**

E. Antimycobacterial Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. isoniazid **4.0**
 - b. rifampin **4.0**
 - c. pyrazinamide **4.0**
 - d. ethambutol **4.0**
 - e. streptomycin **4.0**
 - f. azithromycin **4.0**
 - g. clarithromycin **4.0**
 - h. rifabutin **4.0**
 - i. dapsons **4.0**
 - j. thalidomide **3.0**
2. Discuss the first line antitubercular drugs and understand their mechanisms of action. **4.0**
3. Discuss the various phases of active- and slow-growing *Mycobacterium tuberculosis* and compare the relative effectiveness of various drugs. **3.0**
4. Discuss the drugs used in the treatment of Hansen's disease and their mechanism of action. **3.0**
5. Identify the pharmacokinetic profile of isoniazid and rifampin. **3.0**
6. Identify the adverse effects of isoniazid, rifampin, ethambutol and pyrazinamide. **4.0**
7. Describe the drug interactions of rifampin with anticoagulants and other drugs, such as oral contraceptives. **4.0**
8. Describe the regimen recommended for preventive therapy and for conventional chemotherapy. **4.0**
9. Discuss the use of rifabutin, clarithromycin and azithromycin for treatment of *Mycobacterium avium* complex. **3.0**
10. Identify the drugs used for reversing the lepra reactions and the erythema nodosum leprosum reaction. **3.0**
11. Explain the WHO regimen for treatment of leprosy. **3.0**

F. Antiparasitic Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. albendazole **3.0**
 - b. atovaquone **3.0**
 - c. iodoquinol **3.0**
 - d. ivermectin **4.0**
 - e. metronidazole **4.0**
 - f. paromomycin **1.0**
 - g. pentamidine **2.0**
 - h. praziquantel **4.0**
 - i. pyrantel pamoate **4.0**
 - j. sulfadiazine **3.0**
 - k. tinidazole **3.0**

2. Identify the mechanism of action of mebendazole, praziquantel, pentamidine, and atovaquone. 4.0
3. Identify the drugs of choice and alternate drugs available for treatment of diseases due to various helminthes. 3.0
4. Discuss the broad spectrum antihelminthic drugs and their spectrum of activity. 3.0
5. Discuss the opportunistic infections commonly known to occur in AIDS patients and the drugs used for their treatment. 3.0
6. Identify the drugs of choice for treatment of asymptomatic, mild to moderate and severe intestinal disease and hepatic abscess due to *E. histolytica*. 3.0
7. Identify the drugs used for the treatment of protozoal diseases (giardiasis, trypanosomiasis, and leishmaniasis). 3.0
8. Identify the drugs used for toxoplasmosis, an opportunistic infection in AIDS patients. 3.0

G. Antimalarial Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. artemisinin analogs (artesunate and artemether) 2.0
 - b. atovaquone/proguanil 3.0
 - c. chloroquine 4.0
 - d. mefloquine 4.0
 - e. primaquine 4.0
 - f. pyrimethamine 3.0
 - g. quinine 4.0
 - h. sulfadoxine 2.0
2. Describe the various locations in the life cycle of malarial parasites where the antimalarial drugs are effective. 3.0
3. Identify the mechanisms of action of chloroquine, primaquine and pyrimethamine. 4.0
4. Identify the mechanism of resistance to chloroquine. 4.0
5. Identify the mechanism of action of artemisinin derivatives. 4.0
6. Discuss the pharmacokinetic properties of chloroquine. 4.0
7. Discuss the pharmacokinetic properties of artesunate and artemether. 2.0
8. Identify the mechanism of hemolytic anemia induced by primaquine in African-American males. 3.0
9. Discuss cinchonism. 4.0
10. Identify the toxic effects of chloroquine. 4.0
11. Identify the drugs of choice for treatment of uncomplicated illness and severe illness due to *P. vivax*, *P. ovale*, *P. malariae* and *P. falciparum*. 3.0
12. Describe the regimen for prophylaxis for chloroquine-sensitive and chloroquine-resistant areas. 3.0
13. Discuss the drug combination in Fansidar and its therapeutic use. 3.0
14. Identify the therapeutic indications for artemisinin derivatives. 3.0

H. Antifungal Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. amphotericin b 4.0
 - b. caspofungin 4.0
 - c. itraconazole 4.0
 - d. efinaconazole 4.0
 - e. fluconazole, ketoconazole, variconazole 4.0
 - f. terbinafine 4.0

- | | |
|---|-----|
| g. griseofulvin | 4.0 |
| h. ciclopirox | 4.0 |
| i. clotrimazole, miconazole | 4.0 |
| 2. Classify antiviral drugs based upon their site of inhibition in the viral replication cycle. | 3.0 |
| 3. Identify the mechanism of action of each antiviral drug. | 4.0 |
| 4. Discuss the pharmacokinetic properties of acyclovir and ganciclovir. | 3.0 |
| 5. Identify adverse side effects and potential drug interactions. | 4.0 |
| 6. Identify the major therapeutic indications for each antiviral drug. | 4.0 |

I. Antiviral Drugs

- | | |
|---|-----|
| 1. Discuss the following with regard to the objectives stated at the beginning of this section: | |
| a. oseltamivir | 4.0 |
| b. zanamivir | 2.0 |
| c. ribavirin | 3.0 |
| d. acyclovir | 4.0 |
| e. valacyclovir | 4.0 |
| f. famciclovir | 3.0 |
| g. docosanol | 3.0 |
| h. ganciclovir | 4.0 |
| i. valganciclovir | 4.0 |
| j. foscarnet | 4.0 |
| k. interferon-alfa2b | 4.0 |
| l. sofosbuvir/ ledipasvir | 4.0 |
| m. dasabuvir; ombitasvir; paritaprevir; ritonavir | 2.0 |
| n. adefovir | 2.0 |
| o. entacavir | 3.0 |
| p. telbivudine | 3.0 |
| 2. Know the drugs used for treatment of influenza and their side effects. | 4.0 |
| 3. Know the uses and toxicities of ribavirin | 3.0 |

J. Antiretroviral Drugs

- | | |
|---|-----|
| 1. Discuss the following with regard to the objectives stated at the beginning of this section: | |
| a. lamivudine | 4.0 |
| b. emtricitabine | 4.0 |
| c. abacavir | 4.0 |
| d. zidovudine | 4.0 |
| e. tenofovir | 4.0 |
| f. didanosine | 2.0 |
| g. efavirenz | 3.0 |
| h. nevirapine | 3.0 |
| i. atazanavir | 4.0 |
| j. darunavir | 4.0 |
| k. saquinavir | 3.0 |
| l. ritonavir | 3.0 |
| m. lopinavir/ritonavir | 2.0 |
| n. indinavir | 2.0 |

- o. nelfinavir 4.0
 - p. amprenavir 2.0
 - q. tipranavir 2.0
 - r. enfuvirtide 3.0
 - s. maraviroc 3.0
2. Classify anti-HIV drugs based upon their site of inhibition in the viral replication cycle. 4.0
 3. Discuss the use of combinations of different class of anti-HIV drugs. 4.0
 4. Describe the pharmacokinetic properties and drug interactions of protease inhibitors. 4.0
 5. Identify the major side effects of each class of anti-HIV drugs. 4.0

K. Basic Principles of Cancer Chemotherapy

1. Explain the role of chemotherapy in the management of patients with cancer. 4.0
2. Discuss the prospects for "cure", or long term survival in cases of advanced cancer. 4.0
3. Discuss the limitations to effective drug treatment. 4.0
4. Define selective toxicity, mass doubling time, and growth fraction. 4.0
5. Explain the concept of "total cell kill" in cancer patients. 3.0
6. Define *cell cycle specificity* and classify anticancer drugs based on the cell cycle specificity. 3.0
7. Discuss the principles of combination chemotherapy in the treatment of cancer. 4.0
8. Identify the mechanisms of resistance to anticancer drugs. 4.0

XIII. Anticancer Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. cyclophosphamide 4.0
 - b. ifosfamide 4.0
 - c. mechlorethamine 4.0
 - d. carmustine, lomustine 4.0
 - e. Actinomycin D 4.0
 - f. bleomycin 4.0
 - g. irinotecan, topotecan 3.0
 - h. daunorubicin 4.0
 - i. doxorubicin 4.0
 - j. paclitaxel 4.0
 - k. docetaxel 3.0
 - l. etoposide (vp-16) 3.0
 - m. vinblastine 4.0
 - n. vincristine 4.0
 - o. cetuximab 4.0
 - p. rituximab 3.0
 - q. trastuzumab 4.0
 - r. cytarabine 3.0
 - s. 5-fluorouracil 4.0
 - t. gemcitabine 4.0
 - u. 6-mercaptopurine 4.0
 - v. methotrexate 4.0
 - w. erlotinib 4.0
 - x. gefitinib 4.0

y. imatinib	4.0
z. tamoxifen	4.0
aa. flutamide	4.0
bb. leuprolide	3.0
cc. goserelin	3.0
dd. anastrozole	4.0
ee. prednisone	4.0
ff. cisplatin, carboplatin	4.0
gg. hydroxyurea	3.0
2. Identify the mechanism of action of various individual anticancer drugs in each class.	4.0
3. Discuss the bioactivation pathways required for the action of cyclophosphamide.	2.0
4. Discuss the intracellular activation pathways of different antimetabolites.	2.0
5. Describe the use of leucovorin rescue in high dose methotrexate therapy.	4.0
6. Identify the common toxicities of each class of anticancer drugs.	3.0
7. Identify the specific major toxicity of individual anticancer drugs.	3.0
8. Identify the cumulative dose-dependent toxicity of anthracyclines.	3.0
9. Identify the major therapeutic indications of various anticancer drugs.	2.0
10. Discuss the drug combinations that have shown activity against specific types of cancer.	2.0
11. Explain adjuvant chemotherapy and describe various regimens used in the treatment of cancer of different organ systems.	2.0

XIV. Immunosuppressive Drugs

1. Discuss the following with regard to the objectives stated at the beginning of this section:	
a. azathioprine	4.0
b. cyclophosphamide	2.0
c. daclizumab, basilixumab	3.0
d. etanercept	4.0
e. infliximab	4.0
f. Interferons (alpha, beta, and gamma)	4.0
g. methotrexate	4.0
h. muromonab-cd3	2.0
i. mycophenolate mofetil	4.0
j. prednisone	4.0
k. Rho(d) immune globulin	2.0
l. sirolimus (rapamycin)	4.0
m. tacrolimus	4.0
n. cyclosporine	4.0
o. thalidomide	2.0
p. bevacizumab, ranizumab	3.0
q. erythropoietin	4.0
r. granulocyte colony stimulating factor	4.0
s. Glatiramer	2.0
2. Discuss the general principles of immunosuppression and immunostimulation.	4.0
3. Identify the mechanism of action of immunosuppressants and immunostimulants.	4.0
4. Identify the toxicities of antibodies and other agents used as immunosuppressants.	4.0
5. Identify and describe the types of allergic reactions to drugs.	4.0
6. Explain the clinical uses of immunosuppressants.	4.0

XIV. Toxicology and Therapy of Intoxication: Drugs Used as Antidotes

- A. Discuss the following with regard to the objectives stated at the beginning of this section:
- i. n-Acetylcysteine 4.0
 - ii. Air pollutants 2.0
 - iii. Alcohols (ethanol, methanol, ethylene glycol) 4.0
 - iv. Carbon monoxide 3.0
 - v. cyanide 1.0
 - vi. naloxone 3.0
 - vii. iron 4.0
 - viii. chelators 2.0
 - ix. mercury 1.0
 - x. Pesticides (organophosphates and carbamates)/atropine/2-pam 3.0
 - xi. activated charcoal 4.0
 - xii. flumazenil 4.0
 - xiii. methylene blue 2.0
 - xiv. sodium bicarbonate 4.0
 - xv. sodium thiosulfate 1.0
- B. Explain how toxicants are influenced by pharmacokinetic and pharmacodynamic processes such as absorption, distribution, biotransformation, excretion and cellular targets. 2.0
- 1. Explain the principles of bioactivation of chemicals to toxic species. 1.0
 - 2. Identify cellular defense mechanisms. 1.0
 - 3. Explain the concept of threshold levels for toxicity. 1.0
 - 4. Describe measures for determining drug safety and therapeutic ratio. 2.0
 - 5. List the signs and symptoms of toxic exposure to common toxins and toxic drugs. 3.0
 - 6. Explain how exposure to the primary and secondary toxicants can occur, and identify the mechanisms of toxicity. 2.0
 - 7. Compare the toxicity induced by various metals. 2.0
 - 8. Compare the toxicity induced by the neurotoxic pesticides. 2.0
 - 9. Recall the antidote and/or treatment for each toxicant, and explain how to manage acute intoxication. 3.0
 - 10. Differentiate between mutagenicity and carcinogenicity. 1.0

XVI. Herbal Medicine

- A. Discuss the following with regard to the objectives t stated in this section:
- a. ginkgo 2.0
 - b. echinachea 3.0
 - c. glucosamine chondroitin 4.0
 - d. saw palmetto 5.0
 - e. guarana 6.0
 - f. valerian 7.0
 - h. ginseng 1.0
 - i. kava 2.0
 - j. St. John's Wort 4.0
 - k. chamomile 1.0
 - l. milk thistle 1.0
 - m. yohimbe 2.0

1. Explain the mechanisms through which herbal products exert their pharmacological effects. **3.0**
2. Discuss the concept that while there is evidence towards effectiveness for some herbal products, many have shown to have no beneficial effect. **3.0**
3. Identify and discuss the serious drug interactions that occur between herbal products and prescription medicines. **4.0**
4. Identify serious side effects of herbal products and those that should be avoided during pregnancy. **4.0**
5. Discuss the lack of FDA regulation of herbals and what that means regarding safety, efficacy, and content. **4.0**

XVII. Vitamins

1. Discuss the following with regard to the objectives stated at the beginning of this section:
 - a. Vitamins A, D, E, K **3.0**
 - b. Vitamin C, nicotinamide, cyanocobalamin, pyridoxine **3.0**
 - c. Nicotinic acid, folic acid **3.0**
2. Identify populations that have the highest risk of vitamin deficiency. **3.0**
3. Explain the mechanism of action of the water-soluble and lipid-soluble vitamins. **3.0**
4. Describe effects of the deficiency of each of these water and lipid-soluble vitamin types as they relate to disease processes. **3.0**
5. Explain the principal adverse effects and toxicities for overdose and toxic levels of both water-soluble and lipid-soluble vitamins. **3.0**
6. Describe the therapeutic uses of the fat-soluble vitamins, including that of isotretinoin. **2.0**
7. Describe the use of thiamine in the emergency treatment of alcoholism. **3.0**

PHYSIOLOGY LEARNING OBJECTIVES

Cardiovascular

Cell and Membrane

Endocrine Physiology

Gastrointestinal Physiology

Integration and Exercise Physiology

Muscle Physiology

Neurophysiology

Pulmonary Physiology

Renal Physiology

I. Cardiovascular (CARDIAC)

A. Characteristics of Cardiac Muscle

1. Compare and contrast the duration of the action potential and the refractory period in a cardiac muscle, a skeletal muscle, and a neuron. 4.0
2. Describe the temporal relationship between an action potential in a cardiac muscle cell and the resulting contraction (twitch) and explain why cardiac muscle cannot remain in a state of sustained (tetanic) contraction. 4.0
3. Outline the steps in excitation-contraction coupling in cardiac muscle. 4.0
4. Explain the role of Ca^{2+} (including extracellular Ca^{2+}) in the control of contraction and relaxation of cardiac muscle. 4.0
5. Compare and contrast cardiac and skeletal muscle in terms of cell size, electrical connections between cells, and arrangement of myofilaments. 4.0
6. Describe role of gap junctions in creating a functional syncytium, based upon ion permeability and electrical resistance. 4.0
7. Explain how intracellular calcium concentration modulates the strength of cardiac muscle contraction. 4.0
8. Describe and interpret the length tension relationship in a single cardiac cell. 4.0

B. Electrophysiology of the Heart

1. Describe and interpret a typical action potential in a contractile muscle and a pacemaker cell, identifying both the voltage and time axes. 4.0
2. Explain what controls the shapes of the action potentials of different cardiac cells. 4.0
3. Describe the ionic currents that contribute to each phase of cardiac action potentials and the ion channels involved. 4.0
4. Explain how differences in channel population influence the shape of the action potential in the nodal, atrial muscle, ventricular muscle, and Purkinje fiber cardiac cells. 4.0
5. Explain the basis for the long duration of the cardiac action potential, the resultant long refractory period, and their importance. 4.0
6. Describe the normal sequence of cardiac electrical activation. 4.0
7. Explain the role played by excitatory and conducting cells and predict the consequence of a failure to conduct the impulse through any of these areas. 4.0
8. Explain why the AV node is the only normal electrical pathway between the atria and the ventricles. 4.0
9. Explain the functional significance of the slow conduction through the AV node including intrinsic factors that influence conduction velocity through the AV node. 4.0
10. Explain the ionic mechanisms of pacemaker automaticity and rhythmicity. 4.0
11. Identify cardiac cells that have pacemaker potential and their spontaneous rate and humoral factors that influence their rate. 4.0
12. Describe the significance of "overdrive suppression" and "ectopic pacemaker," including the conditions necessary for each to occur. 3.0
13. Compare and contrast the sympathetic and parasympathetic nervous system influence on heart rate and cardiac excitation, and the underlying ionic mechanisms. 4.0
14. Explain how cell injury, resulting in a less negative resting potential, alters ionic events in depolarization and repolarization. 3.0
15. Define *decremental conduction*, *re-entry*, and *circus movement*. 2.0

C. Cardiac Function

1. Correlate the cellular characteristics of length, tension, and velocity of shortening with the intact ventricle characteristics of end diastolic volume, pressure, and dP/dt . 4.0
2. Define *preload*, *afterload*, *contractility*, and *compliance*. 4.0
3. Explain why ventricular end-diastolic pressure, atrial pressure, and venous pressure all provide estimates of ventricular preload, as well as why ventricular end-diastolic pressure provides the most reliable estimate. 4.0
4. Explain the role of Starling's Law of the Heart in keeping the output of the left and right ventricles equal. 4.0
5. Differentiate between the way changes in preload and changes in contractility influence ventricular force development. 4.0
6. Compare the energetic consequences of changes in either pre-load or contractility force modulation. 4.0
7. Explain how arterial pressure influences afterload. 4.0
8. Explain why dP/dt is a useful index of contractility and explain how the calcium transient influences cardiac contractility and differs from events in skeletal muscle. 3.0
9. Differentiate between cardiac performance and cardiac contractility. 3.0
10. Describe the impact of changes in preload, afterload, contractility, and compliance in determining cardiac performance. 3.0
11. Explain how changes in sympathetic activity alter ventricular work, cardiac metabolism, oxygen consumption, and cardiac output. 3.0
12. Explain how the Law of LaPlace applies to ventricular function in the normal and volume overloaded (failing) ventricle. 2.0
13. Relate the ventricular pressure-volume loop to the phases and events of the cardiac cycle (ECG, valve movement). 3.0
14. Differentiate between stroke volume and stroke work, identifying both on a pressure-volume loop. 3.0
15. Define *ejection fraction* and calculate it from end diastolic volume and stroke volume, and predict the change in ejection fraction that would result from a change in preload, afterload, contractility, and compliance. 3.0
16. Describe the changes in pressure-volume loops that would result from changes in afterload, preload, or contractility, for one cycle and the achieved new steady state. 3.0
17. Explain how diastolic filling time can be altered by the autonomic nervous system. 3.0

D. Cardiac Cycle

1. Describe the basic functional anatomy of the atrioventricular and semilunar valves, and explain how they operate. 2.0
2. Draw the pressure, volume, heart sound, and ECG changes in the cardiac cycle in correct temporal relationship (Wiggers diagram). 4.0
3. Identify the intervals of isovolumic contraction, rapid ejection, reduced ejection, isovolumic relaxation, rapid ventricle filling, reduced ventricular filling, and atrial contraction. 4.0
4. Identify the phases of ventricular systole and ventricular diastole. 4.0
5. Describe the relationship between pressure and flow into and out of the left and right ventricles during each phase of the cardiac cycle. 4.0
6. Compare and contrast differences in cardiac function between the left and right sides of the heart. 2.0

E. Physiology of Cardiac Defects and Heart Sounds

1. Define laminar and turbulent flows and describe the factors that contribute to turbulence. **3.0**
2. Describe the timing and causes of the four heart sounds. **4.0**
3. Describe the expected auscultation sounds that define mitral stenosis, mitral insufficiency, aortic stenosis, and aortic insufficiency, ventricular septal defects, patent ductus arteriosus. **2.0**
4. Explain how these pathologic changes described in #3 above would affect cardiac performance and blood pressure. **3.0**

F. The Normal and Abnormal Electrocardiogram (ECG)

1. Describe the electrode conventions used to standardize ECG measurements. **3.0**
2. Identify the electrode placements and polarities for the 12 leads of a 12-lead electrocardiogram and the standard values for pen amplitude and paper speed calibration on a diagram. **3.0**
3. Define *dipole and vector*, and describe how dipoles generated by the heart produce the waveforms of the ECG. **2.0**
4. Identify the components of a typical bipolar (Lead II) ECG tracing and explain the relationship between each of the waves, intervals, and segments in relation to the electrical state of the heart. **4.0**
5. Calculate heart rate from an ECG tracing. **4.0**
6. Explain why the ECG tracing looks different in each of the 12 leads. **3.0**
7. Identify mean electrical vector (axis) of the heart, give the normal range, and determine the mean electrical axis from knowledge of the magnitude of the QRS complex in the standard limb leads. **3.0**
8. Describe the alteration in conduction responsible for tachycardia, bradycardia, AV block, Wolff-Parkinson-White (WPW) syndrome, bundle branch block, flutter, and fibrillation. **3.0**
9. Describe electrocardiographic changes associated respectively with myocardial ischemia, injury, and death. **3.0**
10. Define *injury current* and describe how it alters the height of S-T segment of ECG. **3.0**

G. Cardiac Output and Venous Return

1. Explain how cardiac function (output) curves are generated and how factors that cause changes in contractility can alter the shape of cardiac function curves. **3.0**
2. Describe the principles underlying cardiac output measurements using the Fick, dye dilution, and thermodilution methods. **2.0**
3. Describe the concept of "mean systemic filling pressure," its normal value, and how various factors can alter its value. **3.0**
4. Define *venous return*. **4.0**
5. Describe the concept of "central venous pressure" and factors affecting it. **4.0**
6. Describe the skeletal muscle pump and the thoracic (respiratory) pump. **4.0**
7. Explain how exercise affects venous return from the foot and leg. **4.0**
8. Describe the changes in blood volume and pressure when a person moves from a supine to a standing position. **4.0**
9. Interpret a vascular function (venous return) curve and predict how changes in total peripheral resistance, blood volume, and venous compliance influence this curve. **3.0**
10. Explain how the intersection point of the cardiac function and vascular function (venous return) curves represent the steady-state cardiac output and central venous pressure under the conditions represented in the graph. **3.0**

11. Use the intersection point of the cardiac function curve and vascular function (venous return) curve to predict how interventions such as hemorrhage, heart failure, autonomic stimulation, and exercise will affect cardiac output and right atrial pressure, and predict how physiological compensatory changes would alter acute changes. **3.0**

H. Cardiovascular Fluid Dynamics

1. Explain how Bernoulli's principle predicts a slight collapse tendency of blood vessel tubes at high velocity. **2.0**
2. Describe and differentiate between flow and velocity. **4.0**
3. Describe the relationship between pressure, flow, and resistance in the vasculature, calculate for one variable, if the other two are known; connect this relationship to the arteries, arterioles, capillaries, venules, and veins; and explain how blood flow to any organ is altered by changes in resistance to that organ. **4.0**
4. Describe the factors that influence resistance to flow and the relationships among them, using Poiseuille's Law. **3.0**
5. Describe the relationship between flow, velocity, and cross-sectional area. **3.0**
6. Describe the influence vascular compliance has on flow, velocity, and cross-sectional area. **3.0**
7. Explain critical closing behavior in blood vessels. **3.0**
8. Define *resistance* and *conductance*. **4.0**
9. Describe the effects of adding resistance in series versus in parallel on total resistance and flow. **2.0**
10. Relate the effects of redistribution of flow from the aorta to the tissues during exercise. **3.0**
11. Identify and describe the factors that shift laminar flow to turbulent flow (using Reynolds number) and the relationship between velocity, diameter, density, viscosity, and audible events, such as murmurs and bruits. **3.0**
12. Describe the principles of flow through collapsible tubes. **2.0**
13. Explain how hemodynamics in blood vessels, especially microcirculation, deviates from theory due to anomalous viscosity and distensibility. **2.0**

I. Arterial Pressure and the Circulation

1. Describe the organization of the circulatory system and explain how the systemic and pulmonary circulations are linked physically and physiologically. **4.0**
2. Explain the components of a blood pressure waveform. **4.0**
3. Describe the estimation of blood pressure with a sphygmomanometer. Explain how it provides estimates of systolic and diastolic pressures. **4.0**
4. Calculate the pulse pressure and estimate the mean arterial pressure given systolic and diastolic blood pressures. **4.0**
5. Explain how arteries function as pressure reservoirs and aid blood flow to tissues after arteries are stretched in systole. **3.0**
6. Describe how arterial systolic, diastolic, mean, and pulse pressure are affected by changes in stroke volume, heart rate, arterial compliance and total peripheral resistance. **4.0**
7. Explain why systolic arterial pressure, but not mean arterial pressure, is higher in leg arteries than in the aorta. **4.0**
8. Predict the ratio of ankle-to-arm systolic arterial pressures in a healthy person. **4.0**
9. Compare and contrast pressures, oxygen saturations, velocity of blood flow and cross-sectional area, and volume in the arteries, arterioles, capillaries, venules, and veins of both the systemic and pulmonary circulations. **3.0**
10. Describe the effects of norepinephrine, angiotensin II, and vasopressin on vascular smooth muscle contraction and Total Peripheral Resistance. **2.0**

11. Describe the effects of nitric oxide, bradykinin, prostaglandins, and histamine on vascular tone.	2.0
J. <u>The Microcirculation and Lymphatics</u>	
1. Explain how water and solutes traverse the capillary wall.	3.0
2. Identify the factors that affect the diffusion-mediated delivery of nutrients from the capillaries to the tissues [Fick's equation].	3.0
3. Define and give examples of <i>diffusion-limited</i> and <i>perfusion-limited exchange</i> .	3.0
4. Describe how each component of the <i>Starling equation</i> influences fluid movement across the endothelium.	4.0
5. Explain the involvement of endothelial cells in the regulation of vascular diameter and inflammatory responses.	3.0
6. Explain how altering pressure or resistance in pre- and post-capillary regions alters capillary pressure, and discuss the consequence of this change on transmural fluid movement.	3.0
7. Explain why fluid does not usually accumulate in the interstitium of the lungs, using the components of the Starling equation.	3.0
8. Explain how histamine alters the permeability of the post-capillary venules, as well as how the loss of albumin into the interstitial space promotes localized edema.	3.0
9. Identify critical functions of the lymphatic system in fat absorption, interstitial fluid reabsorption, and clearance of large proteins from the interstitial spaces.	4.0
10. Describe and interpret the relationship between interstitial pressure and lymph flow, and explain why edema does not normally develop as interstitial pressure increases.	3.0
11. Explain how edema develops in response to venous obstruction, lymphatic obstruction, increased capillary permeability, heart failure, tissue injury or allergic reaction, and malnutrition.	4.0
K. <u>Regulation of Arterial Pressure</u>	
1. Describe the functional components of the baroreceptor reflex.	3.0
2. Describe the sequence of events in the baroreceptor reflex that occurs after an acute increase or decrease in arterial blood pressure, including receptor response, afferent nerve activity, CNS integration, efferent nerve activity to the SA node, ventricles, arterioles, venules, and hypothalamus.	4.0
3. Describe the sequence of events mediated by the cardiopulmonary (volume) reflex that occurs after an acute increase or decrease in arterial blood pressure and central venous pressure including receptor response, afferent nerve activity, CNS integration, efferent nerve activity to the heart, kidney, hypothalamus, and vasculature.	4.0
4. Compare and contrast the sympathetic and parasympathetic nervous system control of heart rate, contractility, total peripheral resistance, and venous capacitance.	4.0
5. Predict the cardiovascular consequence of altering sympathetic nerve activity and parasympathetic nerve activity.	4.0
6. Compare and contrast the relative contribution of short- and long-term mechanisms in blood pressure and blood volume regulation.	4.0
7. Describe the cardiovascular reflexes initiated by decreases in blood O ₂ and increases in blood CO ₂ and H ⁺	4.0
8. Identify the stimuli for the release and cardiovascular actions of angiotensin II, atrial and brain natriuretic peptides, bradykinin, and nitric oxide.	3.0

L. Local Control of Blood Flow

1. Explain autoregulation of blood flow to the brain, and distinguish between short-term and long-term autoregulatory responses and the mechanisms responsible for each. **4.0**
2. Explain how the theory of metabolic regulation of blood flow accounts for active hyperemia and reactive hyperemia. **4.0**
3. Identify the role of P_{O_2} , P_{CO_2} , pH, adenosine, K^+ and micronutrients in the metabolic control of blood flow to specific tissues. **4.0**
4. Describe the synthetic pathway (including its substrate) for nitric oxide, and the interplay between endothelium and vascular smooth muscle. **3.0**
5. Describe the interaction of intrinsic (local), neural, and humoral control mechanisms, and contrast their relative dominance in the CNS, coronary, splanchnic, renal, cutaneous, and skeletal muscle vascular beds. **4.0**
6. Describe the role of angiogenesis in providing a long-term match of tissue blood flow and metabolic need. **4.0**

M. Hemorrhage and Shock

1. Distinguish between mild and severe shock. **3.0**
2. Describe the direct cardiovascular consequences of the loss of 30% of the circulating blood volume on cardiac output, central venous pressure, and arterial pressure, and describe the compensatory mechanisms activated by these changes. **3.0**
3. Identify positive feedback mechanisms activated during severe hemorrhage that may lead to circulatory collapse and death. **3.0**

N. Coronary and Skeletal Muscle Circulations

1. Describe how most flow of blood to the ventricular myocardium occurs during diastole. **3.0**
2. Identify the area of the ventricle most susceptible to ischemic damage and explain why the risk is increased at high heart rates. **3.0**
3. Explain how arteriovenous O_2 difference and oxygen extraction in the heart is unique when compared with other body organs. **2.0**
4. Explain the mechanism whereby coronary blood flow is coupled to myocardial workload, and identify stimuli that cause increases in coronary blood flow to occur. **3.0**
5. Explain how sympathetic stimulation alters heart rate, contractility and coronary vascular resistance, and directly and indirectly changes coronary blood flow. **3.0**
6. Describe what is meant by coronary vascular reserve and the role of collateral blood vessels and describe the physiological and pathological events that decrease coronary vascular reserve. **2.0**
7. Compare and contrast the neural and local control of skeletal muscle blood flow at rest and during exercise. **3.0**
8. Compare and contrast the effect of phasic and sustained skeletal muscle contraction on extravascular compression of blood vessels and on central venous pressure. **3.0**

O. Cerebral, Splanchnic, and Cutaneous Circulation

1. Compare and contrast the local and neural control of cerebral blood flow, and describe the relative importance of O_2 , CO_2 , and pH in regulating cerebral blood flow. **3.0**
2. Compare and contrast the local and neural control of the splanchnic circulation. **2.0**
3. Compare and contrast local and neural control of cutaneous blood flow. **3.0**

II. Cell Membranes and Bioelectricity

A. Body Fluid Compartments

1. Estimate the total body water, lean body mass, extracellular fluid volume, interstitial fluid volume, intracellular fluid volume, blood volume, and plasma volume, given the body weight and percentage of body fat in an individual. 4.0
2. Compare and contrast the movement between intracellular and extracellular compartments, including the interstitial compartment, caused by changes in extracellular fluid osmolality. 4.0
3. Given the composition and osmolality of a fluid, identify it as hypertonic, isotonic, or hypotonic and predict the change in transcellular fluid exchange that occurs when a cell is placed in solutions with varying tonicities. 4.0
4. Identify major routes and normal ranges for water intake and loss, and predict how these changes affect the distribution of total body water. 4.0
5. Describe and use the indicator dilution principle to measure plasma volume, blood volume, extracellular fluid volume, and total body water; and identify compounds used to measure each volume. 2.0

B. Solutes and Solutions

1. Describe the three-dimensional composition of a cell membrane, and explain how the distribution of phospholipids and proteins influences the membrane permeability of ions, hydrophilic, and hydrophobic compounds. 2.0
2. Define *reflection coefficient*, and explain how the relative permeability of a cell to water and solutes will generate an osmotic pressure. 3.0
3. Compare the effects of changes in concentration of an osmotically active solute with one that is osmotically inactive on the generation of osmotic pressure. 3.0
4. Identify the typical value and normal range for extracellular and interstitial fluid (plasma) concentrations of Na^+ , K^+ , H^+ (pH), HCO_3^- , Cl^- , Ca^{2+} , glucose, proteins, creatinine, and urea, and their relative intracellular values. 3.0
5. Differentiate between osmole, osmolarity, osmolality and tonicity. 3.0
6. Identify the typical values and normal range for plasma and cellular osmolality and explain why they should be similar. 3.0
7. Predict the general change in extracellular volume, extracellular osmolality, intracellular volume, and intracellular osmolality caused by infusion of three liters of 0.9% NaCl, 0.45% NaCl, and 7.5% NaCl. 3.0

C. Transport systems

1. Differentiate between diffusion, facilitated diffusion, secondary active transport, primary active transport, symport (co-transport), antiport (exchange) and uniport. 3.0
2. Explain how the presence of specific membrane transport proteins (carriers and channels) facilitate the movement of hydrophilic solutes across a membrane. 3.0
3. Explain how energy from ATP hydrolysis is used to transport ions such as Na^+ , K^+ , Ca^{2+} , and H^+ against their electrochemical gradients. 3.0
4. Explain the role of ATP-binding cassette transporters in movement across membranes, as well as their role in multi-drug resistance and its significance for cancer chemotherapy. 1.0
5. Explain how energy from the Na^+ and K^+ electrochemical gradients across the plasma membrane can be used to drive the net “uphill” (against a gradient) movement of other solutes (e.g., Na^+ /glucose co-transport; Na^+ / Ca^{2+} counter-transport). 3.0

6. Explain the role of water channels (aquaporins) in facilitating the movement of water across biological membranes. 3.0
7. Explain in which cell types, and why, you would expect a high level of aquaporin water channels expression. 3.0
8. Describe how larger solutes can cross membranes using endo- or exocytosis 3.0

D. Electrochemical Equilibria

1. Define electrochemical equilibrium and describe the similarities and differences seen when non-electrolytes, ions, fluids and gases are at equilibrium 1.0
2. Define *Donnan equilibrium* and describe resulting characteristics. 1.0
3. Use Fick's law of diffusion to predict how changes in a type of solute, concentration (or pressure) gradient, surface area, and distance will affect the rate of diffusion for a given substance. 4.0
4. Explain how an electrical potential difference across a membrane will affect the driving force of charged solutes across that membrane. 3.0
5. Define *steady state* and differentiate it from equilibrium. 3.0
6. Explain how the pump-leak model maintains steady-state ion contents, and its role in maintaining cell solute gradients and cell volume. 3.0
7. Explain the Nernst equation and describe how it uses ionic concentrations to predict the voltage that stops net ion flow when a given ionic species is at equilibrium 3.0
8. Compare the equilibrium (Nernst) potentials for Na^+ , K^+ , Ca^{2+} and Cl^- . Given the equilibrium potential for an ion, be able to predict its direction of flux across a membrane. 3.0
9. Calculate an equilibrium potential for an ion using the Nernst equation. 3.0
10. Explain how a membrane potential is generated and why/when it would change. 3.0
11. Describe the relative permeabilities for K^+ , Na^+ and Cl^- in a typical excitable cell. 3.0
12. Predict how the membrane potential would change in response to changes in either permeability or ionic concentrations. 3.0
13. Explain why changes in extracellular K^+ have a greater effect on membrane potential than changes in extracellular Na^+ . 3.0

E. Excitable Cells

1. Define *gating*, *activation*, and *inactivation*. 3.0
2. Describe the cell properties that determine the rate of electrotonic conduction. 2.0
3. Differentiate between the properties of electrotonic conduction, conduction of an action potential, and saltatory conduction, and identify regions of a neuron where each type of electrical activity may be found. 3.0
4. Compare and contrast the transfer of information between a pre-synaptic cell and a post-synaptic cell using a chemical synapse vs an electrical synapse. 3.0
5. Describe and differentiate temporal summation and spatial summation for the chemical synapse. 3.0
6. Describe the principle of the voltage clamp and how it is used to identify the ionic selectivity of channels. 1.0
7. Compare and contrast the gating of ion-selective channels by extracellular ligands, intracellular ligands, stretch, and voltage. 2.0
8. Describe the properties of voltage-gated Na^+ , K^+ , and Ca^{2+} channels, and explain how voltage influences their gating, activation, and inactivation. 3.0
9. Describe the ionic basis of the action potentials for the various types of excitable cells and distinguish the type of cell by the characteristic shape of its action potential. 4.0

F. Cell Volume Regulation, Intracellular pH, and Organelles

1. Explain how cells utilize transport mechanisms for various ions, e.g. Na⁺, K⁺, Cl⁻, and other solutes to regulate cell volume. **3.0**
2. Explain how various transporters (e.g., Na⁺/H⁺ exchange, Cl/HCO₃ exchange, Na⁺HCO₃ co-transport, etc.) contribute to the control of intracellular pH. **2.0**
3. Describe the role of endoplasmic reticulum and mitochondria in the regulation of intracellular Ca²⁺ dynamics. **3.0**
4. Explain how cell molecular motors interact with cytoskeletal elements to generate force, to transport organelles and other cargo, and induce cellular movement. **1.0**

G. Epithelial Cell

1. Compare and contrast paracellular versus transcellular transport. **3.0**
2. Describe the cellular mechanisms for transepithelial transport (absorption and secretion) of various types of ions and organic solutes **4.0**
3. Describe the role of the “tight” junctions in leaky and tight epithelia. **2.0**
4. Describe the functional significance of polarized distribution of various transport proteins to the apical or the basolateral cell membrane. **2.0**
5. Describe solute-solvent coupling in transport. **2.0**

III. Endocrine Physiology

A. General Principles

1. Describe the principle of negative feedback control of hormone secretion, and describe an example. **4.0**
2. Describe the principles of positive feedback and feed forward control of hormone secretion, and describe an example of each. **4.0**
3. Identify the bases of hormone measurements. **1.0**
4. Compare and contrast endocrine, paracrine, and autocrine based on the site of hormone release and the pathway to the target tissue, and describe an example of each. **3.0**
5. Describe major differences in mechanisms of action of peptides and amines working through membrane receptors and steroids, vitamin D, and thyroid hormones working through nuclear receptors. **4.0**
6. Define *hormone*, *target cell*, and *receptor*. **4.0**
7. Compare and contrast hormone actions that are exerted through changes in gene expression with those exerted through changes in protein phosphorylation, and describe an example of each. **4.0**
8. Describe the effects of plasma hormone binding proteins on access of hormones to their sites of action and degradation and on the regulation of hormone secretion. **3.0**
9. Describe the effects of secretion, excretion, degradation, and volume of distribution on the concentration of a hormone in blood plasma. **3.0**

B. Posterior Pituitary

1. Compare and contrast the anterior and posterior pituitary lobes with respect to cell types, vascular supply, development, and innervation. **3.0**
2. Identify the target organs and/or cell types for oxytocin, and describe its effects on each. **3.0**
3. Identify the stimuli for oxytocin release during parturition or lactation. **3.0**

4. Identify the target cells for vasopressin (antidiuretic hormone). 4.0
 5. Describe the stimuli and mechanisms that control vasopressin (ADH) secretion. 3.0
 6. Identify disease states caused by over-secretion and under-secretion of vasopressin (ADH), describe the principle signs and symptoms of each, and provide a physiological basis for these. 3.0
- C. Anterior Pituitary**
1. Describe the general structure and actions of the glycoprotein hormones FSH, LH, and TSH. 3.0
 2. Describe the general structure, actions, and metabolism of the GH/prolactin family. 3.0
 3. Describe the general structure and actions of the POMC family: ACTH, MSH, β -lipoprotein, β -endorphin. 3.0
 4. Identify hypothalamic factors that control the secretion of each of the anterior pituitary hormones, and describe their route of transport from the hypothalamus to the anterior pituitary. 4.0
 5. Describe and interpret the short-loop and long-loop negative feedback control of anterior pituitary hormone secretion. 3.0
 6. Predict the changes in secretory rates of hypothalamic, anterior pituitary, and target gland hormones caused by over-secretion or under-secretion of each of these hormones or receptor deficit for these hormones. 4.0
 7. Describe the importance of pulsatile and diurnal secretion, and describe an example of each. 3.0
- D. Thyroid Gland**
1. Outline the steps in the biosynthesis, storage, and secretion of tri-iodothyronine (T_3) and thyroxine (T_4) and their regulation. 3.0
 2. Define *iodine pool*. 2.0
 3. Describe the distribution of iodine and the iodide metabolic pathway, and relate the distribution of radioiodide in the body to thyroid hormone synthesis, metabolism, and excretion. 2.0
 4. Describe factors that control the synthesis, storage, and release of thyroid hormones and describe the importance of thyroid hormone binding in blood on free and total thyroid hormone levels. 3.0
 5. Explain the significance of the conversion of T_4 to T_3 and reverse T_3 (rT_3) in extra-thyroidal tissues. 3.0
 6. Describe the actions of thyroid hormones on development and metabolism. 4.0
 7. Discuss the causes and consequences of over-secretion and under-secretion of thyroid hormones, and explain why either condition can cause an enlargement of the thyroid gland. 4.0
- E. Parathyroid Gland**
1. Describe the cells of origin for parathyroid hormone, its biosynthesis, and its transport within the blood. 3.0
 2. Identify the target organs and cell types for parathyroid hormone and describe its effects on each. 4.0
 3. Describe the functions of the osteoblasts and the osteoclasts in bone remodeling, and identify the factors that regulate their activities. 4.0
 4. Identify the time course for the onset and duration for each of the biological actions of parathyroid hormone. 3.0

5. Describe the regulation of parathyroid hormone secretion and the role of the calcium-sensing receptor. 3.0
6. Describe the causes and consequences of over-secretion and under-secretion of parathyroid hormone. 4.0
7. Identify the sources of vitamin D, the biosynthetic pathway, and the organs Involved in modifying it to the biologically active $1,25(\text{OH})_2\text{D}_3$ (1-25 dihydroxy cholecalciferol) form. 4.0
8. Identify the target organs and cellular mechanisms of action for vitamin D. 4.0
9. Describe the negative feedback relationship between the parathyroid hormone and the biologically active form of vitamin D [$1,25(\text{OH})_2\text{D}_3$]. 3.0
10. Describe the consequences of vitamin D deficiency and vitamin D excess. 4.0
11. Identify the cell of origin and target organs or cell types for calcitonin. 3.0
12. Identify the stimuli that can promote secretion of calcitonin. 3.0
13. Describe the actions of calcitonin, and identify the physiological importance of each. 3.0

F. Adrenal Gland

1. Identify the functional zones, innervation, and blood supply of the adrenal glands and the principal hormones secreted from each zone. 3.0
2. Describe the biosynthesis of the adrenal steroid hormones (glucocorticoids, mineralocorticoids, and androgens) and the key features that distinguish each class. 3.0
3. Describe the cellular mechanism of action of adrenal cortical hormones. 3.0
4. Outline the major actions of glucocorticoids on metabolism and the target organs on which they are produced. 4.0
5. Describe the actions of glucocorticoid hormones in injury and stress. 4.0
6. Describe the components of the neuroendocrine axis that control glucocorticoid secretion and describe how factors in the internal and external environment influence the neuroendocrine axis. 4.0
7. Identify the causes and consequences of over-secretion and under-secretion of glucocorticoids and adrenal androgens. 4.0
8. Identify the major mineralocorticoids, as well as their biological actions and target organs or tissues. 4.0
9. Identify the physiological stimuli that promote increased mineralocorticoid secretion, and relate these stimuli to regulation of sodium and potassium excretion. 4.0
10. Identify the factors can modulate the adrenal medullary secretory response and describe how they are detected. 4.0
11. Identify the causes and consequences of over-secretion and under-secretion of mineralocorticoids. 4.0
12. Describe the negative feedback control of aldosterone secretion. 3.0
13. Identify the chemical nature of catecholamines, their biosynthesis, mechanism of transport within the blood, and explain how they are degraded and removed from the body. 3.0
14. Identify how the structure of norepinephrine differs from epinephrine. 2.0
15. Describe the biological consequences of activation of the adrenal medulla, and identify the target organs or tissues for catecholamines. 4.0
16. Explain how epinephrine and norepinephrine can produce different effects in the same tissues. 4.0
17. Describe the change in the ratio of epinephrine to norepinephrine release from the adrenal medulla during sympathetic activation (fight and flight), or in prolonged food deprivation. 4.0

18. Identify the key stimuli causing catecholamine secretion. 3.0
19. List the factors that can modulate the secretory response and the responses of target tissues to adrenal catecholamines. 3.0
20. Describe the interactions of adrenal medullary and cortical hormones in response to stress. 4.0
21. Identify disease states caused by an over-secretion of adrenal catecholamines. 3.0
- G. Pancreas**
1. Identify the major hormones secreted from the endocrine pancreas, their cells of origin, and their chemical nature. 4.0
2. List the target organs or cell types for glucagon, and describe its principal actions on each. 4.0
3. Identify the time course for the onset and duration of the biological actions of glucagon. 3.0
4. Describe the control of glucagon secretion. 4.0
5. Identify the major target organs or cell types for insulin, the major effects of insulin on each, and the consequent changes in concentration of blood constituents. 4.0
6. Identify the time course for the onset and duration for the biological actions of insulin. 4.0
7. Describe the relationship between blood glucose concentrations and insulin secretion, and explain the roles of neural input and gastrointestinal hormones on insulin secretion. 4.0
8. Identify the factors that modulate the secretory response to insulin. 4.0
9. Identify disease states caused by over-secretion, under-secretion or decreased sensitivity to insulin. 4.0
10. Describe the principal signs and symptoms of each and provide a physiological basis for these. 4.0
- H. Growth**
1. Describe the relationship between growth hormone and the insulin-like growth factors and their binding proteins in the regulation of growth. 4.0
2. Describe the regulation of growth hormone secretion, and identify the roles of hypothalamic factors and IGF-I. 4.0
3. Identify the target organs or cell types for insulin-like growth factors that account for longitudinal growth. 4.0
4. Describe how thyroidal, gonadal, pancreatic and adrenal hormones modulate growth. 3.0
5. Describe the nature and actions of local growth factors. 3.0
- I. Endocrine Integration of Energy and Electrolyte Balance**
1. Identify the normal range of plasma glucose concentrations, as well as the chemical forms and anatomical sites of storage pools for glucose and other metabolic substrates. 4.0
2. Identify the hormones that promote the influx and efflux of glucose, fat, and protein into and out of energy storage pools and their impact on the uptake of glucose by tissues. 4.0
3. Describe the specific actions for insulin, glucagon, glucocorticoids, catecholamines, growth hormone, and thyroid hormone in integrating energy and electrolyte balance. 4.0
4. Describe the changes in metabolic fuel utilization that occurs in long- and short-term fasting and in acute and sustained exercise, and describe how increases or decreases in hormone secretion produce these changes. 3.0
5. Describe the role of appetite and metabolic rate in the maintenance of long-term energy balance and fat storage. 2.0
6. Identify factors that regulate appetite and fuel oxidation. 2.0
7. Identify the normal range of dietary sodium intake, sodium distribution in the body, and routes of sodium excretion. 2.0

- | | |
|---|-----|
| 8. Describe the roles of antidiuretic hormone, aldosterone, angiotensin, and atrial natriuretic hormone in the regulation of sodium balance. | 2.0 |
| 9. Identify the normal range of dietary potassium intake, potassium distribution in the body, and routes of potassium excretion. | 3.0 |
| 10. Explain how acute changes in aldosterone, insulin, and acid/base concentrations affect the plasma potassium concentration and the movement of potassium into and out of the intracellular compartment. | 3.0 |
| 11. Describe the ongoing regulation of body potassium balance and plasma potassium levels by aldosterone through its actions on renal excretion, intestinal excretion, and dietary appetite/absorption. | 3.0 |
| 12. Identify the normal range of dietary calcium intake, calcium distribution in the body, and routes of calcium excretion. | 3.0 |
| 13. Describe the regulation of the plasma calcium concentration by parathyroid hormone, vitamin D, and calcitonin based on exchange with bone, renal excretion, and intestinal excretion and/or absorption. | 3.0 |
| 14. Identify the normal range of dietary phosphate intake, phosphate distribution in the body, and routes of phosphate excretion. | 3.0 |
| 15. Describe the regulation of the plasma phosphate concentration by parathyroid hormone, vitamin D, and calcitonin based on exchange with bone, renal excretion, intestinal excretion and/or absorption. | 3.0 |
|
J. <u>Male Reproductive Physiology</u> | |
| 1. Describe the physiological functions of the major components of the male reproductive tract. | 2.0 |
| 2. Describe spermatogenesis and the role of different cell types in this process. | 2.0 |
| 3. Describe the endocrine regulation of testicular function: the role of the GnRH pulse generator, FSH, LH, testosterone, and inhibin. | 3.0 |
| 4. Identify the cell of origin for testosterone, its biosynthesis, mechanism of transport within the blood, how it is metabolized and how it is eliminated. List other physiologically produced androgens. | 2.0 |
| 5. Identify the target organs or cell types for testosterone and describe its effects on each. | 3.0 |
| 6. Describe the cellular mechanisms of action for testosterone. | 2.0 |
| 7. Identify the neural, vascular, and endocrine components of the erection and ejaculation response. | 2.0 |
| 8. Identify the causes and consequences of over-secretion and under-secretion of testosterone for prepubescent and postpubescent males. | 3.0 |
| 9. Compare and contrast the actions of testosterone, dihydrotestosterone, estradiol, and Müllerian inhibitory factor in the development of the male and female reproductive tracts. | 2.0 |
|
K. <u>Female Reproductive Physiology</u> | |
| 1. Describe oogenesis and its relationship to changes in the ovarian follicle and the roles of FSH, LH, estradiol, inhibin, and paracrine agents in oogenesis and follicular maturation. | 3.0 |
| 2. Describe ovulation, as well as the formation and decline of the corpus luteum. | 3.0 |
| 3. Explain the roles of pituitary hormones in the formation and decline of the corpus luteum. | 3.0 |
| 4. Describe the hormonal regulation of estrogen and progesterone biosynthesis and secretion by the ovary. | 3.0 |
| 5. Identify the cells responsible for the biosynthesis of estrogen and progesterone, the mechanism of their transport in the blood, and explain how they are degraded and removed from the body. | 3.0 |

6. Identify the target organs or cell types for estrogen action and describe its effects on each. **3.0**
7. Describe the cellular mechanisms of action for estrogen. **3.0**
8. Identify the principal physiological actions of progesterone, its target organs or cell types, and describe its effects on each and the importance of “estrogen priming.” **3.0**
9. Describe the cellular mechanisms of action for progesterone. **3.0**
10. Describe and interpret the changes in the endometrium and the ovary during the menstrual cycle and correlate these changes with changes in blood concentrations of FSH, LH, estradiol, progesterone, and inhibin. **2.0**
11. Describe how the changes in ovarian steroids produce the proliferative and secretory phases of the uterine endometrium and menstruation and changes in basal body temperature during the menstrual cycle. **2.0**
12. Identify the pathways of sperm and egg transport that can result in fertilization and the movement of the fertilized embryo to the uterus. **2.0**
13. Identify the protein hormones secreted by the placenta, and describe the role of human chorionic gonadotropin (hCG) in the rescue of the corpus luteum in maintaining pregnancy early post-implantation. **2.0**
14. Describe the interactions between the placenta and the fetal adrenal cortex in the production of estrogens during pregnancy. **2.0**
15. Discuss the roles of oxytocin, relaxin, and prostaglandins in the initiation and maintenance of parturition. **2.0**
16. Describe the role of estrogens, progesterone, placental lactogen, prolactin, and oxytocin in mammary gland development during puberty, pregnancy, and lactation. **2.0**
17. Describe the basis for the inhibition of milk secretion during pregnancy and the initiation of lactation after parturition. **2.0**
18. Differentiate between milk secretion and milk ejection, and describe the hormonal regulation of both during lactation, including the role of suckling. **2.0**
19. Describe the physiological bases for the antifertility actions of contraceptive steroid hormones. **2.0**
20. Describe the age-related changes in the male and female reproductive systems, including the mechanisms responsible for these changes: In utero development, puberty and senescence. **2.0**

IV. Gastrointestinal Physiology

A. Functions and Regulation of GI Tract

1. Describe the overall role of the gastrointestinal system with respect to the whole-body balance of water, electrolytes, carbohydrates, fats, and proteins. **3.0**
2. Explain the processes of digestion, absorption, metabolic production, metabolic consumption, secretion, and excretion. **3.0**
2. Identify appropriate metabolic waste products present in the feces. **1.0**
3. Differentiate between the processes of ingestion, digestion, absorption, secretion, and excretion, including the carbohydrates, proteins, and fats. **1.0**
4. Identify the approximate normal volumes of fluid entering and leaving the gastrointestinal tract daily. **2.0**
5. Describe the major characteristics of and temporally relate the cephalic, gastric, and intestinal phases of GI tract regulation. **1.0**
6. Describe the four classes of luminal stimuli that trigger GI reflexes. **1.0**
7. Identify and locate the myenteric and submucosal plexus, given either a cross-section or a longitudinal section of the intestine. **1.0**

8. Compare and contrast the sympathetic and parasympathetic modulation of the enteric nervous system and the effector organs of the GI tract. **3.0**
 9. Classify the following enteric nervous system neurotransmitters as excitatory or inhibitory in effect: norepinephrine, acetylcholine, NO, CCK, VIP, histamine, and somatostatin. **3.0**
 10. Define long reflex and short reflex with respect to the GI tract. **3.0**
 11. Describe the regulation of gastrointestinal function by neural, hormonal, paracrine and single unit vascular smooth muscle mechanisms. **3.0**
 12. Define incretins, and identify two gastrointestinal hormones that function in this manner. **3.0**
- B. Salivary Gland**
1. Compare and contrast the plasma and salivary concentrations of Na^+ , Cl^- , and HCO_3^- at both low and high secretion rates, and identify the principal cell types involved in each secretion rate. **1.0**
 2. Describe the functions of salivary amylase (ptyalin) and transcobalamin **2.0**
 3. Identify the stimuli and cell types involved in GI secretion of mucus, and describe the function of salivary mucus. **2.0**
 4. Describe the cephalic, oral and esophageal-gastric phases of salivary secretion. **1.0**
 5. Identify the components of saliva important in oral hygiene. **2.0**
- C. Esophagus**
1. Describe the mechanisms which create the high basal tone observed in the upper esophageal sphincter (UES) & lower esophageal sphincter (LES) and the consequences of inappropriate lowering of LES basal tone. **2.0**
 2. Identify the stimulus that initiates the swallowing sequence, as well as the point at which the swallowing sequence becomes automatic (independent of voluntary control). **2.0**
 3. Describe the pressure changes that occur in the esophagus as a bolus of food moves from the pharynx to the stomach, addressing the roles of receptive relaxation and NO in the process. **1.0**
 4. Compare and contrast primary and secondary peristalsis based on initiating event, voluntary control, reflex propagation, and regions of the pharynx and esophagus involved. **1.0**
 5. Compare and contrast the lower esophageal tone, innervation, and motility defects that lead to gastroesophageal reflux disease (GERD)/heartburn with those leading to achalasia. **2.0**
- D. Stomach**
1. Explain the storage, digestion, and motility roles of the stomach. **3.0**
 2. Compare and contrast the Na^+ , K^+ , and Cl^- concentrations of gastric secretion with that of plasma at low and at high gastric secretion rates, and identify the cell types that mediate this change. **1.0**
 3. Identify the protein component of chief cell secretions. **3.0**
 4. Describe the generation of an “alkaline tide” in the hepatic portal venous system following ingestion of a meal. **2.0**
 5. Describe the role of HCl in the gastric digestion of carbohydrates, proteins, and fats. **2.0**
 6. Describe the mechanisms that alter intra-gastric pH during a meal and following a meal. **1.0**
 7. Identify the stimuli for pepsinogen release and the mechanism for activating pepsinogen, and describe the digestion products of pepsin activity. **2.0**
 8. Explain the role of the stomach in preventing pernicious anemia. **3.0**
 9. Describe the regulation of H^+/K^+ ATPase, the stimuli for activation, and process of activation, including vesicular fusion with the luminal plasma membrane. **2.0**
 10. Describe the mechanism of gastric H^+ generation and secretion, including the role of K^+ , Cl^- , HCO_3^- , carbonic anhydrase, H^+/K^+ ATPase and Na^+/K^+ ATPase. **2.0**

11. Describe the stimulation of gastric acid secretion by vagus, gastrin, histamine, and the modulating role of somatostatin in this secretion. 2.0
 12. Describe the pathways for the gastric absorption of electrolytes, water, lipids, amino acids, and carbohydrates. 2.0
 13. Identify the mechanism for damage to the gastric mucosal barrier by aspirin, NSAIDs, bile acids, and *Helicobacter pylori*. 3.0
 14. Identify the stimuli that increase gastrin release and inhibit gastrin release. 2.0
 15. Describe the mechanism by which duodenal acid, fat, and high osmolarity regulate gastric secretion. 2.0
 16. Explain receptive relaxation of the stomach, and identify mechanism and consequence. 2.0
 17. Describe origin and form of electrical activity and the progression of peristaltic waves across the body and antrum of the stomach, including their roles in mixing and propulsion of gastric contents. 2.0
 18. Explain how the intensity of contraction is altered by the volume of gastric contents. 1.0
 19. Define gastroparesis and explain how diabetes can cause it. 2.0
 20. Predict the effects of meal content (osmolarity, fat content, etc.), particle size, and volume on the rate of gastric emptying, including duodenal feedback. 2.0
 21. Identify the causes of peptic ulcer disease. 3.0
- E. Pancreas**
1. Identify the major ionic and peptide/protein components secreted by the exocrine pancreas. 3.0
 2. Compare and contrast the plasma and pancreatic concentrations of Na⁺, Cl⁻, and HCO₃⁻ at low secretion rates and at high secretion rates and the principal cell types involved in each secretion rate. 3.0
 3. Describe the mechanisms by which chyme from the stomach is neutralized in the duodenum. 3.0
 4. Describe the mechanism by which pancreatic zymogens are activated in the small intestine. 2.0
 5. Identify the stimuli that release secretin and CCK (the enterogastrones) and the cellular mechanisms by which these agents control pancreatic secretion, as well as any synergistic effects between them. 2.0
 6. Describe the role of CFTR in pancreatic ductular secretion and predict the consequences of cystic fibrosis on the GI system. 2.0
 7. Discuss the effects of the autonomic nerves on the pancreas. 2.0
- F. Bile**
1. Identify the water, ionic, bile salt, and bilirubin components of bile as secreted by the liver, and explain the modification of bile as it is stored in the gall bladder. 3.0
 2. Explain the role of cholecystokinin (CCK) and secretin in the hepatic liver production of bile. 2.0
 2. Describe the cellular mechanisms for the hepatic uptake, conjugation, and secretion of bile salts and bilirubin. 2.0
 3. Describe the role of CCK in causing release of bile from the gall bladder, including the effects on the sphincter of the hepatopancreatic ampulla (sphincter of Oddi). 2.0
 4. Describe the amphipathic structure of bile acids, and explain how this property assists the digestion of fats. 2.0
 5. Differentiate between primary and secondary bile acids. 1.0
 6. Compare and contrast the physical state of an emulsion with a micellar solution, and explain the conditions for the formation of emulsifications and micelles in the duodenum. 1.0
 7. Define enterohepatic circulation. 2.0

8. Describe the mechanism of reabsorption of bile acids in the early portion of the small intestine with the mechanism found in the later part of the small intestine. **1.0**
 9. Discuss how an increase in hepatic portal vein bile acid concentration affects the rate of bile secretion (choleretic effect), bile acid synthesis, and diseases of the gallbladder. **1.0**
- G. Small Intestine**
1. Describe the role of the microvilli, the unstirred layer, and tight junctions in determining the rate at which glucose, amino acids, water, lipids, and electrolytes are absorbed. **2.0**
 2. Identify the types of carbohydrates in duodenal chyme and describe the mechanisms of digestion and absorption across the intestine. **2.0**
 3. Explain the small intestinal and colonic consequence of a deficiency in the enzyme lactase. **2.0**
 4. Identify the types of proteins in duodenal chyme and describe the mechanisms of digestion and absorption across the intestine. **2.0**
 5. Identify the mechanisms involved in secondary transport of amino acids and oligopeptides in the duodenum. **2.0**
 6. Identify the types of the lipids in duodenal chyme, and describe the mechanisms of digestion and absorption across the intestine, and explain the roles of pancreatic lipase, colipase, and micelles. **2.0**
 7. Explain the role of the endoplasmic reticulum in processing lipids absorbed across the apical membrane of enterocytes. **1.0**
 8. Describe the composition and formation of chylomicrons, their movement across the enterocyte basolateral membrane, and the route of entry into the cardiovascular system. **1.0**
 9. Define steatorrhea, and explain the effects of steatorrhea on the absorption of fat soluble vitamins. **2.0**
 10. Explain the absorption of water-soluble vitamins, including the roles of salivary R protein and intrinsic factor in the absorption of vitamin B12. **3.0**
 11. Describe the changes in osmolarity that occur in chyme as it passes from the stomach through the duodenum, and identify the cause of this change. **1.0**
 12. Describe the pathways by which sodium ions, water, iron, and calcium are absorbed in the small intestine and colon. **2.0**
 13. Describe the cellular mechanisms of colonic sodium, potassium, and bicarbonate secretion as well as regulation of this process by aldosterone. **2.0**
 14. Define dietary fiber and identify sources commonly found in the US diet. **1.0**
 15. Identify substrates and products of colonic bacterial metabolism, and explain the impact of metabolites on the rate and composition of intestinal gas formation (flatus). **1.0**
 16. Describe the production and absorption of short chain fatty acids in the colon. **1.0**
- H. Intestinal Motility**
1. Describe the characteristics of the basic electrical rhythm (BER) of the small intestine, and explain its function in setting the frequency of smooth muscle contractile activity. **3.0**
 2. Describe the role of “interstitial cells of Cajal” in generation of electrical slow waves, and explain the consequence of the frequency gradients of electrical slow waves occurring within the intestinal tract. **2.0**
 3. Describe the functional significance of modulation of the ENS by ongoing activity of enteric inhibitory motor neurons to intestinal smooth muscle. **1.0**
 4. Define ileus and explain why surgery can cause it. **1.0**
 5. Compare and contrast the patterns of intestinal motility (segmentation, peristalsis & MMC’s) seen during the absorptive phase with that of the post-absorptive phase between meals. **3.0**

6. Compare and contrast the effects of parasympathetic and sympathetic nervous activity in modulating small intestinal motility. 3.0
7. Describe the effects of distension on small intestinal motility. 2.0
8. Describe the effects of increased pressure in the ileum and cecum on the ileocecal sphincter, and relate to gastroileal reflex. 2.0
9. Compare and contrast colonic motor activity with the motor activity in the small intestine during normal activity versus diarrhea and constipation. 2.0
10. Compare and contrast the colonic motor activity during a mass movement with that during haustral shuttling, and explain the consequence of each type of colonic motility. 2.0
11. Describe the defecation reflex, resetting the ano-rectal angle and the neural control of defecation. 3.0

V. Integration: Thermoregulation and Exercise Physiology

A. Thermoregulation

1. Describe the thermal balance for the body, including heat production (metabolism, exercise, shivering) and heat loss (convection, conduction, radiation, and evaporation). 2.0
2. Identify those mechanisms that shift from heat production to heat loss when environmental temperature exceeds body core temperature. 3.0
3. Explain the thermoregulatory set point, and describe the negative feedback control of body core temperature, including the role of the hypothalamic set point. 3.0
4. Compare and contrast the stability of body core with that of skin temperature, especially for lower extremity. 3.0
5. Explain the role of cutaneous blood flow and sweating on skin temperature. 3.0
6. Identify the mechanisms for maintaining thermal balance in different environments. 2.0
7. Explain how the change in core temperature that accompanies exercise differs from that produced by fever, which alters the thermoregulatory set point. 3.0
8. Identify and describe the physiological changes that occur as a result of acclimatization to heat and cold. 1.0

B. Exercise

1. Describe the cardiovascular consequences of exercise on peripheral resistance, cardiac output, AV oxygen difference, and arterial pressure. 3.0
2. Describe the redistribution of cardiac output to the CNS, coronary, splanchnic, cutaneous, and skeletal muscle vascular beds during sustained exercise (distance running), and explain the relative importance of neural and local control in each vascular bed. 3.0
3. Compare and contrast the normal distribution of cardiac output during sustained aerobic exercise and anaerobic (brief maximal burst) exercise. 3.0
4. Explain the local regulation of blood flow and the role of capillary reserve in altering skeletal muscle blood flow. 3.0
5. Define VO_{2MAX} and identify situations in which it is limited by cardiac output and by pulmonary gas exchange. 3.0
6. Identify the control mechanism by which an increase in minute ventilation and heart rate accompanies exercise and how it can occur without any measurable change in arterial blood gas values. 2.0
7. Discuss the effects of training on the heart and coronary circulation and how these changes contribute to an increase in VO_{2MAX} . 1.0
8. Explain how muscle fatigue, VO_{2MAX} , anaerobic threshold, gender, and age can all alter exercise performance. 1.0

9. Describe how frequent physical activity alters insulin sensitivity and glucose entry into cells. **3.0**

VI. Muscle Physiology

A. Skeletal Muscle Structure and Mechanism of Contraction

1. Explain the function and role of the heavy and light chains of myosin. **2.0**
2. Describe the relationship of the myosin thick filament bare zone to the shape of the active length:tension relationship. **3.0**
3. Describe and interpret the sequence of chemical and mechanical steps in the cross-bridge cycle, and explain how the cross-bridge cycle results in shortening of the muscle. **4.0**

B. Control of Skeletal Muscle Contraction

1. Describe the steps in excitation-contraction coupling in skeletal muscle, and describe the roles of the sarcolemma, transverse tubules, sarcoplasmic reticulum, thin filaments, and calcium ions. **4.0**
2. Describe the roles of ATP in skeletal muscle contraction and relaxation. **4.0**
3. Describe the basic structure of the neuromuscular junction. **4.0**
4. Identify the steps, in sequence, involved in neuromuscular transmission in skeletal muscle, and identify the location of each step on a diagram of the neuromuscular junction. **4.0**
5. Differentiate between an endplate potential and an action potential in skeletal muscle. **3.0**
6. Identify the possible sites for blocking neuromuscular transmission in skeletal muscle, and provide an example of an agent that could cause blockage at each site. **4.0**

C. Mechanics and Energetics of Skeletal Muscle Contraction

1. Describe the relationship of preload, afterload, and total load in the time course of an isotonic contraction. **3.0**
2. Differentiate between an isometric and isotonic contraction. **4.0**
3. Differentiate between a twitch and a tetanus in skeletal muscle and explain why a twitch is smaller in amplitude than a tetanus. **4.0**
4. Describe and interpret the length versus force diagram for muscle, and label the three lines that represent passive (resting), active, and total force and describe the molecular origin of these forces. **4.0**
5. Describe the interaction of the length:tension and force:velocity relationships. **3.0**
6. Describe and interpret force versus velocity relationships for two skeletal muscles of equal maximum force generating capacity but of different maximum velocities of shortening. **2.0**
7. Relate the power output of skeletal muscle to its force versus velocity relationship, using a diagram. **2.0**
8. Describe the influence of the series elastic element on contractile function. **3.0**
9. Identify the energy sources of muscle contraction and rank the sources with respect to their relative speed and capacity to supply ATP for contraction. **3.0**
10. Describe muscular fatigue. **4.0**
11. Compare and contrast the structural, enzymatic, and functional features of fast-glycolytic and slow-oxidative fiber types in skeletal muscle. **3.0**
12. Describe the role of the myosin crossbridges acting in parallel to determine active force, and the rate of crossbridge cycling to determine muscle speed of shortening and rate of ATP utilization during contraction. **3.0**

13. Describe and interpret the functional consequences of the parallel and series arrangement of sarcomeres in a skeletal muscle. 3.0
14. Explain how the attachment of a skeletal muscle to the skeleton can influence mechanical performance of the muscle. 3.0
15. Define *motor unit* and describe the order of recruitment of motor units during skeletal muscle contraction of varying tension (size principle). 2.0
16. Describe what basic science information can be learned from an electromyographic (EMG) examination. 4.0

D. Smooth Muscle

1. Describe the differences in myosin regulation of smooth and skeletal muscle, and compare and contrast their respective contractile units. 3.0
2. Compare and contrast the length versus tension relationships in skeletal and smooth muscle, and describe the functional implications of the differences observed. 2.0
3. Compare and contrast the force versus velocity relationships in skeletal and smooth muscle, and describe the primary basis for the observed differences in velocity of shortening. 2.0
4. Explain why smooth muscles can develop and maintain force with a much lower rate of ATP hydrolysis than skeletal muscle. 3.0
5. Differentiate between muscle relaxation from the contracted state and the phenomenon of stress relaxation and give examples of each process. 2.0
6. Compare and contrast the excitation-contraction coupling mechanism in smooth muscle with that of skeletal muscle. 3.0
7. Describe the distinguishing characteristics of multi-unit and unitary smooth muscles. 3.0

E. Cardiac Muscle

1. Describe the physiological consequences of the low-resistance pathways between cardiac muscle cells. 3.0
2. Describe and interpret the relationship between an action potential and a twitch in cardiac muscle, and explain how this prevents a tetanic contraction. 4.0
3. Describe and interpret the steps in the excitation-contraction coupling mechanism in cardiac muscle. 4.0
4. Compare and contrast the excitation-contraction coupling mechanism in cardiac muscle with that of skeletal muscle. 4.0
5. Describe and interpret the length versus tension curve for cardiac muscle and skeletal muscle, showing the active and passive relationships. 4.0

VII. Neurophysiology

A. Electrophysiology

1. Define: *dendrite, axon, axon hillock, soma, synaptic cleft*. 4.0
2. Explain the Nernst equation, as well as the effects of altering the intracellular or extracellular Na^+ , K^+ , Cl^- , or Ca^{2+} concentration on the equilibrium potential for that ion. 3.0
3. Describe the normal distribution of Na^+ , K^+ , Ca^{2+} , and Cl^- across the cell membrane. 4.0
4. Explain how the relative permeabilities to Na^+ , K^+ , Ca^{2+} , and Cl^- create a resting membrane potential. 4.0

5. Describe the ionic basis of an action potential. 4.0
 6. Compare and contrast the generation and conduction of graded potentials with that of action potentials, identifying the area on a neuron in which each occurs. 3.0
 7. Describe the basis for the calculation and the role of the space constant and time constant of neuronal processes. 1.0
 8. Define *membrane capacitance* and describe its role in the spread of current in myelinated and demyelinated neurons. 2.0
 9. Compare conduction velocities in a compound nerve, identifying how the diameter and myelination lead to differences in conduction velocity. 2.0
 10. Describe the effects of demyelination on action potential propagation and nerve conduction. 4.0
 11. Describe the ionic basis for inhibitory and excitatory post-synaptic potentials, and explain how these changes can alter synaptic transmission. 4.0
 12. Differentiate between postsynaptic inhibition and presynaptic inhibition and provide examples of each. 3.0
 13. Describe the effects of hyperkalemia, hypercalcemia, and hypoxia on the resting membrane and action potential. 4.0
- B. Neurochemistry**
1. Compare and contrast electrical and chemical synaptic transmission based on velocity of conduction, fidelity, and the possibility for neuromodulation (facilitation or inhibition). 3.0
 2. Describe chemical neurotransmission, listing in correct temporal sequence events beginning with the arrival of a wave of depolarization at the presynaptic membrane and ending with a graded potential generated at the postsynaptic membrane. 4.0
 3. Identify the characteristics of a neurotransmitter. 3.0
 4. Describe the synthetic pathways, inactivation mechanisms, and neurochemical anatomy and mechanisms of receptor transduction for neurotransmitters and neuromodulators. 1.0
- C. Spinal Cord Physiology**
1. Describe the anatomical location, function, and afferent neurotransmission of muscle spindle and Golgi tendon organs. 4.0
 2. Describe, in sequence, the events of the myotatic reflex (the patellar tendon reflex). 4.0
 3. Compare and contrast the myotatic reflex with the inverse myotatic reflex and the role of the Golgi tendon organ in the latter. 4.0
 4. Describe the role of the gamma efferent system in the stretch reflex, and explain the significance of alpha-gamma co-activation. 4.0
 5. Describe the flexor reflex initiated by touching a hot stove, identifying the neuronal connections, when pain is sensed, when flexor contraction occurs, and role of the crossed extensor reflex. 3.0
- D. Nerve Conduction and EMG Studies**
1. Describe the procedure used for measuring nerve conduction velocity. 2.0
 2. Compare and contrast the different EMG findings in neuropathy and myopathy. 3.0
 3. Describe the physiological deficit of myasthenia gravis. 3.0
- E. Brainstem Reflexes**
1. Describe the function of the cardiovascular baroreceptor and respiratory stretch receptor. 3.0
 2. Identify the stimulus and its receptor, the afferent pathway, the brain stem nuclei involved,

the efferent pathway, and the resulting effect for each brain stem reflex. **3.0**

F. Cerebrovascular System

1. Describe the local factors affecting brain blood flow, and contrast their effectiveness with that of autonomic regulation of cerebral blood flow. **3.0**

G. Somatosensory System

1. Differentiate between feed-forward and feedback inhibition within neuronal circuits, and provide physiological examples of each. **2.0**

VIII. Pulmonary Physiology

A. Pulmonary Mechanics

1. Explain how pleural pressure, alveolar pressure, airflow, and lung volume change during a normal quiet breathing cycle. **4.0**

2. Identify the onset of inspiration, cessation of inspiration, and cessation of expiration on a diagram of pleural pressure, alveolar pressure, airflow, and lung volume during a normal quiet breathing cycle. **4.0**

3. Explain how differences in pressure between the atmosphere and alveoli cause air to move in and out of the lungs. **4.0**

4. Define compliance and describe and interpret a normal pulmonary pressure-volume (compliance) curve. **2.0**

5. Identify two common clinical conditions in which lung compliance is higher or lower than normal and relate these to P-V curves. **4.0**

6. Describe and interpret the pressure-volume (compliance) curves for the lungs, chest wall, and respiratory system on the same set of axes. **3.0**

7. Show and explain the significance of the resting positions for each of these three structures. **2.0**

8. Identify the forces that generate the negative intrapleural pressure when the lung is at functional residual capacity, and predict the direction that the lung and chest wall will move if air is introduced into the pleural cavity (pneumothorax). **4.0**

9. Describe and interpret a normal spirogram, identifying the four lung volumes and four capacities. **4.0**

10. List the volumes that comprise the four lung capacities. **4.0**

11. Identify which lung volumes and capacities cannot be measured by spirometry. **4.0**

12. Describe how changes in lung volumes occur in patients with emphysema and pulmonary fibrosis. **3.0**

13. Define *surface tension*. **3.0**

14. Explain how surface tension affects lung mechanics, including the effects of alveolar size and the role of surfactants. **3.0**

15. Define *atelectasis*, and explain the role of surfactants in preventing it. **3.0**

16. Describe the principal components of pulmonary surfactant and explain the roles of each. **1.0**

17. Describe the effects of airway diameter and turbulent flow on airway resistance. **3.0**

18. Describe how airway resistance alters dynamic lung compliance. **3.0**

19. Describe and interpret a spirogram resulting from a maximal expiratory effort, and identify the forced vital capacity (FVC), timed forced expiratory volumes (FEVs), as well as the maximal expiratory flow rate between 25-75% of FVC (FEF_{25-75%}). **3.0**

20. Describe and interpret a normal maximal effort flow-volume curve and identify the effort-dependent and -independent regions. **2.0**

21. Explain why each point in the effort-independent region of the curve represents a maximal flow rate that is uniquely dependent on lung volume, based upon the concept of dynamic compression or airways. 2.0
22. Discuss how and why the shape of the flow-volume curve is shifted in obstructive and restrictive lung disease. 3.0
23. Differentiate between the two broad categories of restrictive and obstructive lung disease, including the spirometric abnormalities associated with each category. 3.0
24. Describe the regional differences in alveolar ventilation in a healthy lung and explain the basis for these differences. 2.0

B. Alveolar Ventilation

1. Define: *hypoventilation, hyperventilation, hypercapnia, eupnea, hypopnea, hyperpnea*. 4.0
2. Define *partial pressure* and *fractional concentration* as they apply to gases in air. 4.0
3. List the normal fractional concentrations and sea level partial pressures for O₂, CO₂, and N₂. 3.0
4. Identify the normal airway, alveolar, arterial, and mixed venous PO₂ and PCO₂ values, as well as the normal arterial and mixed venous values for O₂ saturation, [HCO₃⁻], and pH. 4.0
5. Differentiate between anatomic dead space, physiologic dead space, wasted (dead space) ventilation, total minute ventilation, and alveolar minute ventilation. 4.0
6. Describe the concept by which physiological dead space can be measured. 1.0
7. Differentiate the relationships between alveolar ventilation and the arterial PCO₂ and PO₂. 4.0
8. Describe the relationship between alveolar ventilation and PCO₂ based on the alveolar ventilation equation. 2.0
9. Estimate the alveolar oxygen partial pressure (PAO₂) using the simplified form of the alveolar gas equation and describe the relationship between deadspace and alveolar PO₂. 3.0

C. Pulmonary Circulation

1. Compare and contrast the systemic and pulmonary circulations with respect to pressures, resistance to blood flow, and response to hypoxia. 3.0
2. Describe the regional differences in pulmonary blood flow in an upright person. 2.0
3. Identify and describe zones I, II, and III in the lung, with respect to pulmonary vascular pressure and alveolar pressure. 2.0
4. Explain how pulmonary vascular resistance changes with alterations in cardiac output or pulmonary arterial pressure. 2.0
5. Explain changes in pulmonary vascular resistance in terms of distension and recruitment of pulmonary vessels. 2.0
6. Explain how pulmonary vascular resistance changes with lung volume, as well as in terms of alterations in alveolar and extra-alveolar blood vessels. 2.0
7. Describe the consequence of hypoxic pulmonary vasoconstriction on the distribution of pulmonary blood flow. 3.0
8. Discuss the effects of inspired nitric oxide on pulmonary vascular resistance and hypoxic vasoconstriction. 2.0
9. Explain the development of pulmonary edema by increased hydrostatic pressure, increased permeability, impaired lymphatic outflow and hemodilution (e.g. with saline volume resuscitation). 3.0
10. Describe the major functions of the bronchial circulation. 2.0

D. Pulmonary Gas Exchange

1. Define *hypoxia, hypercapnia, hyperoxia*. 4.0
2. Identify the factors that affect diffusive transport of a gas between alveolar gas and pulmonary capillary blood. 4.0
3. Describe the kinetics of oxygen transfer from alveolus to capillary and the concept of capillary reserve time. 3.0
4. Define *oxygen diffusing capacity*. 3.0

E. Ventilation Perfusion Relationship

1. Describe how the ventilation/perfusion (V_a/Q) ratio of an alveolar-capillary lung unit determines the PO_2 and PCO_2 of the blood emerging from that lung unit. 3.0
2. Identify the average V/Q ratio in a normal lung. 3.0
3. Explain how V_a/Q is affected by the vertical distribution of ventilation and perfusion in the healthy lung. 3.0
4. Describe the normal relative differences from the apex to the base of the lung in alveolar and arterial PO_2 , PCO_2 , pH, and oxygen and carbon dioxide exchange. 2.0
5. Explain how the presence of abnormally low and high V_a/Q ratios in a person's lungs will affect arterial PO_2 and PCO_2 . 3.0
6. Describe two causes of abnormal V_a/Q distribution. 3.0
7. Define *right-to-left shunts, anatomic and physiological shunts, and physiologic dead space*. 3.0
8. Describe the consequences of right-to-left shunts, anatomic and physiological shunts, and physiologic dead space for pulmonary gas exchange. 3.0
9. Describe the airway and vascular control mechanisms that help maintain a normal ventilation/perfusion ratio. 2.0
10. Identify two compensatory reflexes for V_a/Q inequality. 2.0
11. Calculate the alveolar to arterial PO_2 difference, $(A-a)DO_2$. 2.0
12. Describe the significance of an elevated $(A-a) DO_2$. 3.0
13. Identify five causes of hypoxemia. 3.0

F. Transport of oxygen and carbon dioxide

1. Define *oxygen partial pressure, oxygen content, and percent hemoglobin saturation* as they pertain to blood. 4.0
2. Outline the information that can be received from the following tests/devices: spirometer, arterial blood gas (ABG) analysis, pulse oximeter, transcutaneous oximeter, hyperspectral imaging 4.0
3. Describe and interpret a hemoglobin- O_2 dissociation curve, showing the relationships between oxygen partial pressure, hemoglobin saturation, and blood oxygen content. 4.0
4. Draw the relationship between PO_2 and dissolved plasma O_2 content (Henry's Law). 4.0
5. Compare the relative amounts of O_2 carried bound to hemoglobin with that carried in the dissolved form. 4.0
6. Describe how the shape of the oxyhemoglobin dissociation curve influences the uptake and delivery of oxygen. 3.0
7. Define $P50$ of the hemoglobin- O_2 dissociation curve and describe its physiological significance. 4.0
8. Describe how the oxyhemoglobin dissociation curve is affected by changes in blood temperature, pH, PCO_2 , and 2, 3-DPG, and describe a situation where such changes

- have important physiological consequences. 4.0
9. Describe how anemia and carbon monoxide poisoning affect the shape of the oxyhemoglobin dissociation curve, PaO₂, and SaO₂. 3.0
 10. Identify the forms in which carbon dioxide is carried in the blood, as well as the percentage of total CO₂ transported as each form. 4.0
 11. Explain the importance of the chloride shift in the transport of CO₂ by the blood. 3.0
 12. Identify the enzyme that is essential to normal carbon dioxide transport by the blood and its location. 2.0
 13. Describe the hemoglobin-CO₂ dissociation curve, the effect of O₂ on this relationship (Haldane effect), and the significance of this effect in CO₂ discharge at the lungs. 3.0
 14. Explain why the total gas pressure of the venous blood is subatmospheric and why this situation is accentuated when breathing 100% O₂. 3.0
 15. Explain how breathing 100% O₂ can result in further arterial O₂ desaturation in hypoxemic patients who develop mucous plugging of their airways (absorption atelectasis). 4.0
 16. Describe the CO₂ Bohr effect and its significance for delivery of O₂ at the tissue levels. 3.0
 17. Define *respiratory acidosis* and *alkalosis*. 4.0
 18. Identify clinical examples of respiratory acidosis and alkalosis. 4.0
 19. Describe the mechanism and function of respiratory acid base compensations. 4.0
- G. Respiratory Control**
1. Describe the specific roles of groups of neurons that are involved in the generation and control of automatic cyclic breathing. 3.0
 2. Identify examples of reflexes involving pulmonary receptors that influence breathing frequency and tidal volume, including the receptors and neural pathways involved. 3.0
 3. Identify the anatomical locations of chemoreceptors sensitive to changes in arterial PO₂, PCO₂, and pH that participate in the control of ventilation and the relative importance of each in sensing alterations in blood gases. 3.0
 4. Describe how changes in arterial PO₂ and PCO₂ alter alveolar ventilation, including the synergistic effects when PO₂ and PCO₂ both change. 4.0
 5. Describe the respiratory drive in a COPD patient, and predict the change in respiratory drive when oxygen is given to a COPD patient. 3.0
 6. Describe some abnormal breathing patterns that are found in metabolic or neurologic diseases, such as Kussmäl's, Biot's, and Cheyne-Stokes' breathing. 2.0
 7. Describe the significance of the feed-forward control of ventilation (central command) during exercise, and the effects of exercise on arterial and mixed venous PCO₂, PO₂, and pH. 2.0
- H. Environmental Influences**
1. Describe the mechanisms for the shift in alveolar ventilation that occur immediately upon ascent to high altitude, after remaining at altitude for two weeks, and immediately upon return to sea level. 2.0
 2. Identify the site of erythropoietin production, the adequate stimulus for erythropoietin release, and the target tissue for erythropoietin action. 2.0
- I. Age Effects and Nonrespiratory Lung Functions**
1. Describe the effect of aging on lung volumes, lung and chest wall compliance, blood

- gases, and respiratory control. 1.0
- 2. Identify the mechanism by which particles are cleared from the airways. 3.0
- 3. Describe mechanisms for clearance of vasoactive substances from the blood during passage through the lung. 2.0
- 4. Identify a substance that is almost completely cleared from the blood during passage through the lung, as well as one that is not cleared to any significant extent. 1.0
- 5. Describe how the airway chloride transporter (CFTR) promotes a watery layer beneath the mucus layer to facilitate upward ciliary transport of mucus-trapped microbes and particulates. 2.0

IX. Renal Physiology

A. Structure of Kidney and Nephron

- 1. Outline the tubular segments through which ultrafiltrate flows after it is formed at Bowman's capsule to when it enters the renal pelvis, and identify each structure as being located in the renal cortex or renal medulla. 3.0
- 2. Distinguish between cortical and juxtamedullary nephrons, based on the glomerulus location and the length of the loop of Henle. 3.0
- 3. Identify and describe the afferent and efferent arterioles, glomerular capillary network, peritubular capillaries and vasa recta. 3.0
- 4. Identify and describe mesangium, Bowman's capsule, and the juxtaglomerular apparatus (including the specialized juxtaglomerular arteriole cells and the macula densa). 3.0
- 5. Describe the three layers comprising the glomerular filtration barrier and identify the filtration barriers that impede the filtration of H₂O, Na⁺, inulin, albumin, and red blood cells. 3.0
- 6. Explain the role of somatic, (pudendal) sympathetic, and parasympathetic nerves in the micturition reflex and in urination. 2.0

B. Renal Clearance

- 1. Explain the clearance principle and use the clearance equation and an appropriate compound to estimate the glomerular filtration rate, renal plasma flow, and renal blood flow. 4.0
- 2. Explain why creatinine, inulin, or Cystatin C are used for measuring GFR 2.0
- 3. Calculate the filtered load, tubular transport, excretion rate, and clearance of inulin, Creatinine, para-amino hippuric acid (PAH), glucose, and penicillin, given the plasma and urine concentrations and the urine flow rate. 3.0
- 4. Predict how changes in filtration, reabsorption, and secretion will affect renal excretion of inulin, creatinine, para-amino hippuric acid (PAH), glucose, and penicillin. 3.0
- 5. Identify the tubular load, tubular transport maximum (T_{max}), and splay for each substance, using a graph of the urinary excretion of glucose, creatinine, PAH, penicillin and inulin. 3.0

C. Glomerular Filtration Rate and Renal Hemodynamics

- 1. Define *renal blood flow*, *renal plasma flow*, *glomerular filtration rate*, and *filtration fraction*, and list typical values for each. 4.0
- 2. Identify the filtration coefficient at the glomerular capillary explain its role in

- determining GFR. 3.0
3. Describe the effects of reductions in GFR on plasma creatinine concentrations. 4.0
 4. Calculate the net filtration force at the glomerular capillaries, given the capillary and Bowman's capsule hydrostatic and oncotic pressures. 3.0
 5. Predict the changes in glomerular filtration caused by increases or decreases in the capillary and Bowman's capsule hydrostatic and oncotic pressures. 3.0
 6. Describe the relative resistances of the afferent and efferent arterioles and the effects on renal blood flow and GFR of selective changes in each. 3.0
 7. Describe the myogenic and tubuloglomerular feedback mechanisms that mediate the autoregulation of renal plasma flow and glomerular filtration rate. 3.0
 8. Predict the change in renal blood flow and glomerular filtration rate caused by an increase in renal sympathetic nerve activity. 3.0
 9. Predict the change in renal blood flow and glomerular filtration caused by increased synthesis of angiotensin II, or by increased release of atrial natriuretic peptide. 3.0
 10. Identify components of the filtration barrier whose dysfunction would result in hematuria and proteinuria. 2.0
 11. Predict the changes in net filtration force that occur as blood travels along the glomerular capillary where hydrostatic pressure falls and colloid osmotic pressure increases, based on Starling's forces. 2.0
 12. Predict the change in renal blood flow and GFR caused by urinary tract obstruction, hypoalbuminemia, and diabetic nephropathy. 3.0
 13. Compare blood flow to, and oxygen consumption by, the kidneys with that of resting skeletal and cardiac muscle. 2.0

D. Transport Properties of Nephron Segments

1. Describe the contribution of the major nephron segments to the reabsorption of the filtered load of solute and water. 4.0
2. Describe the effects of changes in peritubular capillary hydrostatic and colloid osmotic pressures on net proximal tubular fluid reabsorption. 3.0
3. Contrast the transcellular and paracellular pathways for movement across proximal tubular epithelia, using glucose, para-amino hippuric acid (PAH), water, and Cl^- . 2.0
4. Describe the cellular mechanisms for the transport of Na^+ , Cl^- , K^+ , HCO_3^- , Ca^{2+} , phosphate, organic solutes (e.g., glucose, amino acids, and urea), and water by the major tubular segments. 3.0
5. Describe the function of the following renal transporters and their predominant localization along the tubules with regard to nephron segment and apical versus basolateral membranes: transport ATPases (Na^+/K^+ -ATPase, H^+/K^+ -ATPase, H^+ -ATPase, and Ca^{2+} -ATPase); ion and water channels (K^+ , ENaC, Cl^- , Ca^{2+} , aquaporins); coupled transporters (Na^+ -glucose, Na^+/H^+ -antiporter, $\text{Na}^+/\text{K}^+/\text{2Cl}^-$ -symporter, Na^+ -phosphate symporter, Na^+/Cl^- -symporter, $\text{Na}^+/\text{HCO}_3^-$ symporters, $\text{Cl}^-/\text{HCO}_3^-$ antiporter). 3.0
6. Describe the nephron sites and molecular mechanisms of action of the following classes of diuretics (osmotic, carbonic anhydrase inhibitors, loop, thiazide, K^+ -sparing). 3.0

E. Urine Concentration and Dilution

1. Predict how changes in body fluid volume and osmolality caused by a net water loss or gain would alter the rate of urine production and the osmotic composition of the urine. 4.0
2. Predict how changes in body fluid volume and osmolality caused by a net NaCl loss or

- gain would alter the rate of urine production and the osmotic composition of the urine. **3.0**
3. Explain the creation of the hypertonic renal interstitium, including the roles of the counter current multiplier, urea recycling, and the counter current exchanger. **3.0**
 4. Describe the role of the ascending limb of the loop of Henle in producing a high renal interstitial fluid osmolality. **4.0**
 5. Compare and contrast, beginning with the loop of Henle, the tubular fluid and interstitial fluid osmolality changes that allow either a dilute or a concentrated urine to be produced and excreted. **4.0**
 6. Predict the consequence on urine concentrating ability if the medullary osmotic gradient is disrupted, and describe how the osmotic gradient would be re-established. **3.0**
 7. Name the two most powerful stimuli promoting ADH release, and describe the negative feedback control mechanisms for each. **4.0**
 8. Identify and describe the tubular section and cellular mechanisms by which ADH increases permeability to water and urea, and explain the role of these to produce either dilute or concentrated urine. **4.0**
 9. Calculate osmolar and free water clearance and estimate expected free water clearance for an individual producing either dilute or concentrated urine, given urine and plasma osmolarities and urine volume. **1.0**
 10. Describe the actions of the different classes of diuretics on the ability of the kidneys to maximally concentrate and dilute urine. **2.0**
 11. Differentiate between central and nephrogenic diabetes insipidus based on plasma ADH levels and the response to an injection of ADH. **3.0**

F. Na⁺ Balance and Regulation of Extracellular Fluid Balance

1. Identify the major routes of Na⁺ loss from the body and describe the role of Na⁺ in maintaining extracellular fluid volume. **3.0**
2. Calculate the normal filtered load of Na⁺ and identify the tubular sites of Na⁺ reabsorption. **3.0**
3. Describe how Na⁺ reabsorption in euolemia is altered by volume depletion or volume expansion. **4.0**
4. Describe the receptors involved in the monitoring of ECF volume (e.g., high-pressure baroreceptors and low-pressure cardiopulmonary stretch receptors), and describe the neural reflex regulation of renal Na⁺ and water excretion. **3.0**
4. Describe and interpret the formation and generation of angiotensin II, beginning with renin and identify the factors that can promote renin release. **3.0**
5. Describe the regulation of Na⁺ reabsorption along the nephron, including the effects of sympathetic nerves, angiotensin II, aldosterone, and atrial natriuretic peptide. **3.0**
6. Describe the actions of the different classes of diuretics on Na⁺ handling by the kidneys and ECF volume regulation. **3.0**
7. Explain the contribution of the kidneys to progression of and/or the compensation for the altered fluid volume regulation characteristic of congestive heart failure and hepatic cirrhosis. **3.0**
8. Describe the regulation of proximal tubule reabsorption that underlies the phenomenon of Glomerulotubular balance. **2.0**
9. Describe the role of the renin-angiotensin-aldosterone system in the regulation of systemic arterial blood pressure in volume-replete and volume-depleted states and in secondary forms of hypertension. **4.0**

G. K⁺ Balance

1. Explain the role of extracellular K⁺ in maintaining normal nerve and muscle function. **3.0**
2. Describe K⁺ distribution within the body, and identify the major routes of K⁺ loss from the body. **3.0**
3. Describe extrarenal K⁺ homeostasis, the role insulin, epinephrine, and aldosterone in the movement of K⁺ between intracellular and extracellular pools and describe the K⁺ shift caused by acidosis. **3.0**
4. Calculate the normal filtered load of K⁺. **3.0**
5. Identify the tubular sites of K⁺ reabsorption and secretion. **3.0**
6. Describe the factors that regulate K⁺ secretion in the collecting duct (e.g., aldosterone, Plasma K⁺), and distinguish these from other factors that alter K⁺ secretion at this site (e.g., luminal fluid flow rate, acid-base disturbances, anion delivery). **3.0**
7. Contrast the tubular sites of action of K⁺ wasting and K⁺ sparing diuretics. **2.0**

H. Ca²⁺ and Phosphate Balance

1. Identify the major storage pools of Ca²⁺ and phosphate, as well as major routes of Ca²⁺ and phosphate loss from the body. **3.0**
2. Calculate the normal filtered loads of Ca²⁺ and of phosphate, given GFR and plasma levels of Ca²⁺ and phosphate **3.0**
3. Identify the tubular sites of Ca²⁺ reabsorption and of phosphate reabsorption. **3.0**
4. Describe the renal regulation of Ca²⁺ and phosphate transport by PTH, calcitonin, and 1,25-dihydroxy vitamin D (calcitriol), and distinguish from other factors that alter their transport (ECF volume, acid-base disorders). **3.0**
5. Describe the role of the kidney in the production of 1,25-dihydroxy vitamin D (calcitriol). **3.0**
6. Describe the effects of diuretics on Ca²⁺ and phosphate excretion, especially noting the effect of thiazides to decrease Ca²⁺ excretion and loop diuretics to increase Ca²⁺ excretion. **2.0**

I. Acid-Base Balance

1. Identify the normal range of pH values, and the upper and lower limits compatible with life. **4.0**
2. Identify the magnitude and the time course of the compensations that act to minimize change in pH of the body fluids, including buffers, respiratory adjustments, and renal adjustment, given a sudden increase or decrease in pH. **3.0**
3. Describe the respiratory and renal regulation of the CO₂/HCO₃⁻ buffer system, which allows a buffer with a pKa of 6.1 to be physiologically important in the maintenance of the normal plasma pH of 7.4. **4.0**
4. Differentiate between CO₂-derived (volatile acid) and non-volatile acid (titratable and NH₄⁺), the relative amounts produced each day through dietary intake and cellular metabolism, and the normal routes of loss from the body. **3.0**
5. Calculate the filtered load of HCO₃⁻, and identify the major sites of reabsorption (and secretion) along the nephron. **3.0**
6. Describe the cellular mechanisms responsible for net transepithelial movement of HCO₃⁻, emphasizing the importance of H⁺ secretory mechanisms in this process. **3.0**
7. Describe the adjustments in filtered load and HCO₃⁻ reabsorption (H⁺ secretion) by alterations in systemic acid-base balance and distinguish these from other factors that

- alter this process (e.g. ECF volume, aldosterone, and angiotensin II). 3.0
8. Describe net acid excretion by the kidneys of non-volatile acids, the importance of urinary buffers, and the production and excretion of ammonia. 3.0
 9. Differentiate between the reclamation of filtered bicarbonate and the formation of new bicarbonate. 3.0
 11. Identify simple and mixed metabolic and respiratory acid-base disorders based on arterial gases, PCO_2 , and pH. 3.0
 12. Distinguish between each of the following based upon blood values: increased and normal anion gap metabolic acidosis; chloride-sensitive and chloride-resistant metabolic alkalosis and acute and chronic respiratory disturbances. 2.0
 12. Explain processes that lead to acid-base disturbances and list common causes of these processes. 4.0
 13. Describe the effects of carbonic anhydrase inhibitors and other classes of diuretics on acid-base balance and the reabsorption of HCO_3^- by the nephron. 3.0

J. Integrative and Pathophysiological Aspects

1. Describe the relationships between sodium balance and plasma volume as they contribute to cardiovascular hemodynamics and arterial pressure. 4.0
2. Explain the role of the renin-angiotensin-aldosterone systems in the regulation of sodium balance and arterial pressure, with emphasis on the actions of angiotensin II on various target organs and tissues. 4.0
3. Describe pressure natriuresis and the mechanisms mediating and modulating this process. 3.0
4. Describe how impairments in renal function and pressure natriuresis contribute to the long-term regulation of arterial pressure, as well as the development and maintenance of hypertension. 3.0

BEHAVIORAL MEDICINE LEARNING OBJECTIVES

Behavioral Medicine: Behavioral medicine is an interdisciplinary approach to healthcare involving the integration of biological, psychological, and social sciences to help inform culturally-sensitive care and mental health assessment while promoting treatment compliance, prevention, rehabilitation, and referral, as clinically indicated.

1. Identify the diagnostic criteria for diagnosing depressive disorders as defined by the DSM. 4.0
2. Identify strategies for medical and behavioral management of depressive disorders and interdisciplinary referral, as needed. 4.0
3. Identify the diagnostic criteria for bipolar disorders as defined by the DSM. 4.0
4. Describe the importance of medications and behavioral modification in the management of mania. Recognize potential risky behaviors and consequences of treatment non-adherence. 4.0
5. Recognize symptoms of anxiety disorders as described in the DSM. 4.0
6. Differentiate between functional and dysfunctional anxiety. 4.0
7. Identify strategies for medical and behavioral management of anxiety and interdisciplinary referral, as needed. 4.0
8. Recognize the impact of traumatic experience as they relate to diagnoses such as Posttraumatic Stress Disorder. Identify options for trauma-informed care. 4.0
9. Explain the manifestations of adjustment disorders and recommendations for self-care and referral. 4.0
10. Identify potential pitfalls in prescribing psychotropic medications without a comprehensive psychiatric assessment. 4.0
11. Recognize primary counseling skills for patients presenting with psychosocial distress. 4.0
12. Recognize signs of developmental disabilities. Identify approaches to the management of conditions, including, intellectual disability, autism-spectrum disorders, and attention-deficit/hyperactivity disorder. 4.0
13. Differentiate between delirium and dementia. Identify their distinctive etiologies. 4.0
14. Describe short and long-term consequences of anger and approaches to de-escalating agitation. 4.0
15. Describe signs of somatoform illnesses in contrast to symptoms feigned for secondary gain. 4.0
16. Describe signs of abuse in vulnerable adults. Identify referral options for safety and advocacy. 4.0
17. Describe signs of child abuse and neglect. Identify referral options for safety and advocacy. 4.0
18. Summarize the responsibility to report adult and child abuse and neglect. Identify state-specific protocol for mandated reporting. 4.0
19. Describe symptoms of adjustment disorders and recommendations for self-care and referral. 4.0
20. List helpful strategies for managing patients who exhibit traits of a personality disorder. Describe basic knowledge of dialectical behavior and interpersonal communication techniques. 4.0
21. Recognize implications of chronic disease, pain, stress, aging, diabetes and other medical conditions on mental health. 4.0
22. Recognize common signs of the impaired physician and professional burnout. Identify avenues for self-care. 4.0
23. Define criteria for substance abuse disorders as defined by the DSM. Identify referral options for detoxification and rehabilitation. 4.0
24. Identify signs of psychotic disorders. 4.0
25. Describe the importance of medications and behavioral modification in the management of schizophrenia and other psychotic disorders. Recognize potential consequences of untreated psychosis. 4.0
26. Identify the biological, psychological, and social components of the biopsychosocial model. 4.0
27. Recognize the importance of diversity awareness and sensitivity considering factors such as ethno-cultural and socioeconomic variability. 4.0
28. Recognize the importance of compassionate and respectful communication with those who self-identify as LGBTQIA. Describe risks of misattribution of symptoms to sexual orientation. 4.0
29. Identify dysfunctional patterns of sleep and strategies for improved sleep hygiene. Recognize potential consequences of disrupted sleep and the importance of behavioral modification before prescribing medication. 4.0

30. Describe locus of control and the stages of readiness for change as they relate to patient care and treatment compliance. Explain techniques for motivational interviewing. **4.0**
31. Explain the five stages of grief as defined by the Kubler-Ross model as well as common end-of-life considerations and resources. **4.0**

COMMUNITY HEALTH LEARNING OBJECTIVES

Public Health

Biostatistics

Jurisprudence in Public and Community Health

Epidemiology

I. Public Health

1. Define:
 - a. *illness* 4.0
 - b. *disease* 4.0
 - c. *quality assessment and assurance* 3.0
 - d. *quality improvement* 3.0
2. Differentiate between health care, medical care, and public health. 4.0
3. Distinguish between epidemic, endemic, and pandemic. 4.0
4. Outline the evolution of health care in the United States, including the changes in organization structure, social structure, and technology. 2.0
5. Describe changes in disease patterns as health care has evolved in the United States:
 - a. epidemics of acute infectious diseases affecting population groups 3.0
 - b. acute infectious and traumatic events affecting individuals 3.0
 - c. burden of chronic diseases 3.0
 - d. special chronic diseases (related to genetic make-up, environmental hazards and individual lifestyle) 3.0
6. Discuss factors contributing to an increase in health care spending including predictors of health services utilization. 3.0
7. Discuss the origin and development of health insurance in the US. 2.0
8. Recognize comparative health care models internationally (e.g., England, Canada, Germany, Cuba, etc.). 2.0
9. Describe the various categories of health insurance in the United States (e.g., Federal, military, private, etc.). 3.0
10. List and describe the three major criteria areas upon which quality assessment is based (structure measures, process of care measures, outcome of care measures). 2.0
11. Discuss the major components of, and implications of, the Patient Protection and Affordable Care Act (ACA). 2.0
12. Explain the role of a Professional Review Organization (PRO) as it pertains to utilization review. 3.0
13. Describe the mission and basic layout of the US Department of Health and Human Services (DHHS). 2.0
14. Discuss various agencies in the US that provide or use public health services (e.g., Health and Medicine Division of the National Academies of Science [previously the Institute of Medicine], Department of Labor to include the Occupational Safety and Health Administration [OSHA], National Institutes of Health [NIH], Centers for Medicare and Medicaid Services [CMS], Center for Disease Control and Prevention [CDC], Food and Drug Administration [FDA], and the United States Preventive Services Task Force). 3.0
15. Explain the function of the US Surgeon General. 2.0
16. List and describe the ten essential public health services as they relate to the clinical practice of podiatric medicine. 4.0
17. Explain the goals and focus objectives of “Healthy People 2030”. 4.0
18. Explain the function of state and local health departments. 3.0
19. Discuss the ecological model of community health development. 1.0
20. Define the “Triple Aim” in healthcare as defined by the Institute for Healthcare Improvement (i.e., improving the health of populations, enhancing the experience of care for individuals, and reducing the per capita cost of health care) 2.0
21. Discuss the federal Occupational Safety and Health Administration’s (OSHA) standards and guidelines for healthcare 4.0
22. Describe the various levels of prevention as they pertain to public health practice (i.e., primary, secondary, tertiary prevention, and maintenance or custodial care). 4.0

23. Recognize the impact of social determinants of health on the health and well-being of populations, as defined by the CDC. 4.0
24. Describe the five primary determinants of health of a population as recognized by CDC: Biology and genetics, individual behavior, social environment, physical environment, and health services. 3.0

II. Biostatistics

1. Define:
 - a. inferential statistics 3.0
 - b. descriptive statistics 3.0
 - c. confidence interval 3.0
2. Define and calculate the measures of central tendency. 4.0
3. Define and calculate the measures of dispersion. 4.0
4. Differentiate continuous, discrete, ordinal (ranked), nominal (categorical), and dichotomous data types. 4.0
5. Compare normal, binomial, and skewed distributions. 3.0
6. Differentiate the central limit theorem from central tendency. 2.0
7. Differentiate between independent and dependent variables. 4.0
8. Describe the role of hypothesis testing in research. 4.0
9. Differentiate clinical significance from statistical significance. 4.0
10. Discuss the importance of reliability and validity as they pertain to medical tests and research design. 4.0
11. Define the p value and describe its role in supporting or rejecting the null hypothesis. 4.0
12. Explain null and alternative hypotheses. 4.0
13. Distinguish between type one (alpha) and type two (beta) errors. 4.0
14. Describe the standard error of the mean and how this plays a role in the confidence interval. 3.0
15. Differentiate parametric versus non-parametric testing and recognize the indications for each test. 3.0
16. Describe the interrelationships among power, sample size, effect size, and statistical significance. 4.0
17. Describe the various statistical tests used to measure trends, differences and associations. 2.0

III. Jurisprudence in Public and Community Health

1. Identify the three branches of government and their role in the creation and practice of health law and policy. 2.0
2. Differentiate between statutes and administrative regulations. 3.0
3. Discuss the importance of scope of practice in podiatric medicine. 4.0
4. Summarize healthcare privacy and security requirements under the Health Insurance Portability and Accountability Act (HIPAA). 4.0
5. Demonstrate understanding of laws regarding patient's right to control and access their protected health information. 4.0
6. Recognize situations that may give rise to an Emergency Medical Treatment and Active Labor Act (EMTALA) claim. 3.0
7. Provide examples of events that might result in disciplinary action by a professional licensing board. 4.0

8. Describe the purpose and reporting requirements of the National Practitioner Data Bank. **3.0**
9. Distinguish between different business models (e.g., sole proprietor, partnership, corporation) in healthcare delivery. **2.0**
10. Discuss the Healthcare Quality Improvement Act (HCQIA) and its role in peer-review and credentialing. **3.0**
11. Describe fraud, waste and abuse within the healthcare business environment. **4.0**
12. Differentiate between Physician Self-Referral (Stark Law) and the Anti-Kickback Statute. **3.0**
13. Summarize the False Claims Act and Qui Tam enforcement. **4.0**
14. Explain inurement laws and their impact on physician practice. **3.0**
15. Recognize the legal ramifications and requirements associated with mandatory reporting of child abuse and neglect. **4.0**
16. Discuss standard of care and negligence as they relate to medical malpractice. **4.0**
17. Define statute of limitations. **4.0**
18. Compare and contrast implied consent and informed consent. **4.0**
19. Explain investigative procedure, deposition, and discovery as they relate to medical malpractice. **2.0**
20. Define respondeat superior. **2.0**
21. Describe the doctor patient relationship in the context of a contract. **3.0**
22. Explain the importance of timely and accurate charting with respect to medical malpractice and billing. **4.0**
23. Explain the purposes of quality improvement and risk management within a health care facility. **3.0**
24. Recognize strategies for preventing medical error. **4.0**
25. Describe the legal requirements for prescribing controlled substances. **4.0**
26. Define advance directives and surrogate decision-making (e.g., health care power of attorney). **4.0**

IV. Epidemiology

1. Define:
 - a. epidemiology **4.0**
 - i. descriptive epidemiology **4.0**
 - ii. analytical epidemiology **4.0**
 - b. relative risk **3.0**
 - c. odds ratio **3.0**
 - d. hazard ratio **3.0**
2. Differentiate between incidence and prevalence. **4.0**
3. Differentiate between sensitivity and specificity and discuss the relationship to false positives and false negatives. **4.0**
4. Differentiate between positive and negative predictive values of a diagnostic test. **4.0**
5. Distinguish between crude rates and adjusted rates. **3.0**
6. Calculate sensitivity, specificity, relative risk, and odds ratios when appropriate. **2.0**
7. Describe the utility of receiver operating characteristic (ROC) curves. **3.0**
8. Interpret likelihood ratios. **3.0**
9. Differentiate between internal and external validity. **3.0**
10. Recognize threats to internal and external validity. **3.0**
11. Differentiate between observational and experimental studies. **4.0**
12. Identify sources of, and means to control bias, including: randomization, blinding,

- and matching, etc. **4.0**
13. Discuss the hierarchical levels of evidence of a study based on study design. **4.0**
14. Differentiate between a systematic review, meta-analysis, Clinical Practice Guideline (CPG), Clinical Consensus Statement, Decision Analysis and Cost-effectiveness Analysis. **4.0**
15. Interpret number needed to treat (NNT), number needed to prevent (NNP), and number needed to harm (NNH). **4.0**
16. Describe the role of the Institutional Review Board (IRB). **4.0**
17. Differentiate between clinical informed consent for treatment versus informed consent for inclusion as a research subject. **4.0**
18. Apply the three bioethical principles (Respect for Persons, Beneficence, and Justice) that underlie human research, as described in the *Belmont Report*. **3.0**

GERIATRICS LEARNING OBJECTIVES

I. Geriatrics

1. Discuss the present and future care and economic issues resulting from demographics that reflect a steadily rising geriatric population within the U.S. **4.0**
2. Apply principles of the biology of aging related to geriatric pharmacotherapy and diagnostic laboratory values. **4.0**
3. Explain the role of the podiatrist in a multi-disciplinary geriatric healthcare team. **4.0**
4. Identify and discuss clinical situations wherein life expectancy, functional status, patient preference, and/or goals of care override standard recommendations for treatment in the geriatric patient. **4.0**
5. Create a management plan for falls, balance disorders and gait disorders in the geriatric patient. **4.0**
6. Identify challenges associated with the evaluation and management of urinary incontinence. **3.0**
7. Discuss cognitive and behavioral disorders in the geriatric patient. **4.0**
8. List and differentiate between types of code status, healthcare proxies, and advanced directives as indicated by the clinician's state of practice/training. **4.0**
9. Discuss the unique needs of the geriatric patient in institutional settings. **4.0**
10. Explain the spectrum of institutional healthcare settings available to the geriatric patient. **4.0**
11. Recognize signs of elder abuse and explain protocol for reporting abuse. **4.0**
12. Discuss the spectrum of end-of-life care as a positive, active treatment option for a patient with advanced disease. **4.0**

MEDICINE LEARNING OBJECTIVES

Infectious diseases

Neurologic disorders

Cardiovascular disorders

Rheumatologic disorders

Metabolic and endocrine disorders

Hematologic disorders, including anemias and leukemia

Immunologic disorders (allergic and sensitivity reactions, and immunosuppressive states)

Respiratory disorders (including asthma, emphysema, infectious pneumonitis)

Behavioral medicine (depression, abuse, anger disorders, and noncompliant patients)

Emergency medicine (medical/surgical)

Dermatology

Gastroenterology

Geriatrics

Pre- and Postoperative Treatment

I. Infectious diseases

1. Interpret aspects of a focused history and physical to identify patients with infectious disease. 4.0
2. Analyze laboratory, physiologic, or imaging data that is utilized in diagnosing and recognizing infectious disease. 4.0
3. Describe potential host defenses and responses against an invading organism. 3.0
4. Define *fever of unknown origin (FUO)*, list common causes, and describe how FUOs are classified. 4.0
5. Discuss the Centers for Disease Control and Prevention (CDC) guidelines for hand hygiene. 4.0

A. Bacterial

1. List common bacterial infections and the most likely causative organism in skin and joints. 4.0
2. Recommend proper antibiotic selection and usage for a given organism. 4.0
3. Discuss the etiology, presentation, diagnosis, and treatment of joint space infections and puncture wounds. 4.0
4. Classify osteomyelitis and puncture wounds. 3.5
5. List the symptoms of, and common antibiotics used for, the treatment of urinary tract infections. 2.0
6. List the treatment available for patients with sexually transmitted diseases. 2.0
7. Differentiate between colonization and infection in the diabetic foot ulcer. 4.0
8. Assess the need for the use of antibiotic prophylaxis, SCIP (Surgical Care Improvement Program). 4.0
9. Assess the various bite wounds with respect to prevalence, usual etiologic agents, risk of infection, treatment options, and potential complications. 4.0

B. Viral

1. Identify incidence, prevalence, transmission and pathology of HIV. 2.0
2. List the manifestations of AIDS on the lower extremity with respect to dermatological, neurological, vascular, and musculoskeletal findings. 4.0
3. Explain how the Absolute CD4 (T-helper) Lymphocyte Count, CD4 Lymphocytes, and Viral Load are used as predictors of outcome in HIV. 4.0
4. Discuss the basic principles of highly active antiretroviral therapy (HAART). 3.0
5. Describe preventive strategies for needlestick and sharps injuries intended to reduce the transmission of blood borne pathogens (hepatitis B, hepatitis C, and HIV). 4.0
6. Discuss basics of post-exposure prophylaxis, including indications, efficacy and side effects of post-exposure prophylaxis for Hepatitis B and HIV/AIDS. 3.0
7. Discuss the route of transmission, incubation period, duration of illness, duration of viral shedding, duration of (uncomplicated) illness, and the timing of the "flu season", lab diagnosis, and vaccination of the population. 2.0
8. Describe the diagnosis, clinical findings, prevention, treatment, and complications of HSV1 & 2, Varicella and Zoster, Mononucleosis and CMV 2.0
9. Describe the diagnosis, clinical findings, prevention, treatment, and complications of Measles, Mumps, Poliomyelitis, and Rubella. 2.0
10. Describe the diagnosis, clinical findings, prevention, treatment, and complications of Dengue, Colorado Tick Fever, Hemorrhagic Fevers and Yellow Fever. 2.0

C. Fungal and Mycobacterium

1. Outline the various presentations of TB and list the populations most at risk. 3.0
2. Explain the role of TB skin testing in TB screening and discuss conditions which may produce false negative or false positive results. 3.0
3. List the populations most at risk for TB. 2.0
4. List the treatment and prophylaxis regimen for mycobacterium tuberculosis. 2.0
5. Differentiate between the manifestations and treatment of histoplasmosis, blastomycosis, sporotrichosis, candidiasis, aspergillosis, and crypto. 2.0

II. Neurologic disorders

1. Explain the basic pathophysiology, diagnostic methods, and treatment regimens for the common neurologic podiatric complaints. 4.0
2. List the pathologies that can be diagnosed via NCV and EMG. 3.0
3. Assess the use of electromyography to evaluate peripheral neuropathies. 3.0
4. Describe the etiology, pathophysiology, clinical presentation, laboratory studies, diagnosis, treatment/management, course, complications, and prognosis in sciatic nerve damage. 3.0
5. Describe the etiology, pathophysiology, clinical presentation, laboratory studies, diagnosis, treatment/management, course, complications, and prognosis of diseases of the peripheral nervous system. 4.0
6. Describe the etiology, pathophysiology, clinical presentation, laboratory studies, diagnosis, treatment/management, course, complications, and prognosis of complex regional pain injuries I and II. 4.0
7. Classify neuropathy due to poison, deficiency states, and metabolic disorder; neuropathy secondary to neoplasm; inflammatory and infectious neuropathy; genetically determined neuropathy. 4.0
8. Assess the nature of sensory, motor, and autonomic neuropathies in a given diabetic patient. 4.0
9. Describe Charcot Joint, including definition, etiology, stages, clinical findings of each stage, diagnostic studies, differential diagnoses, diagnosis, concepts of treatment, and prognosis from the neurological perspective. 4.0
10. Differentiate common etiologies and clinical manifestations in radicular pain. 4.0

A. Central Nervous System Disorders, Including Diseases of the Spinal Cord

1. Differentiate between the types of seizure disorders 3.0
2. Assess the use of anticonvulsant medications in the perioperative period. 4.0
3. Demonstrate a neurologic examination with emphasis on reflex, sensory, and strength testing. 4.0
4. Describe the clinical manifestations of movement disorders, and their treatments. 4.0
5. Differentiate between the clinical presentation of upper motor versus lower motor neuron lesions. 4.0
6. Describe features of coma with reference to the Glasgow coma scale. 3.0
7. Explain the staging, diagnostic work-up, and treatment of the different types of demential and pseudo-dementia. 3.0
8. Discuss clinical principles of acute and chronic pain management. 4.0
9. Describe the clinical manifestations, course of illness, treatment, and prognosis of demyelinating diseases. 3.0
10. Identify types of headaches. 2.0
11. Describe relationships of findings on neurologic exam to segmental levels. 3.0

12. Differentiate between extra-medullary and intra-medullary lesions of the spinal cord. **3.0**
13. Identify risk factors, diagnosis, and treatment for the different types of Cerebrovascular accidents. **3.0**
14. Discuss the clinical aspects of neurofibromatosis. **3.0**
15. Explain the impact of neurodegenerative diseases on gait function. **4.0**
16. List the etiologies, clinical features and treatment of muscular dystrophies. **3.0**
17. Describe the etiology, incidence, pathophysiology, clinical presentation, diagnosis, treatment, course, and prognosis of cerebral palsy. **3.0**
18. Describe the incidence, etiology, pathophysiology, clinical presentation, laboratory studies, diagnosis, treatment/management, course, and prognosis of alcohol malnutrition polyneuropathy. **3.0**
19. Define and describe the teology, clinical presentation, diagnosis, course, treatment, and prognosis of disorders of the neuromuscular junction with emphasis on Myasthenia Gravis. **2.0**
20. Describe ALS (Combined Upper and Lower Motor Neuron Syndrome) in clinical terms. **2.0**

III. Cardiovascular Disorders

A. Major Cardiac

1. Distinguish the major types of myocardial injury and relate specific principles of medical management. **4.0**
2. Describe the physiologic basis of congestive heart failure and relate specific principles of medical management. **4.0**
3. Describe major cardiovascular diseases including endocarditis, valvular pathology, and cardiomyopathies, acute and chronic coronary heart disease and hypertension and relate to specific principles of medical management. **4.0**
4. Identify the major types of pediatric cardiac disorders with emphasis on cyanotic versus acyanotic manifestations. **4.0**
5. Assess the lower extremity manifestations associated with cardiovascular disease. **4.0**
6. Explain how to perform a focused history and physical for the cardiac system. **4.0**
7. Identify the laboratory, physiologic, or imaging data that is utilized in identifying cardiac pathology. **4.0**
8. Identify the cardinal symptoms and signs of cardiac pathology. **4.0**
9. Explain general concepts of electrocardiography with emphasis on presentation of maglignant arrhythmias and ischemic heart disease. **3.0**
10. Explain how to correlate EKG findings with the patient's clinical presentation from a perioperative standpoint. **4.0**
11. Describe the management of atrial fibrillation from a clinical and pharmacologic point in the perioperative period. **4.0**
12. Explain the roles and pharmacology of commonly prescribed cardiac medications in the treatment of cardiac diseases. **4.0**
13. Describe clinical manifestations and treatments of dyslipidemia. **3.0**
14. Discuss the principles of BLS (Basic Life Support) and ACLS (Advanced Cardiac Life Support). **4.0**
15. Discuss the standards for cardiac monitoring a patient under local, regional, and general anesthetics. **4.0**
16. Explain the types and clinical manifestations of pericardial diseases. **2.0**
17. Discuss the pathogenesis of valvular heart disease and it's relationship to endocarditis. **4.0**

B. Rheumatic Fever and Endocarditis

1. Describe the clinical manifestations of rheumatic fever and its clinical complications with an emphasis on valvular heart disease and endocarditis. **3.0**
2. List the heart valves most commonly affected by rheumatic fever in decreasing frequency. **3.0**
3. Describe how the Jones Criteria is used to diagnose rheumatic fever, using “major” and “minor” criteria. **2.0**
4. Describe appropriate treatment and prevention for rheumatic fever. **3.0**

C. Arterial, Venous, Lymphatic

1. Identify clinical signs and symptoms of venous insufficiency. **4.0**
2. Identify potential complications and recommend appropriate treatment concepts of venous insufficiency. **4.0**
3. Identify potential complications of abdominal aortic aneurysm, arteriovenous malformations and carotid artery disease. **3.0**
4. Discuss the proper work-up and instrumentation contained in the noninvasive vascular exam. **4.0**
5. Identify the clinical findings and sequelae associated with venous disease. **4.0**
6. Explain how to perform a focused history and physical, to identify patients with acute and or chronic peripheral vascular disease. **4.0**
7. Identify laboratory, physiologic, or imaging data that is utilized in identifying acute and or chronic peripheral vascular disease. **4.0**
8. Explain the cardinal symptoms and signs of acute and/or chronic peripheral vascular disease. **4.0**
9. Determine, classify, and compare and contrast diabetic versus non-diabetic vascular disease. **4.0**
10. Determine, classify, and compare and contrast conservative versus surgical Treatments in PVD. **4.0**
11. Describe the etiology, pathophysiology, differential diagnoses, and complications of deep venous thrombosis. **4.0**
12. Describe the clinical findings of DVT, clinical laboratory studies, medical, and surgical treatment (including the Greenfield filter). **4.0**
13. Describe the etiologies, differential diagnoses, laboratory studies, and principles of management of localized edema. **4.0**
14. Describe the etiologies, differential diagnoses, laboratory studies, and principles of treatment of primary and secondary lymphedemas. **3.0**
15. Explain acute arterial occlusion, including intrinsic and extrinsic etiology, reperfusion, clinical findings, diagnosis, management, and morbidity/mortality rates. **3.0**
16. Describe the etiologies, clinical manifestations, and management of blue toe syndrome. **4.0**
17. Describe the diagnosis, prognosis, surgical workup, and complications of aneurysms. **4.0**
18. Describe the following variants of cold injury: **4.0**

IV. Rheumatologic Disorders

A. Myopathies (Primary, Secondary)

1. Describe the clinical features and assessment of myopathies. **3.0**
2. Define arthritides. **4.0**

3. Describe the demographics, clinical course, physical, radiographic, and laboratory findings and management of osteoarthritis, RA, and seronegative Spondyloarthropathies, crystal-induced and infectious arthritides. **4.0**
4. Explain how to perform a focused history and physical to identify patients with rheumatologic diseases. **4.0**
5. Define SLE and give examples of other select connective tissue diseases. **4.0**
6. Describe the demographics, clinical course, physical, radiographic and laboratory findings and management of SLE and other select connective tissue diseases. **3.0**
7. Describe the demographics, clinical course, physical, radiographic, and laboratory findings and management of fibromyalgia. **3.0**
8. Analyze the signs and symptoms of and polymyalgia rheumatica (PMR) and Giant Cell Arteritis. **3.0**
9. Identify the most common infecting organisms responsible for infectious arthritis and their risk factors. **4.0**
10. Describe the etiology, clinical presentation, differential diagnoses, studies, diagnosis, treatment, and complications of vasculitis. **4.0**
11. Discuss the definition, clinical manifestations, lab findings and treatment of idiopathic inflammatory myopathies **3.0**

V. Metabolic and Endocrine Disorders

A. Diabetes

1. Identify the types of diabetes mellitus. **4.0**
2. Describe clinical presentations of diabetes mellitus. **4.0**
3. Outline the diagnostic process of interpretation of laboratory testing in diabetes mellitus. **4.0**
4. Discuss diabetic emergencies involving ketoacidosis, hypoglycemia, and hyperglycemia. **4.0**
5. Explain the basis for diabetic management in the following setting: outpatient, inpatient, and perioperative clinical scenarios. **4.0**
6. Describe indications and contraindications for oral hypoglycemic and insulin therapies. **3.0**
7. Explain medical management of serum glucose in the perioperative period. **4.0**
8. Identify patient-physician educational strategies for diabetes. **4.0**
9. Discuss microvascular and macrovascular complications of diabetes mellitus. **4.0**
10. Discuss the pathogenesis, treatment, and prevention of diabetic nephropathy. **4.0**
11. Discuss the pathogenesis and resulting effects of peripheral neuropathy. **4.0**
12. Discuss the clinical features and management of diabetic foot infections. **4.0**
13. Discuss the host response to infections in diabetics versus non-diabetics soft tissue infections in diabetics versus non-diabetics. **4.0**
14. Discuss clinical features of diabetic muscle infarction. **2.0**
15. Identify other types of infections in diabetic patients aside from those in the lower extremity. **4.0**

B. Gout

1. Describe the etiology clinical presentation, differential diagnoses studies, diagnosis treatment, and complications of gout and CPPD. **4.0**

C. Adrenal and Pituitary

1. Describe the diagnosis, clinical manifestations, and laboratory abnormalities in patients with adrenal dysfunction. **3.0**

2. Identify perioperative issues in patients with adrenal dysfunction. **4.0**
3. Explain the clinical and lab findings, differential diagnosis, treatment complications and prognosis of pheochromocytoma. **2.0**

D. Thyroid and Parathyroid

1. Correlate the clinical picture seen with hyposecretion and with hypersecretion of each hormone to the physiological effects of each hormone. **3.0**
2. Describe a perioperative management plan for a patient with hyper/hypothyroidism. **3.0**
3. Discuss the etiology, clinical signs and symptoms, and treatment of the common cause of hypercalcemia and hypocalcemia, with emphasis on the disorders of the parathyroid gland. **3.0**

E. Renal

1. Explain the components and implications of the results of a urinalysis. **4.0**
2. Identify clinical manifestations and etiology of nephrolithiasis. **3.0**
3. Explain the clinical impact of end-stage renal disease on the lower extremity, including lower extremity surgical outcomes. **4.0**
4. Evaluate the impact of renal disease on medication dosing. **4.0**
5. Explain perioperative management of podiatric patients with renal disease. **4.0**
6. Describe the clinical, laboratory, physiologic or imaging data used in identifying acute and or kidney injury versus chronic renal disease. **3.0**
7. Distinguish asymptomatic bacteriuria from a urinary tract infection. **3.0**
8. Identify and evaluate appropriate laboratory, physiologic, and imaging data specific for the diagnosis of acute and or chronic renal disease. **3.0**
9. Discuss nephrotic syndrome. **4.0**
10. Describe azotemia versus uremia. **4.0**
11. Discuss the implications of the use of contrast agents in patients with acute kidney injury and chronic renal disease. **4.0**

F. Fluid and Electrolyte Disorders

1. Explain the clinical implications and management of hypo/hy[ernatremia and hypo/hyperkalemia. **4.0**
2. Discuss IV fluid management in the acute care and perioperative settings **4.0**
3. Discuss other electrolyte disorders including but not limited to magnesium, calcium and phosphorus. **3.0**

G. Bone

1. Describe the dynamics of bone metabolism. **3.0**
2. Describe metabolic bone disease, including types, pathology, appropriate tests, and treatment. **4.0**
3. Explain the causes and mechanisms for osteoporosis and osteomalacia. **4.0**
4. Discuss renal osteodystrophy. **3.0**

VI. Hematologic Disorders, Including Anemias and Leukemia

1. Identify clinical implications of red blood cell, WBC and platelet abnormalities. **4.0**
2. Identify a differential diagnosis for a case of thrombocytopenia, given a clinical scenario. **3.0**
3. Discuss the factors that lead to "pathologic" thrombosis. **4.0**

4. Discuss the effects and diet recommendations relating to nutritional disorders or medications which affect the clotting factors of blood and bone density. 3.0
5. Discuss the risks and benefits of transfusion therapy. 3.0
6. Discuss the causes of B12 deficiency, folate deficiency, and iron deficiency. 3.0
7. Discuss the diagnosis of "anemia of chronic disease". 3.0
8. Discuss the differential diagnosis and diagnostic work up, given a clinical case of normocytic, microcytic or macrocytic anemia. 3.0
9. Compare and contrast "intrinsic" and "extrinsic" causes of hemolytic anemia. 3.0
10. Explain the clinical manifestations and perioperative management of patients with sickle cell disease. 4.0
11. Explain the perioperative management of patients with sickle cell disease. 3.0
12. Identify the risks and benefits of narcotic pain medication in patients with sickle cell disease. 3.0
13. Explain the clinical manifestations of patients with sickle cell disease. 3.0
14. Discuss biochemical abnormalities, the clinical manifestations and laboratory diagnoses of alpha and beta thalassemia. 2.0
15. Discuss the clinical manifestations of leukemia and lymphoma and implications for the podiatric patient. 3.0
16. Define *hemostasis* and discuss the role of the vessel, the platelet, and the plasma proteins, as well as the natural anticoagulants and fibrinolytics in normal hemostasis. 4.0
17. Describe the clinical and laboratory significance of PT, PTT, TT, bleeding time, INR, and mixing study. 4.0

VII. Immunologic Disorders (Allergic and Sensitivity Reactions and Immunosuppressive States)

1. Define *antigen*, *antibody*, and *immunoglobulin*. 4.0
2. Describe antigen-antibody Immunofluorescence reactions of:
 - a. direct technique; and 2.0
 - b. indirect technique. 2.0
3. Describe the complement system, including classical and alternate complement pathway, and explain the biological significance of the complement system. 2.0
4. Describe the following cells involved in and their role in the immune response:
 - a. neutrophils 3.0
 - b. monocytes-macrophages 3.0
 - c. lymphocytes 3.0
 - d. T-lymphocytes (T cell) 3.0
 - e. B-lymphocyte (B cell) 3.0
 - f. basophiles and mast cells 3.0
 - g. eosinophiles 3.0
5. Describe allergies in terms of classification, clinical manifestations, complications, and treatment. 3.0
6. Define hypersensitivity and identify and describe the two major types. 3.0
7. Describe the types of allergic diseases (reactions) according to classification of Gell and Coombs and types (I, II, III, and IV). 2.0
8. Recognize and discuss the management of anaphylaxis and Type IV allergic reactions/Delayed Hypersensitivity Response. 3.0

9. Discuss myeloproliferative disorders, including current classification. **2.0**
10. Evaluate a patient with neutrophils and recommend the proper work-up to differentiate a reactive leukocytosis, chronic myelogenous leukemia and leukemoid reaction. **3.0**
11. Evaluate thrombocytosis and understand the clinical significance of this finding. **3.0**
12. Discuss the current concept of myelodysplastic syndromes. **3.0**
13. Formulate a differential diagnosis for a patient with cytopenia. **3.0**

VIII. Respiratory Disorders (Including Asthma, Emphysema, Infectious Pneumonitis)

1. Discuss clinical manifestations and treatment of chronic bronchitis and emphysema and asthma. **4.0**
2. Identify the populations most at risk for the following types of pneumonia:
 - a. *S. pneumoniae* (pneumococcus) **3.0**
 - b. *mycoplasma pneumoniae* **3.0**
 - c. influenza **3.0**
 - d. gram negative bacilli **3.0**
 - e. legionella pneumonia **3.0**
 - f. viral **3.0**
3. Discuss treatment approaches for pneumonias. **3.0**
4. Identify risk factors for DVT / PE. **4.0**
5. Discuss preventive measures to reduce the risk of DVT. **4.0**
6. Identify the most common area of the venous system contributing to venous thromboembolism. **4.0**
7. Identify strengths and weaknesses of DVT diagnostic modalities. **4.0**
8. Describe the signs and symptoms that suggest PE. **4.0**
9. Identify the laboratory tests appropriate for the diagnosis of PE. **4.0**
10. Define the role of Imaging used in the diagnoses of PE. **4.0**
11. Identify a V/Q mismatch consistent with PE. **4.0**
12. Discuss the mainstays of treatment for an acute PE. **4.0**
13. Describe SIADH and hypertrophic osteoarthropathy. **3.0**
14. Describe the following syndromes according to etiology, symptoms, signs, diagnosis and treatment:
 - a. common cold/influenza/URI/laryngitis/epiglottitis **3.0**
 - b. otitis media and externa **3.0**
 - c. acute and chronic sinusitis **3.0**
 - d. acute bronchitis **3.0**
 - e. pleurisy **3.0**
15. Describe the process of assessing the patency of an airway. **4.0**
16. Discuss the common supplies and techniques in managing the airway in an emergent situation. **3.0**
17. Describe how pulse oximetry can help evaluate gas exchange and discuss the use in a chemical setting. **4.0**
18. Describe the clinical implications how the arterial blood gas report relates to the patient's clinical status. **3.0**
19. Describe the PFT abnormalities in relation to obstructive and restrictive lung diseases. **3.0**
20. Discuss the clinical use of incentive spirometry. **3.0**

- | | |
|--|-----|
| 21. Discuss the perioperative consideration for management of the patient with obstructive, restrictive and interstitial lung disease. | 3.0 |
| 22. Define <i>acute respiratory failure</i> . | 4.0 |
| 23. Discuss the presenting signs, symptoms, and labs for acute respiratory failure. | 4.0 |
| 24. Discuss the approach to management of patients with acute respiratory failure. | 4.0 |
| 25. Define <i>ARDS</i> . | 3.0 |
| 26. Discuss clinical manifestations and implications of obstructive sleep apnea. | 3.0 |

IX. Behavioral Medicine (Depression, Abuse, Anger Disorders, and Noncompliant Patients)

- | | |
|--|-----|
| 1. Identify and describe the major signs and associated symptoms of common psychiatric disorders. | 3.0 |
| 2. Discuss clinical features, course, prognosis, treatment, and mental status findings in the psychoses and personality disorders. | 3.0 |
| 3. Explain the emotional and psychological impact of chronic pain. | 3.0 |
| 4. Describe the podiatrist's role and obligations in dependent adult, child abuse and neglect. | 4.0 |
| 5. Identify signs and symptoms of dependent adult abuse. | 3.0 |
| 6. Identify signs and associated symptoms of child abuse and neglect. | 3.0 |
| 7. Identify guiding principles governing physicians' actions of end-of-life care. | 3.0 |
| 8. Explain the concept of patient autonomy and its implications in caring for dying patients. | 3.0 |

A. Substance Abuse

- | | |
|--|-----|
| 1. Describe etiologies, comorbidities, clinical features, and treatment plans for patient with substance dependence and abuse. | 3.0 |
| 2. Discuss the implication of pain management in patients with substance abuse disorder. | 4.0 |
| 3. Discuss clinical utility of toxicology screens. | 3.0 |
| 4. Discuss effects and side effects of withdrawal of alcohol. | 3.0 |
| 5. Discuss neurological effects of alcohol and Wernicke-Korsakoff syndrome. | 3.0 |

B. Altered Mental Status

- | | |
|--|-----|
| 1. List the components of the mini mental status exam. | 4.0 |
| 2. Define medical decision making capacity. | 4.0 |
| 3. Discuss medical decision making versus competency. | 4.0 |
| 4. Describe the risk factors for developing altered mental status. | 3.0 |
| 5. Explain the diagnostic evaluation of altered mental status. | 3.0 |
| 6. Explain principles of management of the common causes of altered mental status. | 3.0 |
| 7. Differentiate between delirium, dementia, and depression. | 4.0 |
| 8. Describe nonpharmacologic measures to reduce agitation and aggression. | 3.0 |

C. Psychiatric Disorders

- | | |
|---|-----|
| 1. Discuss signs and symptoms of panic disorders and anxiety. | 3.0 |
| 2. Define <i>OCD</i> , <i>Agoraphobia</i> , and <i>social phobia</i> . | 3.0 |
| 3. Explain post-traumatic stress disorder (PTSD). | 2.0 |
| 4. Discuss clinical features and mental status findings of disorders of mood. | 3.0 |
| 5. Discuss the differential diagnosis of schizophrenia, schizophreniform disorder, schizoaffective disorder, and delusional disorder. | 2.0 |

X. Emergency Medicine (Medical/Surgical)

1. List the components of medical history and physical examination necessary for the treatment of the emergency patient. **4.0**
2. Differentiate the signs and symptoms of cardiac versus noncardiac chest pain. **4.0**
3. Discuss symptoms and signs of chest pain due to gastrointestinal disorders, including esophageal disease (GERD, esophagitis, and esophageal dysmotility), biliary disease (cholecystitis and cholangitis), peptic ulcer disease, and pancreatitis. **3.0**
4. Discuss symptoms and signs of chest pain due to musculoskeletal causes, including costochondritis, rib fracture, myofascial pain syndromes, muscular strain, and herpes zoster. **3.0**
5. Discuss symptoms and signs of chest pain due to psychogenic causes. **2.0**
6. Identify the diagnostic discrimination between common causes of abdominal pain based on history, physical exam, laboratory testing, and imaging procedures. **3.0**
7. Discuss and evaluate the management of new onset fever in the Emergency Department setting. **3.0**
8. Discuss the clinical manifestations, lab findings, and treatment of patients with sepsis syndromes. **3.0**
9. Discuss venous stasis, and the postphlebotic syndrome, lymphedema, cellulitis, superficial thrombophlebitis, ruptured popliteal cysts, musculoskeletal injury, and arterial occlusive disorders as causes of unilateral leg pain and swelling. **4.0**
10. Describe the differential diagnosis of acute back pain. **2.0**
11. Recommend the diagnostic studies and treatment of the following:
 - a. ligamentous/muscle strain (nonspecific musculoskeletal back pain) **3.0**
 - b. degenerative arthritis (spondylosis) **3.0**
 - c. disc herniation **3.0**
 - d. spinal stenosis **3.0**
 - e. vertebral compression fracture **3.0**
 - f. traumatic fracture **3.0**
 - g. sacroileitis **3.0**
 - h. spinal metastases **3.0**
 - i. spinal epidural abscess **3.0**
 - j. cauda equina syndrome **3.0**
12. Describe the signs and symptoms of acute asthma, pulmonary embolus, and pneumothorax. **3.0**
13. Discuss hypertensive emergencies, and describe their symptoms and management. **3.0**
14. Explain the situations in which blood pressure lowering is urgent. **3.0**
15. Explain the emergency management of gunshot wounds, lacerations, and crush injuries. **4.0**
16. Discuss the etiology, signs and symptoms, and the treatment of syncope. **3.0**
17. Explain the indications for tetanus immunoprophylaxis and rabies. **4.0**
18. Explain the management of office emergency procedures. **4.0**
19. Describe the management of thermal injuries in the Emergency Department setting. **4.0**

XI. Dermatology

A. Diagnosis

1. Explain the primary, secondary, and special lesions of the skin. **3.0**
2. Describe the clinical presentations of psoriasis, lichen planus, allergic contact dermatitis, ichthyosis and hyperkeratotic disorders. **3.0**

3. Identify the appropriate therapeutic agents for the disorders for eczema and papulosquamous dermatoses and hyperkeratotic conditions. 4.0
4. Describe the clinical presentations of atopic dermatitis and list the associate clinical features of atopy. 3.0
5. Describe the different types of contact dermatitis and how to perform patch testing. 3.0
6. Explain the clinical manifestations, etiological agents, diagnosis, and treatment of viral infections. 4.0
7. Explain the morphology, etiology, and pathogenesis of verrucae. 4.0
8. List and describe the various treatment options and their indications for pedal warts. 4.0
9. Describe the clinical manifestations, treatments, differential diagnosis, pathophysiology, and typical presentations of the cutaneous manifestations of syphilis, disseminated gonorrhoea infection, human papilloma virus, and herpes simplex virus. 4.0
10. Explain the clinical manifestations, etiological agents, diagnosis, and treatment of cutaneous fungal infections. 4.0
11. Explain how to perform and interpret a KOH, fungal culture, PAS. 4.0
12. Diagnose and develop an appropriate treatment plan for tinea pedis. 4.0
13. Explain how and when to use a Wood's light and how to interpret the results. 4.0
14. Describe the pathophysiology of thermal injuries, including systemic manifestations, and clinical management. 4.0
15. Discuss the treatment of chilblais and frostbite. 3.0
16. Recommend a management plan for pedal hyperhidrosis and anhidrosis. 3.0
17. Identify the special sports related pedal skin problems. 3.0
18. Discuss the various xerotic disorders from common xerosis to ichthyosis. 3.0

B. Dermatoses

1. Differentiate mechanical versus genetic causes of hyperkeratotic lesions 3.0
2. Discuss the characteristic concomitant systemic physical findings associated with the genodermatoses. 3.0

C. Local and Systemic Manifestations

1. Explain the relationship between diseases of internal organs and manifestations on the skin and nail. 4.0
 - a. Endocrine
 - b. Cardiac
 - c. Rheumatologic
 - d. Renal
 - e. Pulmonary
 - f. Internal malignancy
2. Explain the necessity to refer patients with underlying systemic diseases to a specialist for management of the primary disease. 4.0
3. Describe the following conditions:
 - a. drug reactions (Stevens Johnson Syndrome and TEN) 3.0
 - b. connective tissue disease 3.0
 - c. necrobiosis lipoidica diabetorum 3.0
 - d. vitiligo 3.0
 - e. vasculitis 3.0
 - f. acanthosis nigricans 3.0

D. Tumors

1. Identify the clinical characteristics distinguishing a benign and malignant lesion. 4.0
2. List the types of benign, premalignant, and malignant skin tumors. 4.0
3. Describe the clinical features of basal cell carcinoma, squamous cell carcinoma, and malignant melanoma. 4.0
4. Explain the different types of skin biopsies. 4.0
5. Describe the following conditions:
 - a. Bowen's disease 3.0
 - b. Kaposi's sarcoma 3.0
 - c. Mycosis Fungoides/Cutaneous T Cell Lymphoma 3.0
 - d. Metastatic disease 3.0

E. Special Disorders of Nails and Appendages of the Skin

1. Discuss the diagnosis and treatment of onychocryptosis and paronychia. 4.0
2. Explain the nail unit's reaction patterns such as Beau's lines, pitting and onycholysis. 4.0
3. Describe the diagnosis and management of onychomycosis. 4.0
4. Identify and define the benign and malignant tumors of the nail. 4.0
5. Identify the differential diagnosis of longitudinal melanonychia. 4.0
6. Recognize the clinical significance of splinter hemorrhage.. 3.0

F. Ulcers

1. Describe the etiology of leg ulcers: arterial, venous, infectious, rheumatological, malignant, and traumatic. 4.0
2. Discuss the distribution of lower extremity ulcers and its relation to etiology. 3.0
3. Identify the etiology and management of venous ulcers. 4.0
4. Identify the etiology and management of arterial ulcers. 4.0
5. Identify the etiology and management of diabetic ulcers. 4.0
6. Identify the etiology and management of neuropathic ulcers. 4.0
7. Explain the vascular perfusion and its role in ulcer management. 3.0

XII. Gastroenterology

1. Identify and evaluate the significance of abnormal liver functions tests. 4.0
2. Identify and clinical manifestations and treatment of acute and chronic hepatitis. 3.0
3. Identify the clinical manifestations and significance of GI bleeding/peptic ulcer disease/GERD. 4.0
4. Identify the clinical manifestations and significance of Inflammatory Bowel Disease. 3.0
5. Identify the clinical manifestations and significance of pancreatitis. 3.0
6. Identify the clinical manifestations and significance of colon cancer and its screening modalities. 3.0
7. Discuss the etiology, clinical manifestations and treatment of C. Diff colitis. 4.0
8. Identify the clinical significance of post-operative constipation. 4.0
9. Discuss the clinical manifestations of celiac disease and IBD. 3.0
10. Discuss medical versus surgical cause of an acute abdomen. 3.0
11. Identify the clinical manifestations and treatment of biliary tract disease. 3.0

XIII. Geriatrics

1. Identify and evaluate urinary incontinence and retention in the perioperative period. **3.0**
2. Identify dementia, delirium, and depression in the perioperative period, with special emphasis on delirium postoperatively. **3.0**
3. Discuss nutritional issues in the geriatric population. **3.0**
4. Explain the evaluation of podiatric problems in the nursing home patient, as well as the recognition of age-associated medical and psycho-social issues. **4.0**
5. Explain the recognition, prevention, and treatment of deep tissue injury (Decubitis) in the geriatric, as well as classifications of Pressure Ulcers. **4.0**
6. Explain the significance of advanced directives and the POLST (Physician Order for Life Sustaining Treatment) form for the geriatric patient. **3.0**
7. Recognize the importance and frequency of Vitamin D insufficiency and deficiency. **3.0**
8. Apply principles of biology of aging related to geriatric pharmacology and diagnostic laboratory findings. **4.0**
9. Explain the role of the podiatrist in a multi-disciplinary geriatric health team. **4.0**
10. Recognize the importance of a management plan for falls, balance and gait disorders in the geriatric patient. **4.0**
11. Explain the spectrum of institutional healthcare settings available to the geriatric patient. **4.0**
12. Recognize signs of elder abuse and explain the protocol for reporting abuse. **4.0**
13. Discuss the spectrum of end-of-life care as a positive, active treatment option for a patient with advanced disease. **4.0**

XIV. Pre and Postoperative Assessment

1. Explain the indications for and evaluation of preoperative laboratory, physiologic, and imaging data. **4.0**
2. Discuss the preoperative evaluation for cardiac risk. **4.0**
3. Explain evaluation of specific organ systems in the preoperative geriatric and pediatric patient. **4.0**
4. Discuss the assessment of the following postoperative problems
 - a. Fever **4.0**
 - b. Altered mental status **4.0**
 - c. Fluid & electrolyte disturbances **4.0**
 - d. Acute Kidney Injury/Chronic renal disease **3.0**
 - e. Chest pain and shortness of breath **4.0**
 - f. Postoperative hypotension and hypertension **3.0**
 - g. Constipation/diarrhea **3.0**
 - h. Delirium **3.0**
5. Explain the management of HPA axis suppression in patients on steroids in the perioperative period. **3.0**

ORTHOPEDICS LEARNING OBJECTIVES

Biomechanics

Pathomechanics

Sports Medicine

General Orthopedics

Pediatric Orthopedics

I. Biomechanics

A. Basic Terminology

1. Identify and describe motions, positions, and fixed positions that occur in each of the cardinal planes as they pertain to the lower extremity with emphasis on the foot and ankle. 4.0
2. Differentiate between the suffixes *-ion*, *-ed*, and *-us*. 4.0

B. Basic Mechanics

1. Define *center of mass* and *center of gravity*. 4.0
2. Define *torques*, *couples*, and *moments*. 4.0
3. Differentiate between energy, kinetic energy, and potential energy. 4.0
4. Define *centripetal force*, *centripetal acceleration*, and *angular acceleration*. 3.0
5. Identify the equations of rotational motion. 3.0
6. Define *linear motion* and identify the equations of linear motion. 3.0
7. Define *power and work*, and describe the relationship between them. 3.0
8. Discuss Newton's Laws of Motion and their application to the process of human gait. 4.0
9. Discuss the basic concepts of inertia, momentum, and motion as they relate to the lower extremity. 4.0
10. Explain the principle of conservation of angular momentum. 3.0
11. Differentiate between rotational and linear motion. 4.0
12. Explain the principle of conservation of linear motion. 3.0
13. Describe the relationship between kinetic and potential energy in gait. 4.0
14. Discuss the concepts of stress and strain physics. 4.0
15. Describe a stress/strain diagram. 4.0
16. Discuss the concept of friction as a force, and explain the laws of friction and coefficients of friction. 3.0
17. Differentiate between friction and shear forces. 4.0
18. Differentiate between scalar and vector quantities. 3.0
19. Describe the concept of a lever and the types of levers with reference to the lower extremity. 4.0
20. Identify and describe the different loading modes. 3.0

C. Tissue Physiology Mechanics

1. Explain functional adaptation of soft tissue (Davis' Law) 4.0
2. Describe basic elements of bone and tendon physics. 4.0
3. Differentiate between the behaviors of adult bones under different loading modes. 4.0
4. Explain combined loading of bone. 4.0
5. Explain functional adaptation of bone (Wolff's Law). 4.0
6. Explain the effect of muscle contraction on bone. 4.0
7. Explain the relationship between the sarcomere and the development of muscle tension. 3.0
8. Describe the biomechanical properties of cartilage. 3.0
9. Describe the biomechanical properties and characteristics of ligaments and tendons. 3.0
10. Describe the length-tension relationship of muscles. 4.0
11. Compare and contrast single and multiple joint muscles. 4.0
12. Describe factors that affect mechanical efficiency. 3.0
13. Define *elastic response*. 4.0

D. Normal Compensation and Static Stance

1. Define *compensation* and distinguish normal and abnormal compensation. 4.0
2. Discuss the effect of deviation of the trunk or leg on the foot. 4.0
3. Discuss the effect of deviation in one part of the foot on the other. 4.0
4. Discuss the effect of deviation of the terrain on the foot. 4.0
5. Describe the distribution of body weight during static stance, including contraction of the gastrocnemius. 4.0
6. Explain osseous restraining mechanisms. 4.0
7. Compare and contrast the contributions of bone, muscles, and ligaments in stability during static stance. 4.0
8. Explain what happens when rotatory moments induced by ground reactive forces cannot be compensated. 4.0
9. Explain why subtalar and midtarsal joints are primarily involved in compensation. 4.0

E. Forces and Functional Anatomy

1. Explain the production of abnormal shear forces during propulsion. 3.0
2. Discuss the role of the swing limb in forward movement of the body. 4.0
3. Compare and contrast the structure and function of the medial and lateral columns of the foot. 4.0
4. Describe the effect that distortion of anatomy has on function. 3.0
5. Describe the locking function of the midtarsal joint and relate the midtarsal motion and position to subtalar joint (STJ) position. 4.0
6. Compare and contrast high and low gear axis of motion (Finn Bojsen-Møller). 3.0
7. Explain beam and truss and relate to contact and propulsion. 4.0
8. Explain the function of the plantar fascia (Windlass mechanism). 4.0
9. Describe and demonstrate the technique for the Hubscher maneuver/Jack's test. 4.0

F. Manual Muscle Testing

1. Describe the techniques used to test muscle strength for lower extremity muscles. 4.0
2. Discuss the standard five point grading scale used to evaluate muscle strength. 4.0

E. Gait

1. Describe the subdivision of gait into phases and periods. 4.0
2. Describe the periods of the stance phase of the gait cycle 4.0
3. Describe the contact, midstance and propulsion periods of the stance phase of the gait cycle. 4.0
4. Describe the contact, midstance, terminal stance and pre-swing periods of the stance phase of the gait cycle 4.0
5. Describe the contact, midstance, active propulsion and passive lift off periods of the stance phase of the gait cycle 4.0
6. Describe the swing phase of the gait cycle. 4.0
7. Define *cadence*, *step length*, *stride length* and *angle and base of gait*. 4.0
8. Define *velocity* and explain its relationship to gait. 4.0
9. Describe the relationship between limb length and cadence. 4.0
10. Describe the distribution of forces across the foot throughout the gait cycle. 4.0
11. Describe the role the leg and body play in participation and support of gait. 4.0
12. Identify the position and the motion of each joint in the lower extremity for any given point throughout the gait cycle, and the moments that are being applied during these phases. 4.0
13. Discuss the function of each muscle or muscle group throughout the gait cycle. 4.0

14. Describe the position of the first ray in each of the phases of the gait cycle and the moments that are being applied during these phases.	4.0
15. Discuss the role of the sesamoid apparatus throughout the gait cycle.	4.0
16. Describe the position of the forefoot to the ground in each of the phases of the gait cycle.	4.0
17. Identify and describe each body segment as it moves in the three body planes.	4.0
18. Describe function of the upper body to the lower body during gait.	4.0
19. Apply the concept of ground reactive force to abnormal positions of the foot throughout the gait cycle.	4.0
H. <u>Phasic Muscle Activity</u>	
1. Differentiate between concentric, eccentric, and isometric muscle contractions and understand the roles that they play in gait.	4.0
2. Determine the type of muscle contraction that lower extremity muscles are undergoing during each phase of the gait cycle.	4.0
3. Identify the normal phasic muscle activity of the anterior thigh; medial thigh; posterior thigh; anterior leg; lateral leg; posterior leg; and intrinsic foot muscle groups during gait.	4.0
4. Differentiate between monophasic and biphasic muscle activity.	4.0
5. Describe the consequences of anterior leg muscle dysfunction relative to gait.	4.0
6. Describe the consequences of posterior leg muscle dysfunction relative to gait.	4.0
7. Describe the consequences of lateral leg muscle dysfunction relative to gait.	4.0
8. Discuss the consequences of intrinsic foot muscle dysfunction relative to gait.	4.0
9. Discuss the muscle dysfunction above the knee relative to gait.	4.0
I. <u>Principles of Shock Absorption</u>	
1. Define shock absorption and identify the gait parameters that influence.	4.0
2. Describe the roles that the subtalar, ankle, knee, and hip joints play in shock absorption.	4.0
3. Explain the influence that timing sequence of the shock absorbing mechanism has on the body's ability to absorb shock.	4.0
4. Describe the pathology and parameters that may lead to poor shock absorption.	4.0
5. Describe the role of the plantar fat pad in shock absorption.	4.0
6. Describe the role that footwear plays in shock absorption.	4.0
J. <u>Principles of Stability</u>	
1. Define <i>stability</i> and <i>instability</i> .	4.0
2. Describe the attributes of joint stability.	4.0
3. Describe the relationship the subtalar joint and midtarsal joint have with respect to stability.	4.0
4. Describe the role that the arch of the foot plays with respect to stability.	4.0
5. Define <i>joint hypermobility</i> and <i>joint congruity</i> .	4.0
6. Describe the role that the soft tissues have on stability.	4.0
7. Contrast and compare positive and negative mechanical advantages.	4.0
8. Explain the theory of proximal stability and apply it to the joints of the lower extremity.	4.0
K. <u>Kinetics and Kinematics</u>	
1. Define <i>kinetics</i> and <i>kinematics</i> .	3.0
2. Define <i>inverse kinematics</i> and <i>forward kinematics</i> .	3.0
3. Interpret a kinematic graph.	3.0
4. Define <i>momentum</i> and explain its relation to any given point in the gait cycle.	4.0
5. Define <i>acceleration</i> and how it relates to the gait cycle.	4.0

6. Identify and explain the factors that influence a muscle's ability to produce power. 4.0
7. Define and distinguish between internal and external moments around a joint axis. 4.0
8. Discuss the moment of any given joint at any particular point in the gait cycle. 4.0
9. Define ground reactive force, ground reactive force vector, center of pressure, line of gravity, center of gravity, center of mass and center of force. 4.0
10. Explain ground reactive force and determine the position and orientation of the force with respect to the joints of the lower extremity during each phase of the gait cycle. 4.0

L. Functional Axes and Planes of Motion

1. Describe the cardinal and anatomic planes of the body. 4.0
2. Describe axis of motion. 4.0
3. Differentiate between uniaxial, biaxial, and triaxial joints. 4.0
4. Differentiate between uniplanar, biplanar, and triplanar joints. 4.0
5. Discuss the concept of planar dominance as it relates to a joint. 4.0
6. Describe the ankle joint axis in terms of orientation/location, and plane of motion. 4.0
7. Describe the subtalar joint axis in terms of orientation/location, and plane of motion. 4.0
8. Describe the midtarsal joint axes in terms of orientation/location, and plane of motion. 4.0
9. Describe the first ray axis in terms of orientation/location, and plane of motion. 4.0
10. Describe the fifth ray axis in terms of orientation/location, and plane of motion. 4.0
11. Describe the first metatarsophalangeal joint axes in terms of orientation/location, and plane of motion. 4.0
12. Describe the role of the lesser metatarsophalangeal joint axes in terms of orientation/location, and plane of motion. 4.0
13. Describe degrees of freedom of motion (rotation and translation). 3.0
14. Describe the motions involved in open and closed kinetic chain pronation and supination. 4.0

M. Spine, Pelvis (SI)

1. Identify and describe the axes of motion and biomechanics of the spine. 3.0
2. Define coupling as it relates to spinal mechanics. 3.0
3. Define motion segment as it relates to spinal biomechanics. 3.0
4. Describe how the pathology at L4-L5 and L5-SI affect the biomechanics of the lower leg and foot. 4.0
5. Discuss the anatomy, function and Instant Axis of Rotation (IAR) of the intervertebral disc. 3.0
6. Describe the motions that occur at the sacroiliac joint. 3.0

N. Hip Joint

1. Describe the hip joint axes in terms of orientation/location, and plane of motion. 4.0
2. Describe and demonstrate the techniques used to measure sagittal, transverse and frontal plane hip range of motion. 4.0
3. State the normal sagittal, transverse and frontal plane ranges of motion for the hip. 4.0
4. Describe the anatomical limitations affecting hip flexion with the knee flexed and with The knee extended. 4.0
5. Describe the anatomical limitations affecting transverse plane hip range of motion with the hip flexed and with the hip extended. 4.0
6. Discuss the position and motion of the hip throughout the gait cycle. 4.0
7. Discuss neutral position versus closed-packed position of the hip. 4.0
8. Calculate the transverse plane neutral position of the hip. 4.0

O. Functional Deviations of the Hip Joint

1. Describe signs, symptoms, and gait changes associated with abnormal hip range of motion. 4.0
2. Discuss the various planal abnormalities about the hip, including coxa varum, coxa valgum 4.0

P. Knee Joint

1. Describe the knee joint axes in terms of orientation/location, and plane of motion. 4.0
2. Discuss the position and motion of the knee throughout the gait cycle. 4.0
3. Discuss the relationship of knee joint function on the hip, leg, and foot. 4.0
4. Discuss the muscles governing knee joint function and describe their role during gait. 4.0
5. Discuss normal patellofemoral joint function. 4.0
6. Discuss the anatomic structures associated with stability and flexibility at the knee. 4.0
7. Describe and demonstrate the techniques used to measure knee range of motion. 4.0
8. Describe and demonstrate the techniques used to evaluate the frontal and sagittal plane position of the knee. 4.0
9. Differentiate between true tibial torsion and malleolar position. 4.0
10. Describe and demonstrate the technique used to measure malleolar position. 4.0
11. State normal values for malleolar position. 4.0

Q. Functional Deviations of the Knee

1. Discuss the planal abnormalities of the knee, including genu varum, tibial varum, genu valgum and tibial valgum, and genu recurvatum. 4.0
2. Describe signs, symptoms, and gait changes associated with abnormal knee position. 4.0
3. Discuss the effects of ankle equinus on the knee. 4.0
4. Discuss the effect of subtalar joint pronation and supination on the knee. 4.0
5. Describe etiologies, signs, symptoms, and gait changes associated with abnormal malleolar position. 4.0

R. Ankle Joint

1. Describe the ankle joint axis in terms of orientation/location, and plane of motion. 4.0
2. Describe and demonstrate the technique used to measure ankle joint dorsiflexion. 4.0
3. State normal ranges of motion for the ankle joint. 4.0
4. Discuss the position and motion of the ankle throughout the gait cycle. 4.0
5. Describe neutral position of the ankle joint. 4.0

S. Functional Deviations of the Ankle

1. Define equinus deformity of the ankle. 4.0
2. Describe the etiologies of ankle joint equinus. 4.0
3. Differentiate between the different types of equinus (bony block, gastrocnemius, gastro-soleus, and pseudoequinus). 4.0
4. Discuss the general clinical features associated with ankle equinus. 4.0
5. Discuss compensation mechanisms and associated gait patterns in the presence of equinus. 4.0
6. Discuss the biomechanical treatment principles for equinus. 4.0
7. Describe the radiographic manifestations of ankle joint equinus. 4.0

T. Subtalar Joint

1. Describe the subtalar joint axis in terms of orientation/location, and plane of motion. 4.0
2. Describe and demonstrate the technique used to measure subtalar joint motion. 4.0

- 3 Describe and demonstrate the technique used to measure and calculate subtalar joint neutral position 4.0
- 4 State normal ranges of motion for the subtalar joint. 4.0
- 5 Discuss the position and motion of the subtalar joint throughout the gait cycle. 4.0
6. Differentiate between open and closed kinetic chain subtalar joint function. 4.0
7. Describe the anatomical limitations affecting subtalar joint range of motion. 4.0
8. Describe the concept of rotational equilibrium on subtalar joint function. 4.0

U. Functional Deviations of the Subtalar Joint

1. Describe the sagittal plane deviations of the subtalar joint axis and discuss the possible outcomes. 4.0
2. Describe the transverse plane deviations of the subtalar joint axis and discuss the possible outcomes. 4.0
3. Describe the effects of subtalar joint range of motion as a result of variations in the position of its axis. 4.0
4. Describe etiologies, signs, symptoms, and gait changes associated with abnormal subtalar joint. 4.0

V. Rearfoot Deformities

1. Differentiate between rearfoot varus and rearfoot valgus. 4.0
2. Identify and discuss the etiologies of rearfoot varus and rearfoot valgus. 4.0
3. Distinguish rearfoot varus from subtalar joint varus. 4.0
4. Distinguish rearfoot valgus from subtalar joint valgus. 4.0
5. Define and identify *tibial varum* and *tibial valgum*. 4.0
6. Differentiate between rearfoot valgus and *calcaneal valgus*. 4.0
7. Discuss how calcaneal varus may contribute to a rearfoot varus deformity 4.0
8. Define and differentiate between resting calcaneal stance and neutral calcaneal stance position. 4.0
9. Describe and demonstrate the technique used to measure resting calcaneal stance position and neutral calcaneal stance position. 4.0
10. Define tibial influence, and its effect on rearfoot position. 4.0
11. Describe and demonstrate the technique used to measure tibial influence. 4.0
12. Discuss the impact of tibial influence on the subtalar joint's ability to compensate. 4.0
13. Identify and discuss possible scenarios that lead to an inverted, everted and perpendicular resting calcaneal stance position. 4.0
14. Discuss why neutral calcaneal stance position represents total rearfoot deformity. 4.0
15. Describe deformities that may cause abnormal stance positions. 4.0
16. Identify the compensations and possible outcomes for a rearfoot varus and rearfoot valgus. 4.0
17. Describe etiologies, signs, symptoms, and gait changes associated with rearfoot varus and rearfoot valgus. 4.0
18. Distinguish between fully compensated, partially compensated and uncompensated rearfoot varus. 4.0
19. Describe the radiographic manifestations of rearfoot varus and rearfoot valgus. 4.0
20. Discuss biomechanical treatment of rearfoot varus and rearfoot valgus. 4.0

W. Midtarsal Joint

1. Describe themidtarsal joint axes in terms of orientation/location, and plane of motion. 4.0
2. Describe and demonstrate the technique used to assessmidtarsal joint motion. 4.0

3. Discuss the position and motion of the midtarsal throughout the gait cycle. 4.0
4. Explain how the midtarsal joint deformity results in a forefoot varus or forefoot valgus 4.0
5. Describe and demonstrate the technique used to measure the forefoot to rearfoot relationship (maximally pronated/locked midtarsal joint) 4.0
6. State the values for the normal midtarsal joint position (forefoot to rearfoot relationship). 4.0
7. Describe the relationship between subtalar joint position and midtarsal joint motion. 4.0
8. Describe the function of the normal midtarsal joint throughout the gait cycle. 4.0
9. Discuss the locking mechanism of the midtarsal joint and the significance of the locking mechanism in normal gait. 4.0
10. Recognize alternate midtarsal joint axis theories/function models. 3.0

X. Functional Deviations of the Midtarsal Joint

1. Identify the sagittal and transverse plane deviations of the oblique midtarsal joint axis and discuss the possible outcomes. 4.0
2. Describe etiologies, signs, symptoms, and gait changes associated with abnormal midtarsal joint position and motion. 4.0
3. Discuss the biomechanical treatment implications of a foot with an altered planal dominance at the oblique midtarsal joint axis. 4.0

Y. Inverted Forefoot Deformities

1. Define and differentiate between types of inverted forefoot deformities, including forefoot varus, forefoot supinatus, metatarsus primus elevatus, plantarflexed lateral column. 4.0
2. Identify and discuss the etiologies of forefoot varus and forefoot supinatus. 4.0
3. Identify the signs, symptoms, and compensation patterns of the different inverted forefoot deformities. 4.0
4. Describe the radiological manifestations of the different inverted forefoot deformities. 4.0
5. Discuss biomechanical treatment for the different inverted forefoot deformities. 4.0

Z. Everted Forefoot Deformities

1. Define and differentiate between types of everted forefoot deformities, including forefoot valgus, plantarflexed first ray, dorsiflexed lateral column. 4.0
2. Identify and discuss a dorsiflexed cuboid. 4.0
3. Discuss the possible outcomes of a dorsiflexed cuboid. 4.0
4. Identify the compensations for forefoot valgus and plantarflexed first ray, and discuss the outcomes. 4.0
5. Identify and discuss the etiologies of forefoot valgus and plantarflexed first ray. 4.0
6. Discuss and differentiate between rigid and flexible plantarflexed first ray deformities. 4.0
7. Discuss and differentiate between rigid and flexible forefoot valgus deformities. 4.0
8. Identify the signs, symptoms, and compensation patterns of the different rigid and flexible everted forefoot deformities. 4.0
9. Describe the radiological manifestations of the different everted forefoot deformities. 4.0
10. Discuss biomechanical treatment for the different everted forefoot deformities. 4.0

AA. First Ray

1. Describe the first ray axis in terms of orientation/location, and plane of motion. 4.0
2. Describe and demonstrate the technique used to measure first ray motion. 4.0
3. Calculate first ray neutral position and determine the sagittal plane deformity. 4.0

4. State normal ranges of motion for the first ray. 4.0
5. Discuss the position and motion of the first ray throughout the gait cycle. 4.0
6. Define *metatarsus primus elevatus*. 4.0
7. Discuss the potential signs, symptoms and biomechanical compensations of metatarsus primus elevatus. 4.0
8. Differentiate between flexible and rigid sagittal plane first ray deformities. 4.0
9. Define *hypermobile first ray*. 4.0
10. Describe etiologies, signs, symptoms, and gait changes associated with abnormal first ray function. 4.0
11. Discuss the relationship between subtalar joint position and first ray motion. 4.0
12. Describe the radiological manifestations of the different first ray deformities. 4.0
13. Discuss biomechanical treatments for first ray deformities. 4.0
14. List biomechanical deformities that cause a hypermobile first ray. 4.0

BB. First Metatarsophalangeal Joint

1. Describe the first metatarsophalangeal joint axis in terms of orientation/location, and plane of motion. 4.0
2. Describe and demonstrate the technique used to measure first metatarsophalangeal joint motion (non-weight bearing and weight bearing). 4.0
3. State normal ranges of motion for the first metatarsophalangeal joint (non-weight bearing and weight bearing). 4.0
4. Discuss the position and motion of the first metatarsophalangeal joint throughout the gait cycle. 4.0
5. Discuss the effect of the first ray position on the first metatarsophalangeal joint range of motion. 4.0
6. Describe etiologies, signs, symptoms, and gait changes associated with abnormal first metatarsophalangeal joint range of motion. 4.0
7. Describe the role of the sesamoid apparatus in normal first metatarsophalangeal joint function 4.0
8. Describe the radiological manifestations of the different first metatarsophalangeal joint deformities. 4.0
9. Discuss biomechanical treatments for first metatarsophalangeal joint deformities. 4.0

CC. Fifth Ray

1. Describe the fifth ray axis in terms of orientation/location, and plane of motion. 4.0
2. Describe etiologies, signs, symptoms, and gait changes associated with abnormal fifth ray function. 4.0
3. List the clinical signs and symptoms associated with a plantarflexed and dorsiflexed fifth ray. 4.0
4. Discuss the relationship between the calcaneal position and fifth ray position. 4.0
5. Describe the radiological manifestations of the different fifth ray deformities. 4.0
6. Discuss biomechanical treatments for fifth ray deformities. 4.0

DD. Central Rays and Digits

1. Identify the axis, location, and range of motion of the lesser metatarsophalangeal joints and digits. 4.0

2. Discuss the anatomical structures that contribute to normal digital stability. 4.0
3. Describe the normal and abnormal metatarsal parabola, including radiographic assessment of the parabola. 4.0
4. Describe the clinical signs and symptoms associated with an abnormal metatarsal parabola. 4.0
5. Describe etiologies, signs, symptoms, and gait changes associated with abnormal lesser metatarsophalangeal joint ranges of motion. 4.0
6. Describe etiologies, signs, symptoms, and gait changes associated with abnormal position and/or ranges of motion of the digits. 4.0
7. Describe the clinical findings and gait changes associated with a plantarflexed or dorsiflexed lesser metatarsal deformity. 4.0
8. Describe the radiological manifestations of the different central ray and digital deformities. 4.0
9. Discuss biomechanical treatments for central ray and digital deformities. 4.0

EE. Computerized Evaluation of Gait

1. Discuss when to measure motion, force, pressure and surfaces. 3.0
2. Discuss the indication, usage and pros and cons of the Topographical scanning technique 3.0
3. Discuss the indication, usage and pros and cons of the Pressure Mapping Technique 3.0
4. Discuss the indication, usage and pros and cons of the Force Plate Measurement 3.0
5. Discuss the indication, usage and pros and cons of the Video Technique 3.0
6. Discuss the indication, usage and pros and cons of 3-D kinematic analysis of gait. 3.0
7. Discuss the benefits of using the gait analysis lab in clinical cases 4.0
8. Critically assess kinematic and kinetic values and their implications 3.0

FF. Functional Deviations of Gait

1. Describe and differentiate abnormal gait findings associated with lower extremity biomechanical pathology. 4.0
2. Describe how asymmetry affects the gait cycle. 4.0
3. Define and describe antalgic and propulsive gait. 4.0
4. Define and describe neuromuscular manifestations of abnormal gait (e.g. steppage, Trendelenburg, Parkinsonian, spastic diplegia, hemiplegia, waddling, ataxic). 4.0
5. Define and describe neuropathic effects on gait. 4.0
6. Describe calcaneus gait and discuss its possible causes. 4.0

GG. Biomechanical Radiographic Interpretation

1. Identify normal radiographic angles and joint relationships. 4.0
2. Describe the standard position for taking radiographs for biomechanical evaluation. 4.0
3. Identify radiographic signs of the rectus foot, pronated foot, and supinated foot. 4.0
5. Identify normal radiographic signs of sagittal, transverse, and frontal plane relationships in the foot. 4.0
7. Identify abnormal radiographic signs of sagittal, transverse, and frontal plane relationships in the foot. 4.0

HH. Orthoses

1. Define orthotics, prosthetics, and pedorthics. 4.0
2. Describe the supporting role the orthotist, prosthetist, and pedorthist play in assisting the podiatrist in treating foot disorders. 4.0
3. Define orthoses and describe the general purpose of orthoses. 4.0

4. Differentiate between and discuss uses of custom orthoses and prefabricated orthoses. 4.0
5. Identify and describe types of materials used for orthoses. 4.0
6. Describe indications and contraindications for foot orthoses to include functional, accommodative, pediatric, pronated, UCBL, Shaffer plate and neutral shell types of foot orthoses 4.0

II. Custom Functional Foot Orthoses

1. Explain the purpose and goals of functional foot orthoses. 4.0
2. Identify the component parts of functional foot orthoses. 4.0
3. Discuss the role of functional orthoses in managing biomechanical forefoot deformities. 4.0
4. Discuss the role of orthoses in resisting abnormal forces in the rearfoot (both pronatory and supinatory). 4.0
5. Describe how to incorporate motion into the rearfoot post of orthoses. 4.0
6. Describe the limiting effect of orthoses on subtalar joint motion. 4.0
7. Describe types of materials used for component parts of functional foot orthoses. 4.0
8. Discuss the effect of functional foot orthoses throughout the gait cycle. 4.0
9. Describe the pathologies that would benefit from functional foot orthoses. 4.0
10. Identify **relative** contraindications for functional foot orthoses. 4.0
11. Discuss indications for rigid, semirigid, and flexible shell materials. 4.0
12. Discuss the indications, limitations and materials for different functional foot orthoses based on shoe type 4.0
13. Discuss the effect of shoe characteristics and construction on functional foot orthoses. 4.0
14. Define and describe the indications, limitations and materials of pronated orthoses. 4.0

JJ. Accommodative Foot Orthoses (Custom)

1. Explain the purpose and goals of accommodative orthoses 4.0
2. Identify the component parts of accommodative orthoses. 4.0
3. Identify and differentiate types of materials used for accommodative orthoses. 4.0
4. Describe foot pathologies that would benefit from accommodative orthoses. 4.0
5. Identify **relative** contraindications for accommodative orthoses. 4.0

KK. Foot Impression Techniques

1. Describe and demonstrate the steps for performing both supine neutral suspension technique and prone neutral technique. 4.0
2. Discuss the advantages and disadvantages of various neutral position casting techniques. 4.0
3. Discuss the goals of plantarflexing the medial column during neutral position casting. 4.0
4. Describe the other types of casting techniques used to fabricate foot orthoses, including partial weight bearing, in-shoe, vacuum, computer imaging/scanning, rectus and pronated. 4.0
5. Evaluate a foot impression using a systematic approach. 4.0
6. Explain the effect of positioning technique errors on the foot impression. 4.0
7. Identify the biomechanical deformities based on the negative cast. 4.0
8. Recommend appropriate casting techniques, given a particular orthosis type. 4.0
9. Discuss the pros and cons of various impression materials. 4.0
10. Discuss the pros and cons of computerized impression techniques. 4.0

LL. Orthosis Prescription

1. List the purpose, indications and contraindications for the following foot orthotic modifications: plate additions, heel lift, metatarsal raise, top cover materials, forefoot extensions, those that improve first ray function, pronation reduction, and addressing equinus. **4.0**
2. List the required components of a foot orthosis prescription. **4.0**
3. Describe the effect that changing the thickness and width of an orthotic device has on foot function. **4.0**
4. Discuss different posting techniques and corrections incorporated into a foot orthotic device. Discuss indications for modifications of positive cast work. **4.0**
5. Explain the indications for rearfoot posting and factors determining how much the rearfoot should be posted and how much motion should be allowed in the rearfoot post. **4.0**
6. Describe the effect of medial and lateral heel modifications on foot function. **4.0**
7. Describe forefoot balancing techniques, including intrinsic and extrinsic posting, and explain when to balance in positions other than zero. **4.0**
8. Differentiate between materials that are effective shock absorbers versus materials that provide total contact. **4.0**

MM. Orthosis Fabrication

1. Discuss the steps involved in fabricating orthoses, including types of pouring techniques, positive and negative cast construction, forefoot platform, soft tissue accommodations, medial, lateral and heel expansions, and different materials used in manufacturing. **4.0**
2. Identify errors in each step of the orthosis manufacturing process. **4.0**
3. Discuss when each pour technique is utilized. **4.0**
4. Discuss the difference between milled and vacuum pressed orthoses. **3.0**
5. Discuss and provide indications for unbalanced, balanced and as sits posts. **3.0**

NN. Orthoses Evaluation

1. Describe the technique used to fit an orthosis into the shoe. **4.0**
2. Discuss the proper procedure in dispensing an orthosis to a patient. **4.0**
3. Discuss the evaluation process for a patient who has been wearing an orthosis. **4.0**

OO. Orthoses Troubleshooting

1. List casting errors that lead to orthosis problems. **4.0**
2. Discuss the implications of a supinated longitudinal midtarsal joint; a dorsiflexed 4th and 5th metatarsophalangeal joint; a supinated oblique midtarsal joint axis; and a pronated subtalar joint axis in a negative cast. **4.0**
3. Discuss the implications of choosing the wrong forefoot and rearfoot posts for an orthosis. **4.0**
4. Discuss the implications of choosing the wrong heel cup height, rearfoot post motion, and/or arch fill. **4.0**
5. Explain the possible ramifications of choosing the wrong material for an orthosis. **4.0**
6. Suggest trouble shooting solutions for common problems encountered when wearing foot orthoses. **4.0**

PP. Shoe Therapy

1. Describe the anatomy of a shoe. 4.0
2. Discuss the types of shoes used in the scope of the podiatric practice, including extra depth and custom molded and the indications of each. 4.0
3. Describe the important aspects of shoe construction including various last shapes and types of materials, 4.0
4. Discuss the various modifications that can be incorporated into shoe gear to assist with treatment of different foot and ankle disorders. 4.0
5. Describe the determinants of proper shoe fit. 4.0
6. Describe the different rocker modifications including their indications, that can be applied to a shoe. 4.0
7. Differentiate between a rocker and a metatarsal bar. 4.0
8. Describe a SACH heel (Solid Ankle Cushion Heel) including its functions, indications, and contraindications. 4.0
9. Recommend a shoe prescription for common podiatric pathologies. 4.0
10. Discuss the role of the insole in regard to shoe function, including the importance of a removable insole. 4.0
11. Discuss the normal tread pattern, and evaluate tread patterns for various types of function. 4.0
12. Identify different types of post-op shoes and discuss the indications, advantages and disadvantages of each. 4.0
13. Identify the types of forefoot off-loading shoes and discuss the advantages, disadvantages, and indications for each. 4.0
14. Identify various types of healing sandals and discuss the advantages, disadvantages, and indications for each. 4.0
15. Differentiate between a flange, a flare and a wedge, and discuss their indications. 4.0
16. List the height limitations for in-shoe and outersole shoe lifts. 4.0
17. Discuss the sole modifications that are required to use a full-length outersole lift. 3.0
18. Identify indications and contraindications for full-length lift versus a heel lift modification. 4.0
19. Discuss the indications for various pads including the following: tongue pad, metatarsal pad, unilateral and bilateral heel lifts, cobra, insole wedging, and Mayo pad. 4.0
20. Discuss the indications and contraindications for a shoe excavation. 2.0
21. Discuss methods and indications for widening the sole of the shoe. 3.0
22. Discuss the indications and different methods for a shoe. 3.0
23. Discuss the use of elastic laces and modified lacing techniques for specific pathologies. 3.0
24. Discuss the benefits of using bilaminar and trilaminar materials. 3.0
25. Discuss the indications for applying toe filler modifications to the insole of a shoe. 4.0

QQ. Custom Molded Shoes

1. Identify indications for custom molded shoes. 4.0
2. Identify the materials, technique, benefits, and limitations of bivalve casting. 3.0
3. Identify the materials, technique, benefits, and limitations of univalve casting. 3.0
4. Discuss the consequences of applying various casting techniques inappropriately. 4.0
5. Discuss the various positive last modifications applied in the manufacturing of custom molded shoes. 3.0

RR. Ankle-Foot Orthoses and Braces

1. Define an ankle-foot-orthosis (AFO) type device. 4.0
2. Discuss the function of and the therapeutic goals, indications and contraindications for a solid AFO. 4.0
3. Discuss the function of and the therapeutic goals, indications and contraindications for a Posterior Leaf Spring/Splint (PSL) AFO. 4.0
4. Discuss the function of and the therapeutic goals, indications and contraindications for a knee-ankle-foot-orthosis (KAFO). 4.0
5. Discuss the casting technique, indications and contraindications for a custom stirrup Orthosis (e.g., Richie brace). 4.0
6. Discuss the function of and the therapeutic goals, indications and contraindications for a patellar-tendon bearing brace. 4.0
7. Discuss the function of and the therapeutic goals, indications and contraindications for a custom gauntlet brace. 4.0
8. Discuss the casting technique, indications and limitations of a custom gauntlet brace. 4.0
9. Discuss the function of and the therapeutic goals, indications and contraindications for a Charcot Restraint Orthotic Walker (CROW). 4.0
10. Discuss the indications for a short leg versus long leg walking boot. 4.0
11. Discuss the function of and the therapeutic goals, indications and contraindications for a double upright brace. 4.0
12. Discuss the function of and the therapeutic goals, indications and contraindications for a hinged brace type AFO. 4.0
13. Discuss the function of and the therapeutic goals, indications and contraindications for a dorsiflexion assist AFO. 4.0
14. Discuss the function of and the therapeutic goals, indications and contraindications for a Tone Reducing Ankle-Foot Orthoses (TRAFO). 4.0

II. Pathomechanics

A. Digital Deformities

1. Describe in detail the origin, course, insertions, and functions of all tendons inserting into the lesser digits. 4.0
2. Explain the “rigid beam effect” of the extensor hood complex on digital function. 4.0
3. Describe the dynamic balance of tendons necessary for maintaining normal digital positioning during the normal gait cycle. 4.0
4. Describe the etiology and definition of Hammer Digit Syndrome. 4.0
5. Describe 3 major pathomechanical etiologies of hammer digit syndrome: Extensor Substitution, Flexor Substitution and Flexor Stabilization. 4.0
6. Explain other factors that could affect the etiology of hammer digit syndrome. 4.0
7. Describe associated foot deformities that may occur due to hammer digit syndrome. 4.0
8. Discuss the various conservative treatments of hammer digit syndrome. 4.0
9. Differentiate between the appearance of hammertoe, mallet toe and claw toe. 4.0
10. Differentiate between the pathomechanics of hammertoe, mallet toe and claw toe deformities. 4.0
11. Describe abductus and adductus deformities of the digits and explain their etiologies. 4.0
12. Describe digiti quinti varus deformities and the pathomechanics leading to the deformities. 4.0
13. Describe curly toe deformity and the pathomechanics leading to the deformities. 4.0

14. Describe hallux interphalangeus and the pathomechanics leading to the deformities. 4.0
15. Discuss digital pathologies associated with predislocation syndrome and metatarsophalangeal joint dislocation. 4.0
- B. Hallux Abducto Valgus and Bunion Deformities**
1. Describe the anatomical structures that govern the function of the first metatarsophalangeal joint. 4.0
 2. Define hallux abducto valgus (HAV). 4.0
 3. List the etiologies and pathomechanics of hallux abducto valgus. 4.0
 4. Describe the adaptive soft tissue and osseous changes that could result from Hallux Abducto Valgus. 4.0
 5. Relate how other lower extremity deformities contribute to the development of HAV. 4.0
 6. Discuss the indications for treatment of Hallux Abducto Valgus deformities. 4.0
 7. Discuss the conservative treatment options for Hallux Abducto Valgus deformities including indications and complications for each option. 4.0
 8. Define and compare *tracking* and *trackbound* motion of the first metatarsophalangeal joint. 4.0
 9. Describe crepitus of the first metatarsophalangeal joint. 4.0
 10. Discuss first ray hypermobility/insufficiency as an etiology of HAV. 4.0
- C. Hallux Limitus, Hallux Rigidus & Metatarsus Primus Elevatus**
1. Define hallux limitus and hallux rigidus. 4.0
 2. Distinguish between structural and functional hallux limitus. 4.0
 3. List the etiologies and pathomechanics for hallux limitus and hallux rigidus. 4.0
 4. Discuss first ray hypermobility/insufficiency as an etiology of hallux limitus and hallux rigidus. 4.0
 5. Discuss the stages of hallux limitus and hallux rigidus. 4.0
 6. List the clinical signs and symptoms associated with hallux limitus and rigidus. 4.0
 7. Describe the compensatory mechanisms for hallux limitus and hallux rigidus. 4.0
 8. Define Metatarsus Primus Elevatus. 4.0
 9. Describe the etiologies of metatarsus primus elevatus. 4.0
 10. Describe the clinical signs and symptoms associated with metatarsus primus elevatus. 4.0
 11. Describe the compensatory mechanisms for Metatarsus Primus Elevatus. 4.0
 12. Identify the conservative interventions for alleviation of symptoms associated with hallux limitus/rigidus. 4.0
 13. Describe the principles of orthosis prescription writing for patients with hallux limitus, hallux rigidus and metatarsus primus elevatus. 4.0
- D. Hallux Varus**
1. Define *hallux varus*. 4.0
 2. List the etiologies and pathomechanics of hallux varus. 4.0
 3. Compare the juvenile and adult forms of hallux varus. 4.0
 4. List the clinical signs and symptoms associated with hallux varus. 4.0
 5. Identify the nonsurgical interventions for alleviation of symptoms associated with hallux varus. 4.0

E. Lesser Rays

1. List the anatomical structures that govern the function of the fifth metatarsophalangeal joint. 4.0
2. Describe the normal and abnormal metatarsal parabola, including radiographic assessment. 4.0
3. Describe the clinical signs and symptoms associated with an abnormal metatarsal parabola. 4.0
4. Describe the pathomechanics of the fifth ray. 4.0
5. Identify the etiology and pathomechanics for a Tailor's bunion deformity. 4.0
6. List the clinical signs and symptoms associated with a plantarflexed and dorsiflexed fifth ray. 4.0
7. Describe the concept of splayfoot and its associated clinical features. 4.0
8. Describe plantarflexed and dorsiflexed lesser metatarsal deformities. 4.0
9. Describe the clinical signs and symptoms and gait changes associated with a plantarflexed and dorsiflexed lesser metatarsal. 4.0
10. List the causes of abnormal lesser metatarsal head shape. 4.0
11. Describe the clinical signs and symptoms associated with abnormal metatarsal head shape. 4.0
12. Recognize the pathomechanics associated with predislocation syndrome/plantar plate dysfunction. 4.0
13. Identify the principles of orthosis prescription-writing for a patient with forefoot pain. 3.0

F. Pes Cavus

1. Discuss the different etiologies and pathomechanics of pes cavus. 4.0
2. List and describe different neuromuscular disorders commonly associated with pes cavus. 4.0
3. List and describe the common clinical signs and symptoms associated with pes cavus. 4.0
4. Describe a diagnostic work-up of a patient with pes cavus. 4.0
5. Discuss nonsurgical treatment options for pes cavus. 4.0
6. Discuss planar dominance in pes cavus deformities 4.0
7. Diagnose and treat neuromuscular pes cavus, when given a clinical scenario. 4.0

G. Flatfoot Deformities

1. Describe different etiologies, including abnormal ontogeny, of flatfoot deformity. 4.0
2. Describe the pathomechanics of flatfoot deformity resulting from joint instability. 4.0
3. Describe clinical signs and symptoms of flatfoot deformities. 4.0
4. Discuss common nonsurgical treatment options for flatfoot deformities. 4.0
5. Discuss planar dominance in flatfoot deformities. 4.0

H. Heel Pain

1. Define *heel pain syndrome*. 4.0
2. Describe the various etiologies and pathomechanics of heel pain. 4.0
3. Identify the clinical signs and symptoms of heel pain. 4.0
4. Discuss nonsurgical treatment options for heel pain. 4.0
5. Discuss subjective and objective assessment methods to differentiate heel pain of systemic origin versus pathomechanical causes. 4.0

I. Sinus Tarsi Syndrome

1. Define sinus tarsi syndrome 4.0
2. Describe the pathomechanics of sinus tarsi syndrome. 4.0
3. Discuss common history findings for sinus tarsi syndrome 3.0
4. List differential diagnoses for sinus tarsi syndrome 3.0
5. Identify the clinical signs and symptoms of sinus tarsi syndrome. 4.0
6. Discuss the non-surgical treatments for sinus tarsi syndrome. 4.0

J. Evaluation and Management of the “At Risk” Foot

1. Discuss the pathomechanical changes associate with neuropathic feet. 4.0
2. Describe the biomechanical management of the “at-risk foot” due to diabetes, peripheral vascular disease, neurological, or other metabolic disorders. 4.0
3. Discuss nonsurgical treatment options for the “at-risk foot.” 4.0

K. Limb Length Discrepancy

1. Differentiate normal and abnormal variances in limb length. 4.0
2. Discuss etiologies of Limb Length Discrepancy (LLD). 4.0
3. Differentiate between structural and functional Limb Length Discrepancy (LLD). 4.0
4. Discuss biomechanical and radiographic techniques used to diagnose limb length discrepancy. 4.0
5. Describe how to differentiate between true limb length versus functional limb length. 4.0
6. List other points of evaluation to determine the presence of a limb length discrepancy. 4.0
7. Describe signs, symptoms, and gait changes associated with asymmetrical limb length. 4.0
8. Identify and describe nonsurgical methods of relieving symptoms associated with LLD. 4.0
9. Describe the effects on the body associated with eliminating compensatory changes in the feet for patients with limb length discrepancy and scoliosis. 4.0

III. Sports Medicine

I. Sports Medicine Practice

1. Describe the psychological, social and physical characteristics unique to the sports medicine patient. 3.0
2. Differentiate between general medical History & Physical Examination versus a Sports Medicine History & Physical Examination. 4.0
3. Discuss the psychological aspects of the competing, elite and special needs athlete. 3.0
4. List the benefits, challenges, and unique characteristics to a sports medicine practice. 3.0
5. Discuss the benefits and challenges of being part of a sports medicine team doctor. 3.0
6. Compare and differentiate the evaluation and management of the child athlete with that of an adult athlete. 4.0
7. Compare and contrast the approach and surgical management of the athlete patient versus the non-athlete patient. 4.0
8. Identify the effects of gender on training, conditioning, endurance, and injury. 4.0
9. Identify the assessment of field injured athlete. 4.0

A. The Female Athlete

1. Describe the psychological, sociological, and cultural challenges facing a female athlete. **3.0**
2. Describe the problems associated with amenorrhea and osteoporosis in the female athlete. **3.0**
3. Describe the effect of diet and eating disorders in the female athlete and their effects on the menstrual cycle. **2.0**
4. Identify the effects of oral contraceptives on the female athlete. **2.0**
5. Discuss the current trends in exercise during pregnancy in the female athlete. **3.0**

B. The Aging Athlete

1. Describe the psychological, sociological, and cultural challenges facing an aging athlete. **3.0**
2. Identify the effects of age on training, conditioning, endurance, and injury. **3.0**
3. Identify the effects of chronic conditions and medications on the aging athlete. **3.0**
4. Describe the nutrition needs to the unique to the aging athlete. **3.0**

D. The Child Athlete

1. Discuss the physical, anatomical, and biomechanical differences between the child/immature athlete and the adult athlete. **4.0**
2. Describe and evaluate the general growth process and its effect on athletic participation. **4.0**
3. Differentiate the anatomical areas of structural weakness in the child athlete. **4.0**
4. Discuss the various injuries and conditions specific for the child athlete. **4.0**
5. Describe the commonly encountered overuse injuries in the pediatric athlete. **4.0**
6. Recommend treatment modalities and protocols for specific injuries common in the child athlete. **4.0**
7. List the effects and limitations of training and conditioning in the child athlete. **3.0**
8. Discuss the unique challenges of understanding and treating the adolescent athlete. **3.0**

E. The Special Needs Athlete

1. Describe the psychological, sociological, and cultural challenges facing a special needs athlete. **2.0**
2. Identify the effects of special needs on training, conditioning, endurance, and injury. **2.0**
3. Identify the effects of medical conditions and medications on the special needs athlete. **2.0**

F. Sports Nutrition

1. Describe the nutritional needs of the athlete and how they differ from the general population. **3.0**
2. List indications and contraindications of the common nutritional supplements and fluid replacement products used by athletes. **3.0**
3. Identify a variety of “doping” or banned substances used by athletes. **3.0**

G. Techniques of Training

1. Discuss the basic training techniques and nomenclature used by athletes, such as long slow distance, intervals, tempo runs, circuit training, sets, and plyometrics. **3.0**
2. Discuss the basic techniques and benefits of unique training forms such as dance, yoga, CrossFit, Pilates and martial arts. **3.0**
3. Explain the principles of conditioning, stretching, and strength training. **3.0**
4. List the factors affecting endurance and performance. **3.0**

5.	Discuss the rationale for sports-specific training.	3.0
H. <u>Biomechanics of Running</u>		
1.	Compare the differences between the walking and running gait cycle.	4.0
2.	Recite the components of the support phase of the running gait cycle.	4.0
3.	Distinguish the components of the non-support phase of the running gait cycle.	4.0
4.	Describe how the loads through the foot differ between walking and running.	4.0
5.	Compare the differences in phasic muscle activity in walking as compared to running.	3.0
6.	Describe the abnormal running biomechanics and its relationship to athletic performance and the development of injury.	4.0
7.	Compare and contrast the gait variances of shod versus barefoot running.	3.0
8.	Describe and correctly evaluate a running shoe.	3.0
9.	Produce an accurate patient prescription for the appropriate running shoe.	3.0
I. <u>Foot Orthoses in the Athlete</u>		
1.	Describe the unique considerations when prescribing orthoses for the sports medicine patient.	4.0
2.	Outline the indications for various orthotic modifications used for treatment of specific sports injuries.	4.0
3.	Differentiate between the specialized orthoses used in specific sports, such as skiing, marathon, track, cycling, dance, skating, and basketball.	3.0
J. <u>Athletic Footwear</u>		
1.	Describe the anatomy, construction, and function of a various athletic shoes, such as running, walking, court, turf, dance, tennis, basketball and cycling.	4.0
2.	Discuss the current techniques and modifications used in the fabrication of athletic footwear designed to reduce injuries and/or alter biomechanics.	3.0
3.	Identify and describe common running shoe wear patterns and the biomechanical, clinical, and therapeutic significance, including the shoe prescription.	3.0
4.	Recognize common problems encountered with basketball shoes and soccer cleats.	3.0
5.	Define motion control and indications.	3.0
6.	Identify extra cushioning shoes and indications.	3.0
K. <u>Sports Equipment & Training Aids</u>		
1.	Explain basic bike fit techniques and describe the common lower extremity injuries seen with improper fit.	4.0
2.	Identify and describe the high tech training aids used by athletes to assess fitness, such as heart rate monitors and power meters.	4.0
3.	Describe the use of personal protective equipment related to various sports.	4.0
II. <u>Sports Injuries</u>		
A. <u>Asymmetry in the Athletic Patient</u>		
1.	Explain the pathological basis of asymmetrical function and the presence or potential for injury.	4.0
2.	Review the appropriate treatment plans for the athlete with various limb length discrepancies.	4.0

- B. Stress Fractures of the Lower Extremity**
1. Discuss the pathomechanics of loads and their relationship to injury to bony tissues. **4.0**
 2. Describe how training errors, nutritional status, gender, age, overuse and other special considerations contribute to development of stress fracture. **4.0**
 3. Discuss the clinical presentation and management of metatarsal and tibial stress fracture. **4.0**
- C. Capsular/Joint Impingement Syndromes**
1. Explain the pathomechanics producing impingement syndromes. **4.0**
 2. Differentiate between soft tissue impingement syndromes and bony impingement syndromes, such as Hallux IPJ, First MTPJ, lesser MTPJ's, calcaneocuboid joint (subluxed cuboid syndrome), subtalar joint (sinus tarsi syndrome), and ankle joint (anterior, posterior, medial and lateral impingement syndrome). **4.0**
- D. Lower Extremity Tendonopathy**
1. Discuss the causes for acute or chronic injuries to specific tendons in the lower extremities. **4.0**
 2. Differentiate between the different types of tendinopathy, such as tendinosis, tenosynovitis, and enthesopathy. **4.0**
 3. Explain the relationship between abnormal biomechanical function and development of injury to specific tendons. **4.0**
 4. List the signs and symptoms associated with tendinopathy. **4.0**
 5. Describe the various methods of treatment for tendinopathy. **4.0**
 6. Discuss diagnostic imaging techniques used in the evaluation of tendinopathy. **4.0**
 7. Describe how training errors, nutritional status, gender, age, and other special considerations (e.g., antibiotics and steroid) contribute to development of tendinopathy. **4.0**
- E. Hip and Thigh**
1. Describe clinical presentation, evaluation, and management of athletic injuries of the hip and thigh, such as trochanteric bursitis, iliotibial band friction syndrome, piriformis syndrome, "snapping hip," hamstring strain, and quadriceps strain. **3.0**
 2. Discuss the pathomechanical factors contributing to sport specific hip and thigh injuries. **3.0**
- F. Knee**
1. Define Runner's knee, Theater Sign, Q-Angle, VMO, Patella Alta, Jumper's Knee and House maid's knee. **4.0**
 2. Describe clinical presentation, evaluation, and management of athletic injuries of the knee, such as chondromalacia patella, patellofemoral joint syndrome, popliteal tendonitis, iliotibial band friction syndrome, meniscal tears, ACL and PCL tears, collateral ligament sprain, plica, impingement syndrome, patellar tendonitis ("jumper's knee"), and pes anserine bursitis. **4.0**
 3. Discuss the pathomechanical factors contributing to sport-specific knee injuries. **4.0**
 4. Describe and demonstrate the evaluation techniques used to determine the integrity of the patellar tendon, collateral ligaments, cruciate ligaments and menisci of the knee joint. **4.0**
 5. Discuss how the "Q" angle relates to patellar tracking. **4.0**
 6. Describe the effect of foot dysfunction on knee pathomechanics. **4.0**

G. Leg

1. Define Tennis Leg, Thomson-Daugherty Test, Tendinosis, Paratenonitis, “Dancers tendonitis”, Dreaded black line, Shin Splints and Fat Fracture. **4.0**
2. Describe clinical presentation, evaluation, and management of athletic injuries of the leg, such as acute and chronic compartment syndromes, “shin splints” [i.e., anterior compartment myositis, deep posterior compartment myositis/Medial Tibial Stress Syndrome (MTSS)], peroneal tendonitis, and tibial stress fracture. **4.0**
3. Discuss the pathomechanical factors contributing to sport-specific leg injuries. **4.0**
4. Describe clinical presentation, evaluation, and management of tennis leg. **4.0**

H. Ankle

1. Describe and demonstrate how to identify and assess the integrity of the lateral collateral ligaments of the ankle. **4.0**
2. List the pathomechanical factors that may predispose patient to lateral ankle sprains. **4.0**
3. Describe and demonstrate the clinical evaluation of lateral ankle sprains, including the need for assessment of non-ankle structures such as the base of the fifth metatarsal, anterior process of the calcaneus, Achilles tendon insertion, peroneal groove, and the proximal fibula. **4.0**
4. Differentiate between types of ankle sprains, such as lateral, medial, and high ankle sprains. **4.0**
5. Discuss of clinical presentation, imaging, and treatment of talar dome injury. **4.0**
6. Describe the specialized radiographic techniques utilized to assess lateral ankle injuries and grade their severity. **4.0**
7. Describe the treatment and return-to-activity protocols for lateral ankle injuries based on grade/severity of injury. **4.0**
8. Describe the appropriate management of an acute and chronic ankle injury including pain and instability. **4.0**
9. Describe and demonstrate how to identify and assess the integrity of eversion ankle sprains. **4.0**
10. Describe the biomechanical etiology, clinical presentation, specialized radiographic findings, and the management of fibular (peroneal) tendon subluxation. **4.0**
11. Assess along with the management of talar dome fractures. **4.0**
12. Describe the clinical presentation and management of injuries to the os trigonum. **4.0**
13. Describe the biomechanical etiology, clinical presentation, specialized radiographic findings, and the management of sport specific anterior and posterior impingement syndrome. **4.0**

I. Rearfoot

1. Describe clinical presentation, evaluation, and management of athletic injuries of the rearfoot, such as Achilles tendinitis, Achilles tendon rupture, paratenonitis, adhesive tendinopathy, calcaneal stress fractures, calcaneal apophysitis, cuboid impingement syndrome, and plantar fasciitis. **4.0**
2. Discuss the pathomechanical factors contributing to sport-specific rearfoot injuries. **4.0**
3. Define Orthotripsy, Ski boot neuropraxia. **3.0**
4. Describe the management and prevention of various nerve impingement syndromes. **3.0**
5. Describe the clinical presentation, evaluation and management of retrocalcaneal

exostosis (Haglund’s deformity).	4.0
J. <u>Midfoot</u>	
1. Define “Dancers fracture”, Jones Fracture, “Cuboid Syndrome”, “N spot” and Basketball foot.	4.0
2. Describe clinical presentation, evaluation, and management of athletic injuries of the midfoot, such as navicular stress fracture, and midfoot sprains.	4.0
3. Discuss the pathomechanical factors contributing to sport-specific midfoot injuries.	4.0
K. <u>Forefoot</u>	
1. Define Tennis toe, Runners toe, Turf toe, Sand toe and Female athlete triad.	4.0
2. Describe clinical presentation, evaluation, and management of athletic injuries of the lesser metatarsal, such as stress fractures, avulsion fracture, capsulitis, and plantar plate rupture.	4.0
3. Describe clinical presentation, evaluation, and management of athletic injuries of the first metatarsophalangeal joint, including turf toe, soccer toe, sesamoiditis, plantar plate injuries, and impingement syndrome.	4.0
4. Discuss the pathomechanical factors contributing to sport-specific forefoot injuries.	4.0
L. <u>Dermatology</u>	
1. Describe the etiology, clinical presentation, management, and prevention of sports-related dermatological conditions, such as subungual hematoma (“Tennis Toe”), blisters, fungal and bacterial infections, taping/bracing skin reactions, and dermal abrasions.	4.0
2. Discuss the implications of MRSA infections in the athlete.	4.0
3. Discuss the importance of the appropriate sport-related sock.	4.0
III. <u>Physical Medicine and Rehabilitation</u>	
A. <u>Patient Assessment</u>	
1. Define Rehabilitation, Athletic Trainer, and Physical Therapy.	4.0
2. Discuss the role of the physical therapy and physical medicine in the treatment of lower extremity pathology.	4.0
3. Distinguish which patients are appropriate for referral to physical therapy and/ physical medicine.	4.0
4. Describe how to evaluate the range of motion of the joints of the lower extremities and distinguish between active and passive range of motion.	4.0
5. Assess muscular strength and power manually.	4.0
6. Identify the indications for additional objective testing of strength and power (e.g., isokinetic instrumentation and computerized gait analysis).	4.0
7. Describe the common goals of physical therapy for lower extremity conditions, including increasing mobility, promoting stability, reducing inflammation, pain spasm, edema, scar tissue and adhesions; increasing ROM, strength, power, and endurance; and improving balance and proprioception.	4.0
8. Describe the methods for the determination of the patient’s readiness to return to activities.	4.0
B. <u>Physical Therapy Modalities</u>	
1. Describe the various types of active and passive range of motion exercises and their	

- | | |
|--|-----|
| indications and contraindications. | 4.0 |
| 2. List the indications and contraindications for the use of therapeutic cold and heat in the lower extremities. | 4.0 |
| 3. Identify the indications and contraindications for phonophoresis, iontophoresis, electrical stimulation, and ultrasound. | 4.0 |
| 4. Identify the indications and contraindications for massage, soft tissue mobilization, traction, and manipulation techniques of the lower extremities. | 4.0 |
| 5. List the indication for hydrotherapy as it pertains to the treatment of lower extremity pathology. | 4.0 |
| 6. Discuss the indications and contraindications of strength training and methods for specific muscle groups. | 4.0 |
| 7. Discuss specific strengthening techniques such as isometric, isotonic, isokinetic, concentric/eccentric, and open and closed kinetic chain in the rehabilitation. | 4.0 |
| 8. Describe the concepts of proprioceptive retraining of the lower extremities and its importance in injury management and prevention of further injury. | 4.0 |
| 9. Write a therapeutic exercise prescription and a physical therapy prescription. | 3.0 |
| 10. Discuss the indications and contraindications of intermittent compression as a modality. | 3.0 |
| 11. List the compression garments and explain when to prescribe them as a treatment. | 3.0 |
|
 | |
| C. <u>Rehabilitative Equipment</u> | |
| 1. Discuss the indications, proper fit, proper use, and patient instructions for ambulatory assistive devices, including cane, crutches, walker, and wheelchair. | 4.0 |
| 2. Describe the indications, contraindications, and adverse effects for the use of immobilizing devices such as casts, ambulatory boots, and CAM-walker boots. | 4.0 |
| 3. Discuss the indications and contraindications for the use of a variety of available knee and ankle braces and supports. | 4.0 |
| 4. Describe how to use the various assistive walking devices during stair ascent and descent. | 4.0 |
| 5. Describe the proper progression of assistive walking device use during ambulation as a patient's condition or stability improves | 4.0 |

IV. General Orthopedics and Disorders of Bone

A. Soft Tissue Neoplasms

- | | |
|---|-----|
| 1. Describe the general histopathological classification, etiology, and pathophysiology of soft tissue neoplasms. | 3.0 |
| 2. Describe the diagnostic modalities utilized in assessing soft tissue neoplasms. | 4.0 |
| 3. Discuss the clinical presentation and management of benign fibrous tumors, as well as malignant fibrosarcoma. | 4.0 |
| 4. Discuss the clinical presentation and management of lipomatous tumors such as the lipoma and the malignant liposarcoma. | 4.0 |
| 5. Discuss the clinical presentation and management of benign tumors of smooth muscle including the leiomyoma, as well as the malignant leiomyosarcoma. | 4.0 |
| 6. Discuss the clinical presentation and management of benign tumors of skeletal muscle including the rhabdomyoma, as well as the malignant rhabdomyosarcoma. | 4.0 |
| 7. Discuss the clinical presentation and management of benign tumors of the vasculature including hemangioma, pyogenic granuloma, glomus tumor, as well | |

- as the malignant angiosarcoma. 4.0
8. Discuss the clinical presentation and management of benign tumors of tendon and synovial tissue, including synovial cyst (ganglion), tenosynovial giant cell tumor (pigmented villonodular synovitis), as well as the malignant synovial sarcoma and clear cell sarcoma. 4.0
 9. Describe the clinical presentation and management of benign tumors of nerve 4.0
 10. tissue, including nerve sheath ganglion, neurilemmoma, and neurofibroma. 4.0
 11. Describe the clinical presentation and management of quasi-tumors of the foot, including foreign body inclusion cyst. 4.0
- B. Osseous Neoplasms**
1. Describe the clinical approach to the radiographic finding of an osseous neoplasm. 4.0
 2. List the characteristics utilized to categorize osseous tumors. 4.0
 3. Describe the most common benign osseous tumors, including osteoma, osteoid osteoma, chondroblastoma, enchondroma, chondromyxoid fibroma, osteochondroma, unicameral bone cyst, aneurysmal bone cyst, fibrous dysplasia, nonossifying fibroma, and intraosseous ganglion and lipoma, as well as their individual radiographic presentations. 4.0
 4. Describe the most common malignant osseous tumors, including osteogenic sarcoma, chondrosarcoma, Ewing's sarcoma, fibrosarcoma, lymphoma, and myeloma, as well as their individual radiographic presentations. 4.0
 5. Discuss the most common quasi-malignant osseous tumors, including giant cell tumor, as well as their individual radiographic presentations. 4.0
 6. Describe the clinical and radiographic characteristics that allow the clinician to differentiate benign from malignant tumors. 4.0
- C. Rheumatology**
- A. Systemic Sclerosis**
1. Discuss scleroderma with regards to epidemiology, clinical presentation, diagnosis, treatment, and prognosis. 4.0
 2. Describe Raynaud's phenomenon and differentiate Raynaud's phenomenon from Raynaud's disease. 4.0
- B. Lupus Erythematosus**
1. Discuss systemic lupus erythematosus (SLE) with regards to epidemiology, clinical presentation, diagnosis, treatment, and prognosis. 4.0
- C. Polymyalgia Rheumatica and Giant Cell Arteritis**
1. Discuss polymyalgia rheumatica with regard to epidemiology, clinical presentation, diagnosis, and treatment. 4.0
 2. Discuss giant cell arteritis with regards to epidemiology, clinical presentation, complications, diagnosis, and treatment. 4.0
 3. Compare and contrast polymyalgia rheumatica and giant cell arteritis with each other and with other rheumatologic diseases. 3.0
- D. Fibromyalgia & Chronic Myofascial Pain**
1. Discuss the epidemiology of fibromyalgia. 4.0
 2. Discuss the diagnostic criteria for fibromyalgia. 4.0
 3. Discuss disorders that are associated with fibromyalgia. 4.0
 4. Describe the clinical presentation of fibromyalgia. 4.0

5. Define *trigger point* and discuss the clinical relevance of trigger points. 4.0
 6. Outline treatment strategies for fibromyalgia. 4.0
 7. Discuss other possible etiologies of myofascial pain. 4.0
- E. Mechanical/Structural Conditions of the Spine**
1. Describe the normal anatomy of the spine. 4.0
 2. Describe the normal ontogeny of the spine. 3.0
 3. Discuss the various etiologies and types of scoliosis including the possible locations for the deformity. 3.0
 4. Discuss the signs and symptoms associated with scoliosis. 3.0
 5. Describe and perform a screening exam for scoliosis. 4.0
 6. Discuss radiographic techniques to diagnose scoliosis. 3.0
 7. Describe common gait changes associated with scoliosis. 4.0
 8. Describe the effects on the rest of the body of eliminating compensatory changes in the feet for patients with scoliosis. 4.0
 9. Discuss the clinical findings, associated function and/or gait disturbances, and treatment of adult spinal disorders, including spinal osteoarthritis, spinal stenosis, kyphosis, herniated intervertebral disk and lumbosacral strain, cervical strain, cervical spondylosis, whiplash cervical injury, fracture of spinal process, flexion fracture of the neck, partial dislocation from hyperextension injury, atlas fracture, and odontoid process fracture. 3.0
 10. Describe the dynamics of lordosis and kyphosis in static stance and gait. 4.0
- F. Mechanical and Structural Conditions of the Hip**
1. Measure the ranges of motion for the hip. 4.0
 2. Evaluate the strength of the muscles crossing the hip joint. 4.0
 3. Evaluate the effect of the hamstrings on the amount of hip flexion available. 4.0
 4. Evaluate the effect of the quadriceps on the amount of hip extension available. 4.0
 5. Evaluate a patient for the presence of coxa varum or coxa valgum. 4.0
 6. Discuss the effect of coxa varum and coxa valgum on the gait cycle. 4.0
 7. Evaluate a patient for iliotibial band syndrome and discuss biomechanical etiologies or factors associated with this diagnosis. 4.0
 8. Describe the clinical findings, associated function and/or gait disturbances, and treatment of adult hip disorders including osteoarthritis, trochanteric bursitis, acute fracture and/or dislocation, and hip replacement. 4.0
- G. Mechanical and Structural Conditions of the Knee**
1. Evaluate the knee to determine the integrity of the collateral ligaments (varus and valgus stress test). 4.0
 2. Evaluate the knee to determine the integrity of the cruciate ligaments (anterior and posterior drawer test). 4.0
 3. Evaluate the knee to determine the integrity of the menisci of the knee. 4.0
 4. Evaluate a patient for the presence of genu varum or genu valgum. 4.0
 5. Determine the Q angle on a patient. 4.0
 6. Evaluate a patient for "tracking" of the patella. 4.0
 7. Identify and describe the signs and symptoms of chondromalacia patella. 4.0
 8. Evaluate a patient for quadriceps tone and the presence of chondromalacia patella. 4.0
 9. Evaluate a patient for pes anserine bursitis and discuss possible biomechanical etiologies associated with this diagnosis. 4.0

10. Differentiate between patello-femoral syndrome and chondromalacia patella. 4.0
11. Evaluate the muscles crossing the knee joint. 4.0
12. Describe the clinical findings, associated function and/or gait disturbances, and treatment of adult knee disorders including Baker's cyst, prepatellar bursitis and infrapatellar bursitis, sprain/rupture of the collateral ligaments, sprain/rupture of the cruciate ligaments, tear/rupture of the menisci, osteoarthritis with or without loose bodies, and knee joint replacement. 4.0
13. Describe synovial joint examination, technique, and analysis. 4.0

H. Bone Healing and Fracture Management

1. Discuss the development and pathomechanic implications of stress reaction and stress fracture. 4.0
2. Discuss tissue healing principles and bone healing/remodeling. 4.0
3. Discuss the common fracture types and management. 4.0
4. Discuss the common diagnostic tests used in the diagnosis of orthopedic pathology. 4.0
5. Discuss the general conservative and operative management of orthopedic disorders. 4.0
6. Discuss the regional interdependence and its implications in treating orthopedic pathology. 4.0
7. Discuss pathophysiology of bone healing and fracture management. 4.0

I. Orthopedic Strapping

1. Discuss the indications, contraindications, and alternatives for orthopedic strapping. 4.0
2. Identify the materials and basic techniques for orthopedic strapping. 4.0

J. Orthopedic Padding

1. Discuss the indications, contraindications, and applications for paddings. 4.0
2. Discuss the alternatives, if any, for L & M pad, metatarsal pad, metatarsal raise, dancer's/sesamoid pad, heel lift, longitudinal arch pad, mayo pad, cuboid pad, varus/valgus pad, morton's extension, reverse morton's extension, digital/ buttress/crest pad, and horseshoe pad. 4.0
3. Identify the materials available for orthopedic padding. 4.0
4. Apply a L & M pad, metatarsal pad, metatarsal raise, dancer's/sesamoid pad, heel lift, longitudinal arch pad, mayo pad, cuboid pad, varus/valgus pad, morton's extension, reverse morton's extension, digital/ buttress/crest pad, and horseshoe pad. 4.0

V. Pediatric Orthopedics

I. Prenatal Development, Birth, and Perinatal Development

1. Describe normal prenatal development. 3.0
2. Describe embryology, ontogeny, and developmental changes in the lower extremities. 3.0
3. Describe normal gestational factors. 3.0
4. List the important milestones of each trimester. 4.0
5. Describe both normal and abnormal labor and delivery. 3.0
6. List important differential factors, implications, and variations in the normal and abnormal birth process. 3.0

7. Review significant factors that affect neurological maturation. 3.0
8. Describe normal neonatal development. 3.0
9. Discuss perinatal development as a function of neurological maturation. 3.0
10. Given a description of a newborn, determine the APGAR score and discuss the significance of the score. 2.0
11. Describe maternal health as related to age, weight, smoking, fetal alcohol syndrome, diabetes, hypertension, HIV status and substance abuse. 3.0

A. Pediatric History

1. Discuss the chronology of the complaint, including any functional limitations associated with the chief complaint 3.0
2. Discuss prior assessment, advice given, and any prior treatment, of the child by other health care providers 3.0
3. Discuss the developmental landmarks and provide normal ages for each of the landmarks to be achieved. 4.0
4. Obtain a family history including number, age, and significant medical history of siblings and adult history information. 3.0
5. Discuss the systems review in the pediatric patient. 3.0
6. Discuss the relevance of the medication allergy and immunization histories. 3.0
7. Discuss comorbidities found in children that make their treatment unique. 3.0
8. Discuss diseases unique to infancy and childhood, such as measles, mumps, rubella, chicken pox, fifth disease, rheumatic fever, and polio. 3.0
9. Discuss problems associated with the patient not being the historian when executing a medical history. 3.0

B. Pediatric General Physical Examination

1. Recognize the differences in general physical examination results for an infant, toddler, and child compared to an adult. 3.0
2. Describe techniques used to obtain vital signs in the infant, toddler, and older child. 3.0
3. Provide age-related normal values for vital signs. 3.0
4. Provide possible etiologies, given an abnormal vital sign. 3.0
5. Discuss the significance of including and evaluating height and weight as part of the vital signs. 3.0
6. Discuss the evaluation of the skin including color, temperature, texture, and adnexa. 3.0
7. Discuss the skin as a marker for disease, including the importance of a lumbosacral skin lesion with respect to tethered cord syndrome 3.0
8. Discuss the differences in the neurologic examination for children of different ages, including evaluation of primitive reflexes, postural reflexes, Gower's sign, and signs of hypotonia and hypertonia. 3.0

C. Osseous Growth Centers

1. Identify osseous growth centers and chronological presentation. 4.0
2. Identify and describe bones that are present at birth. 4.0
3. List and describe the appearance and chronological presentation of bones after birth. 3.0
4. List and identify the appearance of sesamoids, epiphyseal plates, and apophysis in the pediatric foot. 4.0
5. Identify and describe normal variants that may be confused as pathology. 4.0

6. Discuss the histology and physiology of the growth plate. 4.0
- D. Osteochondroses**
1. Define *osteochondroses*. 4.0
 2. Distinguish between true osteochondroses and related conditions such as calcaneal Apophysitis. 4.0
 3. Compare the mechanisms that may cause osteochondroses. 4.0
 4. State the incidence of the common osteochondroses. 4.0
 5. Indicate clinical significance of common osteochondroses. 4.0
 6. List treatment options in the osteochondroses. 4.0
- E. Common Accessory Bones**
1. List the common accessory bones of the pediatric foot. 4.0
 2. List and describe the appearance and chronological presentation of the accessory bones. 4.0
 3. Recognize radiographic appearance of common accessory bones. 4.0
 4. Indicate the clinical significance of accessory bones. 4.0
- G. General Disease/Metabolic Disease/ Genetic Disease/Congenital Problems**
1. Describe anemia, lead poisoning, bone dysplasia, bone tumors, fracture management, rickets, Blount's disease and osteogenesis imperfecta as conditions associated with delayed bone maturation, metaphyseal and epiphyseal abnormalities. 3.0
- H. Pediatric Arthritides and Infections**
1. Discuss pain in the child and provide an algorithmic approach to pain. 3.0
 2. Discuss "growing pains." 3.0
 3. Define *juvenile myalgia*. 3.0
 4. Discuss the signs, symptoms, diagnostic techniques, and treatment for the systemic form of juvenile idiopathic arthritis. 3.0
 5. Define *rheumatic fever*. 3.0
 6. Define *juvenile idiopathic arthritis*. 4.0
 7. Compare and contrast juvenile idiopathic arthritis to other inflammatory processes. 4.0
 8. Summarize the value of lab tests used to diagnose juvenile idiopathic arthritis. 4.0
 9. State the clinical presentation of juvenile idiopathic arthritis. 4.0
 10. List the common treatment regimens in juvenile r idiopathic arthritis. 4.0
 11. Discuss the Polyarticular variants of Juvenile idiopathic Arthritis. 3.0
 12. Discuss the Pauciarticular variants of Juvenile idiopathic Arthritis. 3.0
 13. Discuss the less common pediatric collagen vascular syndromes. 3.0
 14. Define Septic Arthritis. 3.0
 15. Differentiate Septic Arthritis from Juvenile idiopathic Arthritis or osteomyelitis. 4.0
 16. State lab tests needed to diagnose pediatric septic arthritis. 4.0
 17. Explain the clinical significance of septic arthritis. 4.0
 18. Define pediatric hematogenous osteomyelitis. 4.0
 19. State lab tests needed to diagnose pediatric hematogenous osteomyelitis. 4.0
 20. Differentiate pediatric hematogenous osteomyelitis from juvenile idiopathic arthritis. 4.0
 21. Summarize the clinical significance of hematogenous osteomyelitis. 4.0

22. Discuss the etiology and pathology involved with hematogenous osteomyelitis. 4.0
23. Discuss the signs, symptoms, pathology, diagnostic techniques, treatment, and prognosis of early acute osteomyelitis. 4.0
24. Discuss the signs, symptoms, pathology, diagnostic techniques, treatment, and prognosis of late acute osteomyelitis. 4.0
25. Discuss the signs, symptoms pathology, diagnostic techniques, treatment, and prognosis of subacute (chronic attenuated) osteomyelitis. 4.0
26. Outline clinical work-up for suspected osteomyelitis. 4.0
27. Outline laboratory work-up for suspected osteomyelitis. 4.0
28. Outline imaging work-up for suspected osteomyelitis. 4.0
29. Outline a treatment plan for osteomyelitis including antibiotics and surgical intervention. 4.0
30. Describe HIV and treatment available. 2.0

I. Neuromuscular Diseases

1. Define *static encephalopathy* (also known as *cerebral palsy*). 3.0
2. Discuss the etiologies of *static encephalopathy*. 3.0
3. Discuss motor and sensory changes associated with neurological/neuromuscular diseases. 4.0
4. Discuss the orthopedic sequelae of *static encephalopathy*. 4.0
5. Discuss the basic treatment for *static encephalopathy*. 4.0
6. Discuss the types of hereditary sensorimotor neuropathies. 4.0
7. Discuss the clinical picture associated with hereditary sensorimotor neuropathies. 4.0
8. Discuss the basic treatment of hereditary sensorimotor neuropathies. 4.0
9. Discuss the types of muscular dystrophies. 4.0
10. Discuss the clinical picture associated with muscular dystrophy. 4.0
11. Discuss principles of management of muscular dystrophy. 3.0
12. List common congenital medical problems, such as Down syndrome, Ehler-Danlos syndrome, hypotonia, and neuromuscular disease. 4.0
13. Describe and discuss the causes/mechanisms for spasticity, athetosis, paresis, ataxia, paralysis, atonia, ballismus, and rigidity. 3.0
14. Describe gait changes associated with neurological/neuromuscular diseases, including *static encephalopathy*, Guillain-Barre, muscular dystrophy, Charcot-Marie-Tooth, post-cerebral vascular accident, Tabes dorsalis. 3.0
15. Describe circumducted gait, cerebellar gait, foot slap, Trendelenberg gait, drop foot, spastic gait (hemiparetic gait, scissors gait) and calcaneus gait and explain why each occurs. 4.0
16. Discuss in general terms the treatment options available for pediatric gait problems associated with neurological/neuromuscular diseases. 4.0
17. Recognize, identify, and describe the lower extremity manifestations and the signs and symptoms and be able to suspect the neuromuscular, upper motor neuron and lower motor neuron disorders found in children including, *static encephalopathy*, tethered cord syndrome, spina bifida and disastametamyelia, muscular dystrophies, myopathies, peripheral neuropathies, hypotonia, Down Syndrome, Prader-Willi Syndrome, , achondroplasia, Apert Syndrome, Nail-patella Syndrome, Morquio Syndrome, , Mafucci Syndrome, Fetal Alcohol Syndrome, Marfan's Syndrome, osteogenesis imperfect, and Ehlers-Danlos Syndrome. 4.0
18. Discuss the need for referral of the patient with congenital medical problems. 4.0
19. Discuss the techniques used to determine muscle tone. 4.0
20. Discuss the techniques used to determine muscle strength. 4.0

21. Discuss the technique and location used for evaluation of deep tendon reflexes. 4.0
22. Discuss techniques and locations for superficial reflexes. 4.0
23. Discuss gait evaluation as a component of the neuromuscular examination. 4.0
- J. Metatarsus Adductus**
1. Define *metatarsus adductus*. 4.0
 2. Explain the etiological factors seen in metatarsus adductus. 4.0
 3. Describe the clinical appearance of metatarsus adductus. 4.0
 4. Describe the radiographic appearance of metatarsus adductus. 4.0
 5. Differentiate metatarsus adductus from other forefoot pathologies such as forefoot Adductus, talipes equinovarus and skewfoot . 4.0
 6. Identify the patients that benefit from conservative treatment for metatarsus adductus. 4.0
 7. List the potential complications from cast therapy for metatarsus adductus. 4.0
 8. Identify which patient may need surgical correction for metatarsus adductus. 4.0
 9. Discuss significant familial factors associated with the chance of occurrence for metatarsus adductus. 4.0
 10. Discuss the physical exam findings associated with metatarsus adductus. 4.0
 11. Discuss comorbidities associated with metatarsus adductus. 4.0
 12. Provide a step-wise treatment plan for metatarsus adductus. 4.0
 13. Discuss the evaluation of the patient's response to treatment to determine resolution of the metatarsus adductus. 4.0
 14. Discuss conservative measures, including manipulation and casting, shoe gear and bracing, for the treatment of metatarsus adductus. 4.0
 15. Provide a step-wise treatment plan for metatarsus adductus. 4.0
 16. Discuss the evaluation of the patient's response to treatment to determine resolution of the metatarsus adductus. 4.0
 17. Discuss surgical options available based on the patient's age and the severity of the metatarsus adductus. 4.0
 18. Discuss possible long-term sequelae of residual metatarsus adductus. 4.0
- K. Talipes Equinovarus**
1. Define *talipes equinovarus*. 4.0
 2. List the etiological factors of talipes equinovarus. 4.0
 3. Review the pathological anatomy of talipes equinovarus. 4.0
 4. Describe the clinical presentation of talipes equinovarus. 4.0
 5. List the four component deformities of talipes equinovarus. 4.0
 6. Discuss the familial factors for talipes equinovarus. 4.0
 7. List the four different types of talipes equinovarus and discuss the comorbidities, response to therapy, and other factors associated with type. 4.0
 8. Discuss the radiographic findings associated with talipes equinovarus. 4.0
 9. Discuss the techniques used in the radiographic evaluation of talipes equinovarus. 3.0
 10. List and describe the conservative treatments for talipes equinovarus. 4.0
 11. Describe the Ponseti technique for talipes equinovarus correction including casting technique, surgical intervention and long term bracing 4.0
 12. Discuss complications of treatment for talipes equinovarus. 4.0
 13. Outline the order of approach to the deformities involved in talipes equinovarus when treated with the Ponseti technique. 4.0
 14. Discuss the possible complications of treatments for talipes equinovarus. 4.0
 15. Discuss the possible sequelae to talipes equinovarus. 4.0

16. List and describe surgical approaches and procedures, for complicated and uncomplicated TEV.	4.0
L. <u>Congenital Dislocated Hip</u>	
1. Define <i>developmental dysplasia of the hip (DDH)</i> .	4.0
2. Identify the incidence and etiology of developmental dysplasia of the hip.	3.0
3. Summarize the clinical findings seen in developmental dysplasia of the hip.	4.0
4. Describe, and explain the significance of, limitation of abduction, asymmetrical gluteal folds, trendelenberg, sign, anchor sign, and perineal angle.	4.0
5. Describe the Ortolani test and discuss its clinical significance.	4.0
6. Describe the Barlow test and discuss its clinical significance.	4.0
7. Describe the Galleazzi/Allis test and discuss the clinical significance.	4.0
8. Discuss the radiographic views required, as well as evaluation and interpretation, For DDH, including Shenton's line, Perkin's line, and acetabular index.	3.0
9. Discuss the use of dynamic ultrasound for evaluating suspected developmental dysplasia of the hip.	3.0
10. Describe the Thomas test and discuss its clinical significance.	3.0
11. Describe the Ely test and discuss its clinical significance.	3.0
12. Describe the Ober test and discuss its clinical significance.	3.0
13. Discuss imaging techniques used to evaluate for a developmental dysplasia of the hip.	3.0
14. List and describe treatments available for developmental dysplasia of the hip, including success rates and possible long-term sequela.	4.0
15. Discuss the incidence of any comorbidities associated with developmental dysplasia of the hip.	4.0
II. <u>Sagittal, Frontal, and Transverse Plane Deformities of the Hip, Knee, and Foot</u>	
1. Recognize the normal position of the newborn hip, knee, and foot.	4.0
2. State the normal position of the pre-walker's hip, knee, and foot.	4.0
3. Describe the normal position of the beginning walker's hip, knee, and foot.	4.0
4. Describe the normal position of the toddler's hip, knee, and foot.	4.0
A. <u>Hip Joint</u>	
1. Discuss normal transverse and frontal plane development of the hip and femur.	4.0
2. Describe the gait pattern associated with femoral antetorsion.	4.0
3. Describe the gait pattern associated with femoral retrotorsion.	4.0
4. Describe the gait pattern associated with femoral anteversion.	4.0
5. Describe the gait pattern associated with femoral retroversion.	4.0
6. Discuss the possible treatments for versional and torsional problems.	4.0
7. Discuss the normal frontal plane development of the femur.	4.0
8. Provide normal values for the angle of inclination related to age.	4.0
9. Define <i>coxa varum</i> and discuss associated deformities and gait abnormalities.	4.0
10. Define <i>coxa valgum</i> and discuss associated deformities and gait abnormalities.	4.0
11. Discuss treatments available for coxa varum and coxa valgum.	4.0
12. Compare the internal and external transverse plane hip pathology.	4.0
13. Discuss transverse plane hip range of motion, including logic and techniques for measuring with the hip flexed and the hip extended, age-related normal values, and clinical significance of abnormal findings.	4.0
14. Discuss frontal plane hip range of motion including method of measurement, age-related normal values, and discuss clinical significance of abnormal findings.	4.0

15. Discuss sagittal plane hip range of motion including method of measurement, age-related normal values, and clinical significance of abnormal findings.	4.0
B. <u>Knee Joint</u>	
1. Discuss the normal frontal plane development of the knee/tibial segment.	4.0
2. Discuss the physical exam findings associated with tibial varum.	4.0
3. Discuss possible etiologies of pathological tibial varum.	4.0
4. Describe the pathological process involved in Blount's disease.	4.0
5. Describe the resultant gait and possible long-term sequelae of pathological tibial varum.	4.0
6. Differentiate between genu varum and tibial varum.	4.0
7. Discuss the physical exam findings associated with tibial valgum.	4.0
8. Discuss possible etiologies for pathologies tibial valgum and genu valgum.	4.0
9. Discuss the resultant gait and possible long-term sequelae of pathological tibial valgum or genu valgum.	4.0
10. Describe the method used to evaluate tibial torsion and provide normal values for the clinical measurements.	4.0
11. Differentiate between tibial torsion and malleolar position.	4.0
12. Discuss the normal transverse plane development of the tibia.	3.0
13. Discuss tibial torsion including method or measurement, age-related normal values, and clinical significance of abnormal findings.	3.0
14. Discuss knee motion including method of measurement, age-related normal values, and clinical significance of abnormal findings.	3.0
15. Discuss the normal frontal plane development of the knee/tibial segment.	3.0
16. Define pseudotorsion (internal genicular position) and how to differentiate it from Internal tibial torsion	3.0
17. Discuss pseudotorsion including method of measurement, age related normal values and clinical significance of abnormal values	3.0
18. Discuss the treatments available for pseudotorsion	3.0
C. <u>Pediatric Gait</u>	
1. Describe normal and abnormal gait as a function of age.	4.0
2. Identify and discuss abnormal gait for pediatric age.	4.0
3. Recognize, identify, describe, and evaluate deviations from normal gait, including their management.	4.0
4. Recognize, identify, describe, and evaluate causes of toe-walking and their management in children.	4.0
5. Summarize the use of external devices for assistance in pediatric gait.	4.0
D. <u>Intoe Gait</u>	
1. Differentiate between physiological in-toe gait and pathological in-toe gait.	4.0
2. Discuss early childhood gait as a function of anatomical position and neuromuscular development.	4.0
3. Describe the pediatric entity of in-toe gait.	4.0
4. List the etiology and incidence of in-toe gait.	4.0
5. Discuss transverse plane changes related to in-toe gait.	4.0
6. List and describe the non-ambulatory devices used in the treatment of in-toe gait.	4.0
7. List and describe the orthotic devices used in the treatment of in-toe gait.	4.0
8. Compare treatment versus benign neglect for in-toe gait.	4.0

9. Describe the potential complications of the treatment of in-toe gait. 4.0
 10. Identify and describe appropriate footwear for children and the types, and indications for, prescription footwear in the management of pedal pathology. 4.0
- E. Flatfoot Deformities**
1. Differentiate between flexible and rigid flatfoot deformities, and between congenital and acquired flatfoot deformities 4.0
 2. Define *talipes calcaneovalgus*. 4.0
 3. Discuss possible etiologies for talipes calcaneovalgus. 4.0
 4. Discuss the physical findings associated with talipes calcaneovalgus. 4.0
 5. Discuss the radiographic findings for talipes calcaneovalgus. 4.0
 6. Provide a treatment plan for a patient with talipes calcaneovalgus. 4.0
 7. Differentiate between talipes calcaneovalgus and congenital convex pes valgus. 4.0
 8. Describe the soft tissue and bony pathology involved in talipes calcaneovalgus, as well as any associated deformities. 4.0
 9. Describe any long-term sequelae associated with talipes calcaneovalgus. 4.0
 10. List the physical examination tests used to determine the presence of ligamentous laxity. 4.0
 11. Discuss the signs and symptoms associated with ligamentous laxity. 4.0
 12. List any associated systemic pathologies associated with ligamentous laxity such as trisomy 21, , and neuromuscular diseases. 4.0
 13. List common biomechanical deformities associated with flexible flatfoot. 4.0
 14. Describe treatments available for flexible flatfoot. 4.0
 15. Define congenital vertical talus (congenital convex pes valgus) and list the synonyms for this deformity. 4.0
 16. Discuss possible etiologies for congenital vertical talus (congenital convex pes valgus.) 4.0
 17. Discuss the physical exam findings associated with congenital vertical talus (congenital convex pes valgus.) 4.0
 18. Describe the soft tissue and bony pathology involved in congenital vertical talus (congenital convex pes Valgus), as well as any associated pathology. 4.0
 19. Describe the radiographic findings associated with congenital vertical talus (congenital convex pes valgus.) 4.0
 20. List and describe choices of treatments for congenital vertical talus (congenital convex pes valgus), and describe any long-term sequelae associated with the deformity. 4.0
 21. Describe the surgical procedures used in the treatment of congenital vertical talus (congenital convex pes valgus). 4.0
 22. Define *oblique talus* and differentiate from vertical talus. 3.0
 23. Describe the etiology, diagnosis, examination, and treatment of oblique talus. 3.0
 24. Define *tarsal coalition*. 4.0
 25. Describe the signs and symptoms associated with tarsal coalitions. 4.0
 26. List the different types of coalitions in order of their frequency of occurrence. 4.0
 27. Discuss pertinent radiographic projections and expected findings for each of the tarsal coalitions. 4.0
 28. Discuss more advanced imaging techniques that may be used for the evaluation of tarsal coalitions. 4.0
 29. List and discuss conservative and surgical options for each of the tarsal coalitions. 4.0
 30. Describe the long-term sequelae for tarsal coalitions. 4.0
 31. Discuss peroneal spastic flatfoot as a symptom of tarsal coalitions. 4.0
 32. Discuss the diagnosis, treatment, and other etiologies of peroneal spastic flatfoot. 4.0

33. Define <i>flexible pes planus</i> .	4.0
34. Describe flexible pes planus in the pediatric patient.	4.0
35. List the etiologies for flexible pes planus.	4.0
36. Describe the clinical and radiographic findings in flexible juvenile pes planus.	4.0
37. List the common conservative treatment plans for juvenile pes planus.	4.0
38. Differentiate treatment plans for flexible and rigid pes planus.	4.0
39. Describe the orthotic control and devices used for juvenile pes planus.	4.0
40. Describe the treatment of the asymptomatic severe juvenile pes planus.	4.0
41. Review the non-treatment of the mild flexible pes planus.	4.0
42. Differentiate pes planus from normal childhood ontogeny.	4.0
43. Define <i>rigid pes planus</i> .	4.0
44. List the possible etiologies for rigid pes planus.	4.0
45. Describe the clinical findings in pes planus.	4.0
46. Describe the radiographic evaluation of rigid pes planus.	4.0
47. State the natural history of rigid pes planus.	4.0
48. Describe orthotic control devices and other conservative treatment (e.g., shoes, shoe modification, bracing) prescribed in the treatment of rigid pes planus.	4.0
F. <u>Cavus Deformities</u>	
1. Recognize pes cavus (congenital cavus, calcaneocavus, and cavovarus).	3.0
2. Describe the appearance of the cavovarus foot type.	4.0
3. Describe the soft tissue and bony involvement in the cavovarus deformity.	4.0
4. Describe any other pathology associated with cavovarus deformity.	4.0
5. Describe the treatment options for cavovarus.	4.0
6. Describe the appearance of the covoadductus foot type.	4.0
7. Describe the soft tissue and bony involvement in the covoadductus deformity.	4.0
8. Describe any other pathology associated with covoadductus deformity.	4.0
9. Discuss treatment options for covoadductus.	4.0
10. Describe the appearance of the calcaneocavus foot type.	4.0
11. Describe the soft tissue and bony involvement in the calcaneocavus deformit.	4.0
12. Describe pathology associated with calcaneocavus.	4.0
13. Discuss treatment option for calcaneocavus.	4.0
14. Discuss the likelihood of a concurrent neurological disease with the presence of a cavus foot deformity.	4.0
15. Discuss the significance of a unilateral, acquired cavus foot deformity versus a bilateral, acquired cavus foot deformity.	4.0
16. Outline the neurological and/or neuromuscular diseases associated with cavus foot deformity.	4.0
III. <u>Juvenile Hallux Valgus and Digital Deformities</u>	
1. Identify common congenital digital deformities.	4.0
2. Recognize the etiological factors in congenital digital deformities.	4.0
3. Describe the conservative management of digital deformities.	4.0
4. Outline common surgical approaches for juvenile digital deformity.	4.0
5. Define and discuss <i>congenital hallux valgus</i> .	4.0
6. Define and discuss <i>infantile hallux valgus</i> .	4.0
7. Define and discuss <i>juvenile hallux valgus</i> .	4.0
8. Define and discuss <i>adolescent hallux valgus</i> .	4.0
9. Discuss the clinical recognition of hallux valgus.	4.0

- | | |
|--|-----|
| 10. Outline the radiographic interpretation of hallux valgus. | 4.0 |
| 11. Discuss clinical and surgical decision making for the treatment of hallux valgus. | 4.0 |
| 12. Describe and discuss the sagittal plane deformities of the second and fourth toes. | 4.0 |
| 13. Describe and discuss the varus rotation deformities of the third and fourth toes. | 4.0 |
| 14. Discuss surgical decision making for the treatment of second, third, and fourth toe digital deformities. | 4.0 |
| 15. Define digiti quinti varus. | 4.0 |
| 16. Define hallux abducto valgus. | 4.0 |
| 17. Define hallux varus. | 4.0 |
| 18. Define curly toe. | 4.0 |
| 19. Describe and discuss the etiology, clinical appearance, radiographic assessment, and treatment of polydactyly, brachymetatarsia, and syndactaly. | 4.0 |
| 20. Discuss the etiologies of macrodactyly. | 4.0 |
| 21. Describe and recognize longitudinal epiphyseal bracket and how it may contribute to juvenile digital deformities. | 4.0 |

IV. Pediatric Trauma and Child Abuse

- | | |
|--|-----|
| 1. Discuss the physician's role and legal responsibilities in suspected child abuse. | 4.0 |
| 2. Discuss the different types of child abuse and the signs and symptoms of each type. | 3.0 |
| 3. Discuss the common fracture types associated with child abuse. | 4.0 |

RADIOLOGY LEARNING OBJECTIVES

1. Describe the components of a lower extremity x-ray unit, including tubehead, beam limitation devices, and control panel. 3.0
2. Describe in detail basic x-ray tubehead components, including
 - a. cathode with filament(s), focusing cup, anode with embedded target, anode angle, window, filtration, tube housing, and collimator; 3.0
 - b. rotating versus stationary anodes; and 3.0
 - c. line-focus principle and central ray. 3.0
3. Describe x-ray production in terms of
 - a. cathode interactions: thermionic emission and space charge formation; 3.0
 - b. functional cathode design considerations: focusing cup; 3.0
 - c. functional anode design considerations: stationary versus rotating, line-focus principle; 3.0
 - d. anode angle, the line focus principle, and the effect on image sharpness versus heel effect; 3.0
 - e. anode interactions: Bremsstrahlung and characteristic x-ray production; 3.0
 - f. significance of milliamperage and kilovoltage; and graphic polyenergetic x-ray beam with characteristic spikes. 3.0
4. Define x-ray beam intensity in terms of photonic quantity and quality and units of measure. 3.0
5. Illustrate how the following basic factors affect beam intensity:
 - a. intensity = quantity x quality of photons in beam 3.0
 - b. units of exposure (Roentgens) 3.0
 - c. heel effect (non-uniform intensity) 3.0
6. Discuss applications of Bremsstrahlung curves. 3.0
7. Identify and describe four basic factors that affect x-ray beam intensity via photon quantity. 3.0
 - a. kVp
 - b. mA
 - c. distance
 - d. filtration
8. Identify and describe two main factors that affect x-ray beam quality. 3.0
 - a. kVp
 - b. filtration
9. Compare and contrast the major interactions of diagnostic x-rays within matter, centering on the concepts of coherent/elastic scattering, photoelectric interactions, and Compton scattering. 3.0
10. Relate the significance of photoelectric interactions and Compton scattering in terms of safety and image quality. 3.0
11. Define the following terms used to quantify radiation absorption in matter and biologic systems:
 - a. Rad 3.0
 - b. Gray 3.0
 - c. Rem 3.0
 - d. Sievert 3.0
12. Define *exposure*, *absorbed dose*, *dose equivalent*, & relative biologic effectiveness (RBE). 3.0
13. Discuss the image receptors used in radiographic film and fluoroscopic imaging. 2.0

14. Discuss film, in terms of structure of film and its emulsion; types of film and direct versus indirect (screen); and relationship of film type with speed/latitude/detail. **2.0**
15. Discuss film intensifying screens in terms of how they work; reduction in dosage; calcium tungstate versus rare earth types; relationship of screen speed to detail/resolution; and absorption versus conversion efficiency. **2.0**
16. Discuss the different digital radiography detectors, i.e. PSP(CR) + DR CCD, CMOS, & FPD. **3.0**
17. Discuss computed radiography PSP (CR) and direct digital image receptors, with reference to computed radiography (CR) barium fluorohalide screen with plate construction and direct digital radiography (DR). **3.0**
18. Describe how radiographic images are formed for film and fluoroscopic image receptors. **3.0**
19. Discuss how radiographic images are formed for digital PSP(CR) + DR CCD, CMOS, and FPD. **3.0**
20. Explain digital CR latent image processing, in terms of laser scanning the barium Fluorohalide plate; erasure of image; interference by x-ray exposure; exponential image fade with time. **3.0**
21. Discuss fluoroscopic image intensifiers in terms of basic construction *and* how they work. **3.0**
 - a. input phosphor
 - b. photocathode
 - c. output phosphor
 - d. focusing lens
 - e. television image monitoring
22. Discuss film latent image formation, including photon interactions with silver halide crystals that result in latent image formation; reduction of ionic silver; and sensitivity speck and latent image center formation. **2.0**
23. Explain film development in terms of film processing, the basic sequence of processing, and the distinction between clearing and fixing time. **2.0**
24. List basic principles of proper handling and storage of film. **2.0**
25. List/Identify basic determinants of scatter radiation. **3.0**
26. Compare and contrast manual processing versus automatic film processing **2.0**
27. Explain the importance of safelight/spectral matching. **2.0**
28. Discuss the importance of film identification. **2.0**
29. Define radiographic image (*optical*) density. **3.0**
30. Discuss the factors that influence radiographic image (optical) density, and how they affect it, including:
 - a. milliamperage, mAs; **3.0**
 - b. distance; **3.0**
 - c. kilovoltage, kVp; **3.0**
 - d. 15% rule; 5% rule; and **3.0**
31. Define radiographic contrast. **3.0**
32. Delineate between image and subject contrast. **3.0**
33. Correlate basic subject factors with their influence on final image contrast, including:
 - a. Image contrast as defined by thickness differences; **3.0**
 - b. density differences; **3.0**
 - c. atomic number (Z) difference; **3.0**
 - d. effects of kilovoltage **3.0**
34. List the factors that typically affect image quality in terms of fog and artifacts. **3.0**
35. List the factors that typically result in images being too light or too dark. **3.0**
36. Explain image detail and identify the factors that influence appearance. **3.0**

37. Identify the basic causes for a blurred image, and alteration of an object's shape or position. **3.0**
- motion blur
 - geometric factors
38. Define distortion and identify factors that influence its appearance. **3.0**
39. *Radiation Safety*: Discuss the biological effects of ionizing radiation, and how radiation may affect the human body. **4.0**
- Recount the basic molecular and macromolecular effects of ionizing radiation within the cell, both direct and indirect. **4.0**
 - Distinguish between threshold and non-threshold dose/response curves. **4.0**
 - Contrast the relative/differential radiosensitivity of somatic cells. **4.0**
 - Compare and contrast deterministic and stochastic effects of radiation. **4.0**
 - Compare and contrast acute and long-term effects of ionizing radiation. **4.0**
 - Discuss the major early (acute) effects of ionizing radiation on the human body. **4.0**
 - Discuss the late (long term) effects of ionizing radiation. **4.0**
40. Radiation Safety: Minimizing Effects of Radiation - Enumerate principles and basic techniques available to reduce exposure to patients and operators. **4.0**
- Explain how time, distance, and shielding from a radiation source generally influence the amount of exposure. **4.0**
 - Explain the "ALARA" principle. **4.0**
 - Outline the adverse effects of improper collimation. **4.0**
 - Discuss the use of intensifying screens and added x-ray filtration to reduce radiation exposure. **4.0**
41. Describe the different types of radiation protective clothing and explain protective barriers and radiation dosimetry badges. **4.0**
42. Discuss basic scatter radiation "maps" and explain where to stand relative to orientation of tube head and image intensifier. **4.0**
43. Define dose limits. **3.0**
44. Outline the current annual dose limits of thyroid, skin, hands, and feet; lens of the eye; cumulative lifetime; and whole body dose limits for radiation workers, the general public, and the fetus. **3.0**
45. Define position, projection, and view. **4.0**
46. Explain the significance of positioning the foot and ankle in the angle and base of gait. **4.0**
47. For each of the following weight bearing & non-weight bearing views: **4.0**
- Foot*: dorsoplantar (A-P), lateral, lateral oblique, medial oblique, calcaneal axial (Harris-Beath), and axial sesamoid
- Ankle*: anteroposterior, mortise, medial oblique, lateral oblique, lateral, lateral stress, anterior stress, and inversion stress
- Describe the proper technique **4.0**
 - List and discuss indications **4.0**
 - Identify the normal radiographic anatomy **4.0**
48. For the forefoot, midfoot, & rearfoot angles in the transverse, frontal, and sagittal plane: **4.0**
- Identify the angles/axes and measurements
 - Discern normal from abnormal
 - Recognize the angular characteristics and how they change in the various pathologies (flatfoot, cavus foot, metatarsus adductus, etc.)

49. Describe the tangential surfaces concept and its influence on view selection. **4.0**
50. Relate typical changes associated with flatfoot, cavus foot, vertical talus, metatarsus adductus, clubfoot, and bunion deformity. **4.0**
51. Identify the accessory ossicles of the foot and ankle. **4.0**
52. Describe the time of appearance, variance, and completion of ossification of the primary and secondary ossification centers of the foot and ankle for both male and females. **4.0**
53. List the major differentials associated with both acceleration and delay in osseous maturation. **3.0**
54. Explain the basic techniques of administration, optimal scan times, and general indications and usages in current podiatric practice of the following nuclear medicine studies: Tc-99 MDP, Tc-99 HMPAO, Indium-111, gallium-67, sequential marrow/WBC scanning, and PET scanning. **4.0**
55. For the following nuclear medicine studies, Tc-99 MDP, Tc -99 HMPAO, indium-111, gallium-67, sequential sulfur colloid/WBC scanning, SPECT scanning, & PET scanning:
- Explain the basic techniques of administration, optimal scan times, and general indications and contraindications **4.0**
 - Compare and contrast sensitivity and specificity **4.0**
56. Explain the basic interpretation of nuclear medicine studies as they apply to complicated diabetic foot infections and Charcot neuroarthropathy **4.0**
57. Discuss the basic principles and application of ultrasound as applied to foot and ankle musculoskeletal imaging. **4.0**
58. Identify the main components of the ultrasound unit. **3.0**
59. Relate how gain, tissue gain compensation, electronic focusing, spatial compounding, tissue harmonics, read zoom, write zoom, and frequency affect image optimization. **2.0**
60. Identify and describe anisotropy; edge shadowing, posterior acoustic enhancement; posterior acoustic shadowing; partial volume artifact; and reverberation. **3.0**
61. Define *hyperechoic*, *anechoic*, *hypoechoic*, *fibrillar*, and *isoechoic*. **3.0**
62. Describe the main indications and limitations of musculoskeletal diagnostic ultrasound. **4.0**
63. Recognize the normal *and* pathologic appearance on short axis and longitudinal axis of
- plantar fascia, plantar fasciosis, and fascial rupture **3.0**
 - tendons (Achilles tendon, tendinosis, complete rupture); **3.0**
 - fluid-filled soft tissue mass **3.0**
64. Discuss the principles of sectional x-ray imaging that forms the basis for CT scanning. **4.0**
65. Identify sectional anatomy and imaging planes as seen on CT/MRI sections. **4.0**
66. List basic pedal indications and contraindications for CT scanning. **4.0**
67. Discuss MRI of the foot and ankle in terms of indications and contraindications. **4.0**
68. Identify T1, T2W & STIR images with respect to normal anatomy. **4.0**
69. Identify T1, T2W & STIR images with respect to the following pathologies:
- Tumor/tumor-like lesions **4.0**
 - lipoma – ST
 - Morton’s neuroma
 - plantar fibroma
 - ganglionic cyst
 - Tendonopathy **4.0**
 - Achilles tendon
 - posterior tibial tendon
 - peroneal (Fibularis)

c. Trauma	4.0
i. fractures (stress, etc.)	
ii. OCD	
iii. hematoma	
iv. AVN	
v. Lisfranc injuries	
vi. ankle ligament sprain	
d. Infections	4.0
i. soft tissue	
ii. abscess	
iii. cellulitis	
iv. bone	
v. acute osteomyelitis	
e. Miscellaneous	4.0
i. plantar fasciitis	
ii. Charcot disease	
iii. tarsal coalition	
iv. foreign body	
70. List indications and contraindications for the use of contrast (gadolinium) in MR imaging.	4.0
71. Recognize open, closed, comminuted, greenstick, compression, distraction, avulsion, stress, pathological, displaced, non-displaced, angulated, rotated, complete, incomplete, bayonet, and compound fractures.	4.0
72. Explain what is meant by apposition and alignment of fractures in terms of angulation, rotation, displacement, and distraction.	4.0
73. Describe <i>congruity, dislocation, subluxation, diastasis, and effusion</i> as related to the radiographic appearance of joints.	4.0
74. Identify & describe transverse, oblique, spiral, impacted, and intra-articular fracture patterns.	4.0
75. Identify and describe delayed union, nonunion (hypertrophic, oligotrophic, atrophic), malunion, and pseudoarthrosis, in relation to improper fracture healing.	4.0
76. Classify and identify on radiographic ankle images talar dome fractures using the Berndt-Harty grading system.	4.0
77. Classify and identify on calcaneal joint depression fractures using the Sanders CT system.	4.0
78. Define <i>Hawkins' sign</i> and the <i>crescent sign</i> .	4.0
79. Describe and identify on x-ray the Salter-Harris classification of epiphyseal plate fractures.	4.0
80. Describe and identify the radiographic changes/stages of avascular necrosis (osteonecrosis) in both adult and pediatric bone. 4.0 Identify the location and etiology of Legg-Calve-Perthes, Osgood-Schlatter, Blount's, Sever's, Kohler's, Iselin's, Freiberg's, Renandier's, and Diaz' diseases.	4.0
81. Discuss the <i>four</i> stages of the Eichenholtz radiographic classification of neuropathic bone disease (Charcot), along with the clinic-radiographic correlation with each stage.	4.0
82. Describe the radiographic presentations of osteomyelitis in terms of acute, subacute, or chronic (involucrum, cloaca, sequestrum); and hematogenous vs. direct extension/direct inoculation.	4.0
83. Identify and describe the radiographic changes of pyogenic septic arthritis	4.0
84. Identify and describe the radiographic changes of soft tissue infections.	4.0
85. Discuss the appropriate use of radiographic modalities for diagnosis of osteomyelitis and its differentiation from neuropathic bone disease and diabetic osteolysis.	4.0

86. Identify on radiograph image the features of the following pedal arthropathies: **4.0**
- a. Rheumatoid arthritis
 - b. Seronegative spondyloarthropathies
 - c. Gout/tophaceous gout
 - d. CPPD/Pseudogout/chondrocalcinosis
 - e. Diffuse idiopathic skeletal hyperostosis (DISH)
 - f. Osteoarthritis
 - g. Pyogenic septic arthritis
87. Identify typical radiographic features, and distinguish between generalized versus regional osteopenia. **4.0**
88. Radiographically differentiate between rickets, osteomalacia, and scurvy. **4.0**
89. Delineate the basic radiographic features of primary & secondary hyperparathyroidism. **4.0**
90. Identify and describe the radiographic features of renal osteodystrophy. **4.0**
91. Identify and describe the radiographic features of Paget's disease. **4.0**
92. Identify and describe the radiographic features of pedal acromegaly. **4.0**
93. List the basic differentials for generalized periostitis. **4.0**
94. Describe and recognize the basic radiographic features of sickle-cell disease/beta thalassemia. **4.0**
95. Identify and describe the typical radiographic features of enostosis, lead intoxication, osteopetrosis, melorheostosis, osteopoikilosis, osteopathia striata **4.0**
96. Discuss the radiographic features of myositis ossificans. **4.0**
97. Describe and radiographically delineate Monckeberg medial calcific sclerosis, ASO/atherosclerosis, and phleboliths. **4.0**
98. Recognize the basic disorders associated with calcinosis, including metastatic, dystrophic, and generalized calcinosis. **4.0**
99. Describe, identify, and differentiate between the general radiographic features of slow-growing vs. aggressive bone tumor and tumor-like conditions in relation to sclerotic margin, appearance of bone matrix, and periosteal reaction. **4.0**
100. Identify and describe the radiographic characteristics of the following bone tumors and/or tumor-like lesions: **4.0**
- a. Cartilaginous **4.0**
 - i. Osteochondroma & subungual exostosis
 - ii. enchondroma
 - iii. chondroblastoma
 - iv. chondromyxoid fibroma
 - b. Fibrous **4.0**
 - i. nonossifying fibroma
 - ii. fibrous cortical defect
 - iii. fibrous dysplasia
 - c. Osseous **4.0**
 - i. osteoid osteoma
 - ii. osteoblastoma
 - iii. bone island
 - iv. bone infarction

- d. Malignant **4.0**
 - i. Ewing's sarcoma
 - ii. chondrosarcoma
 - iii. conventional osteogenic sarcoma
 - iv. metastases

 - e. Miscellaneous **4.0**
 - v. solitary (unicameral) bone cyst
 - vi. aneurysmal bone cyst
 - vii. giant cell tumor
 - viii. bone abscess (including Brodie's abscess)
101. Identify the plain film radiographic characteristics of tarsal coalitions **4.0**

SURGERY and ANESTHESIOLOGY

LEARNING OBJECTIVES

Anesthesiology
Hospital Protocol
Tumor Surgery
Operating Room Technique
Postoperative Complications
First Metatarsal Surgery
Lesser Digital Surgery
Flat Foot Surgery
Cavus Foot Surgery
Equinus Conditions and Surgery
Traumatology
Nerve Surgery
Heel Surgery
Soft Tissue Surgery
Specific Conditions Involving Surgery
Pediatric Surgery
General Surgical Conditions
Tarsal Coalitions
Arthroscopy and Endoscopy of the Foot and Ankle

I. Anesthesiology

A. Perioperative Management of the surgical patient

1. Describe the components of pre-anesthetic evaluation, including importance and application to the ASA Physical Classification System. **4.0**
2. Describe anesthetic implications for the common disease states affecting the cardiovascular, pulmonary, neurologic, metabolic and endocrine, hepatic and renal, hemopoietic and musculoskeletal systems. **3.0**
3. Discuss the impact of perioperative medications on outpatients and inpatients with co-existing disease. **3.0**
4. Discuss allergic reaction prophylaxis and infection prophylaxis with respect to the anesthetic patient. **3.0**

B. Intra-operative Management of the Surgical Patient

1. Describe the indications for and goals of monitoring for patients undergoing procedures under local, regional, and general anesthesia **3.0**
2. Describe indications for the following types of monitors in anesthesia:
 - a. blood pressure **3.0**
 - b. pulse oximetry **3.0**
 - c. EKG **3.0**
 - d. temperature (aural and esophageal) **3.0**
 - e. capnography **3.0**
 - f. neuromuscular injury that may result from poor positioning **3.0**

C. Airway Management for Patients Undergoing Anesthesia

1. Discuss assessment methods for airway patency and classify common airway systems. **4.0**
2. Describe conditions that predispose a patient to airway impairment. **3.0**

D. Local Anesthesia

1. Classify nerve fiber in relation to local anesthetic actions. **4.0**
2. Make pharmacologic recommendations for the use of amide and ester local anesthetic for plain and non-plain solutions in podiatric medicine, including mechanism of action, pharmacodynamics, and pharmacokinetics. **4.0**
3. Identify known toxic doses for local anesthetics used in podiatric medicine, and recognize signs, symptoms, and management of toxic reaction to local anesthesia. **3.0**
4. Differentiate between toxic and allergic reaction to local anesthesia, including clinical findings, and management of anaphylactic shock. **3.0**

E. Intravenous Anesthesia

1. Explain the concept of "ideal" anesthetic, and describe advantages and disadvantages of IV anesthetics. **3.0**
2. Distinguish between opioid and non-opioid IV anesthetics. **3.0**
3. Recall the pharmacology, including mechanism of action, pharmacodynamics, pharmacokinetics, clinical uses, contraindications, and adverse effects of benzodiazepines, barbiturates, etomidate, and Ketamine. **4.0**

4. Recall the pharmacology, including the mechanism of action, pharmacodynamics, pharmacokinetics, clinical uses, contraindications, and uses Fentanyl meperidine and morphine. 4.0
5. Give examples of opioid antagonists and mixed agonist antagonist opioids. 4.0
6. Describe indications and goals of Total IV Anesthesia (TIVA). 3.0

F. General Anesthesia

1. Define *general anesthesia*, and describe its advantages and disadvantages. 3.0
2. Describe the general mechanism of action, stages, and planes of general anesthetics. 4.0
3. Recall the pharmacology, including the mechanism of action, pharmacodynamics, pharmacokinetics, and toxicity of N₂O and volatile anesthetics. 4.0
4. Describe risks and benefits of inhaled anesthetics, including risk for developing malignant hyperthermia, manifestations, and treatment. 3.0
5. Recall the pharmacology, including mechanism of action, pharmacokinetics, pharmacodynamics, clinical uses, and contra-indications of the commonly used muscle relaxants. 4.0
6. Describe the use and limitations for monitoring neuromuscular blockade, and identify drugs used to reverse neuromuscular blockade. 3.0

G. Regional Anesthesia

1. Recall the anatomy of the spinal column and peripheral nervous system in relation to administration. 3.0
2. Describe the advantages and disadvantages of administering regional anesthesia, including associated safety issues. 4.0
3. Describe principles of neuraxial anesthesia, including the indications and contra-indications, physiologic effects and mechanism of action, effect of position, complications, and drugs utilized for spinal anesthesia. 4.0
4. Describe indications, contra-indications, physiologic effects, mechanism of action, complications, and drugs utilized for epidural anesthesia. 4.0
5. Indicate general principles of peripheral nerve blockade, including indications, contra-indications, and complications. 3.0
6. Describe the common local anesthetic agents used in and the techniques used for the common regional blocks of the lower extremity, including sciatic, femoral, popliteal, common peroneal, posterior tibial, sural, saphenous, and Bier block. 3.0

II. Hospital Protocol

A. Charting and Orders

1. Explain essential components of admission history and physical notes. 3.0
2. Explain essential components of a pre-operative note, post-operative note, and operative report. 3.0
3. Explain essential components of admission orders, peri-operative orders, pre-operative orders, and post-operative orders. 3.0

B. Informed Consent

1. Explain informed consent, including medico-legal implications. **3.0**
2. Identify the party that may give informed consent, and in what circumstances it is required. **3.0**

C. Admitting and Consulting Protocol

1. Describe JCAHO regulations pertaining to podiatric physicians performing histories and physicals for the purposes of hospital admission. **3.0**

D. Organization of Hospital Staff

1. Differentiate between hospital medical staff and other staff, such as allied health. **3.0**
2. Explain principles of granting hospital privileges to clinical staff. **3.0**
3. Describe clinical privileges granted to hospital staff, including:
 - a. active **3.0**
 - b. admitting **3.0**
 - c. consulting **3.0**
 - d. courtesy **3.0**
 - e. surgical **3.0**

III. Tumor Surgery

A. Biopsy Techniques

1. Describe general indications for performing biopsies. **4.0**
2. Differentiate between excisional, incisional, punch, shave, fine needle, and needle core biopsies. **4.0**
3. Summarize indications and contra-indications for excisional, incisional, punch, shave, fine needle, and needle core biopsies. **4.0**

B. Soft Tissue Tumors

1. Describe the salient clinical features and surgical treatment of the following types of malignant lesions of fat, muscle, and nerve origin of:
 - a. liposarcoma **3.0**
 - b. rhabdomyosarcoma **3.0**
 - c. neurofibrosarcoma **3.0**
2. Explain the significance of skin metastases in terms of primary disease state, and identify the most common primary lesions in males and females that give rise to metastases to the skin. **3.0**

C. Bone Tumors

1. Describe the salient clinical features and surgical treatment of the following types of benign bone tumors:
 - a. chondroma 3.0
 - b. chondroblastoma 3.0
 - c. enchondroma 3.0
 - d. ossifying and non-ossifying fibroma 3.0
 - e. aneurysmal and unicameral bone cysts 3.0
 - f. osteoid osteoma 3.0
 - g. osteoblastoma 3.0
 - h. osteochondroma 3.0
 - i. multiple hereditary exostosis 3.0
 - j. giant cell tumor 3.0
 - k. intraosseous ganglion 3.0
 - l. intraosseous lipoma 3.0

D. General principles of Cancer Staging

1. Describe the staging of cancer via the TNM System. 3.0
2. Describe the role of the American Cancer Society in staging various cancers that affect the skin and musculoskeletal systems. 3.0

IV. Operating Room Technique

A. Asepsis

1. Explain and apply Universal Precautions and their application to the sterile technique and within the OR environment. 3.0
2. Describe and apply essential components of sterile technique. 3.0
3. Describe and apply the concept of "Surgical Conscience" and explain potential consequences of breeches in sterile technique, with respect to self and operating field. 3.0
4. Explain routine and biohazard waste handling procedures, as well as general cleaning standards for the OR. 3.0
5. Discuss principles of asepsis, sterilization, and autoclaving. 3.0

B. Instrumentation

1. Classify, including uses of, non-power instrumentation commonly found in a basic foot/ankle surgery tray. 3.0

C. AO Technique/External Fixation Principles

1. Explain principles of A-O fixation. 3.0
2. Discuss the application of A-O technique to foot and ankle surgery and its role in bone healing. 3.0
3. Describe the mechanical basis of stable and rigid internal fixation. 3.0
4. Explain "lag screw" and the techniques utilized in insertion. 3.0
5. Describe the concepts and techniques utilized in static and dynamic interfragmental compression. 3.0

6. Explain screw plates and screws. 3.0
7. Identify and describe instrumentation found in the Mini, Small, and Large, and Cannulated Fragment A-O Sets. 3.0
8. Explain the principles and techniques that dictate the use of K wires and cerclage wires. 3.0
9. Explain the principles and types of external fixation device used in foot and ankle surgery. 3.0

D. Sutures/Technique

1. Explain general principles of usage of the following in foot and ankle surgery sutures: stainless steel wire, nylon, polyester, polyethylene, polypropylene, polyglycolic acid, and polydioxanone. 3.0
2. Classify and describe commonly used suture material utilized in foot and ankle surgery. 3.0
3. Describe biological and mechanical properties of absorbable and non-absorbable sutures. 4.0
4. Discuss surgical needles commonly used in foot and ankle surgery, including material used for construction, and classify them according to needle type, size, curvature, and cross-section, with reference to the needle coding system. 4.0
5. Describe the commonly used suture techniques in foot and ankle surgery, including the use and performance of the following techniques: simple, mattress (vertical and horizontal), retention (superficial and deep), subcuticular, and running. 3.0
6. Describe indications for Kessler, Bunnell, and Krakow suture technique in foot and ankle surgery, as well as other types of technique used in tendon repair. 3.0
7. Explain general principles and instrumentation and techniques which may be used for repairing:
 - a. tendon:tendon 3.0
 - b. tendon:bone 3.0
 - c. soft tissue anchor: bone 3.0

E. Other Biomaterials

1. Describe physical and mechanical properties of materials used for implants in foot and ankle surgery. 3.0
2. Describe physical and mechanical properties of non-metallic materials used in foot and ankle surgery. 3.0
3. Describe physical and mechanical properties of bone morphogenic proteins used in foot and ankle surgery. 3.0
4. Describe the use of topical hemostatic agents used in foot and ankle surgery. 3.0
5. Describe the indications for, and types of bone stimulator used in, foot and ankle surgery. 3.0
6. Explain basic principles and functions of surgical dressings, including description of dressing materials and the anatomy of a surgical dressing. 3.0
7. Describe the types of surgical dressing employed in the practice of foot and ankle surgery. 3.0
8. Describe the role of immobilization in foot and ankle surgery. 3.0

V. Postoperative Complications

A. Systemic Medical (Inpatient Only)

1. Identify the causes of and recognize altered mental status in the postoperative period in a patient. 4.0
2. Identify the causes and recognize the signs, symptoms, and sources of postoperative dehydration. 4.0
3. Identify potential causes and recognize the signs and symptoms of chest pain (Atelectasis versus MI versus PE versus Other) in the postoperative period. 4.0
4. Recognize the signs, symptoms and diagnostic indicators of postoperative urinary tract infection. 4.0
5. Identify the causes and recognize the signs, symptoms and diagnostic indicators of postoperative blood glucose anomalies (diabetic ketoacidosis, hypoglycemia). 4.0

B. Outpatient and Inpatient

1. Identify the causes of and risk factors for postoperative gastrointestinal pathology to include constipation, fecal impaction, nausea, vomiting, and diarrhea (include pseudomembranous colitis secondary to antibiotic). 4.0
2. Recognize the signs and symptoms of postoperative gastrointestinal pathology. 4.0
3. Identify the management strategies for postoperative gastrointestinal pathology. 4.0
4. Recognize the signs and symptoms of postoperative superficial phlebitis. 4.0
5. Understand and recommend appropriate workup, management strategies, and prophylaxis for superficial phlebitis. 4.0
6. Identify the causes and risk factors for postoperative deep venous thrombosis. 4.0
7. Recognize the signs and symptoms of deep venous thrombosis. 4.0
8. Recommend appropriate workup, management strategies, and prophylaxis for postoperative deep venous thrombosis. 4.0
9. Identify the causes and risk factors for postoperative pulmonary embolism. 4.0
10. Recognize the signs and symptoms of pulmonary embolism. 4.0
11. Recommend appropriate workup, management strategies, and prophylaxis for postoperative pulmonary embolism. 4.0
12. Identify the potential causes of postoperative fever, including atelectasis and pneumonia (aspiration), DVT, infection at the surgical site, other infection (UTI/catheter), and medication related (anticholinergic). 4.0
13. Recognize the signs and symptoms of postoperative fever. 4.0
14. Understand and recommend appropriate workup, diagnostic indicators, and management strategies for postoperative fever. 4.0
15. Identify the causes and recognize the signs and symptoms of normal postoperative blood loss versus excessive blood loss secondary to bleeding disorders and coagulopathies. 4.0
16. Recall appropriate workup and management strategies for abnormal postoperative bleeding including prophylaxis. 4.0
17. Distinguish between normal postoperative pain and intractable allodynia. 4.0
18. Identify causes of intractable postoperative pain to include CRPS, post-tourniquet compression neuralgia, bandage/cast related pain. 4.0
19. Recommend diagnostic modalities and management strategies for abnormal postoperative pain. 4.0
20. Identify risk factors and causes of postoperative CRPS. 4.0

- | | |
|--|-----|
| 21. Recognize the signs and symptoms of CRPS. | 4.0 |
| 22. Recommend appropriate workup, management strategies, and prophylaxis for postoperative CRPS. | 3.0 |

C. Foot and Ankle Specific

- | | |
|---|-----|
| 1. Identify the risk factors and causes for postoperative ischemia, including digital and total limb ischemia. | 4.0 |
| 2. Recognize the signs and symptoms of postoperative ischemia. | 4.0 |
| 3. Recommend appropriate workup and diagnostic measures, management strategies, and prophylaxis. | 4.0 |
| 4. Identify the risk factors and causes for postoperative wound/surgical site infection. | 4.0 |
| 5. Recognize the signs and symptoms of postoperative wound/surgical site infection, including the cardinal signs of infection erythema, edema, calor, dolor, malodor, and loss of function. | 4.0 |
| 6. Recommend appropriate workup/diagnostic measures, management strategies, and prophylaxis for postoperative wound/surgical site infections. | 4.0 |
| 7. Identify risk factors and causes of postoperative wound/skin complications to include excessive edema, hematoma, seroma, suture abscess, wound dehiscence, and hypertrophic/keloid scar. | 4.0 |
| 8. Recognize the signs and symptoms of postoperative wound/skin complications. | 4.0 |
| 9. Recommend appropriate workup/diagnostic measures and management strategies for postoperative wound/skin complications. | 4.0 |
| 10. Identify risk factors and causes of complications associated with bone healing, including nonunion (septic and aseptic), delayed union, and malunion. | 4.0 |
| 11. Recognize signs and symptoms of complications associated with bone healing. | 4.0 |
| 12. Recommend appropriate workup /diagnostic measures and management strategies for complications associated with bone healing. | 4.0 |
| 13. Identify risk factors and causes of hardware complications, including pin site complications and internal/external hardware failure. | 4.0 |
| 14. Recognize signs and symptoms of hardware complications in the postoperative patient. | 4.0 |
| 15. Recommend appropriate management strategies for hardware complications in the postoperative patient. | 4.0 |
| 16. Recognize clinical signs and symptoms, as well as radiographic markers of avascular necrosis. | 4.0 |
| 17. Recommend workup /diagnostic measures, as well as management strategies for postoperative avascular necrosis. | 4.0 |
| 18. Identify the causes and recognize the signs and symptoms of specific foot and ankle surgery related complications, including transfer lesions, alignment complications (under/over correction) capsulitis, joint stiffness, and bandage/cast attributed wounds. | 4.0 |

VI. First Metatarsal Surgery

A. Etiology and Radiographic Assessment of Hallux Abducto Valgus Deformity

1. Explain the etiology of hallux abducto valgus deformity, including the biomechanics, heredity, inflammatory rheumatologic diseases, neurological disorders, environment factors, trauma and surgical complications. **4.0**
2. Explain the importance in performing a clinical and physical evaluation of a patient with hallux abducto valgus deformity. **3.0**
3. Describe normal and abnormal angles used in the radiographic evaluation of a hallux abducto valgus deformity in transverse, sagittal, and frontal planes, including metatarsus adductus angle, IM angle, hallux abductus angle, PASA, DASA, hallux abductus interphalangeus angle, metatarsal protrusion distance, and sesamoid position. **4.0**

B. Soft Tissue Procedures for Correction of Hallux Valgus Deformity

1. Describe the surgical anatomy of the first metatarsal and sesamoid complex, as well as the ligamentous attachments of the First MTPJ. **4.0**
2. Describe soft tissue procedures utilized in correction of hallux valgus deformity, including muscle tendon balancing procedures and the concepts of the lateral release including the ligamentous attachments of the First MTPJ. **3.0**

C. Phalangeal Procedures for the Correction of Hallus Valgus Deformity

1. Summarize the procedures, indications, and contraindications of hallux osteotomies. **4.0**
2. Identify potential complications that may arise from performing hallux osteotomies to correct hallux valgus deformity. **4.0**
3. Summarize the procedures, indications, and contraindications of hallux IPJ fusion as part of hallux valgus deformity. **4.0**
4. Identify complications that may arise from performing hallux IPJ fusion to correct hallux valgus deformity. **4.0**

D. Distal Osteotomies of the First Metatarsal for the Correction of Hallux Valgus Deformity

1. Summarize the procedures, indications, and contraindications of distal osteotomies as procedures used in correction of hallux valgus deformity. **4.0**
2. Identify the potential complications specific to any of the distal osteotomies used to correct hallux valgus deformities. **4.0**

E. Shaft Osteotomies of the First Metatarsal for the Correction of Hallux Valgus Deformity

1. Summarize the procedures, indications, and contraindications of the shaft osteotomies of the First metatarsal as procedures used in correction of hallux valgus deformity. **4.0**
2. Identify the potential complications specific to any of the shaft osteotomies of the First metatarsal used to correct hallux valgus deformities. **4.0**

F. Hallux Varus

1. Explain the etiology of the pathomechanics, including iatrogenic versus non-iatrogenic hallux varus deformity. 4.0
2. Describe the treatment plan to correct hallux varus deformity including surgical techniques, both soft tissue and osseous. 4.0

G. Hallux Limitus/Rigidus

1. Discuss the pathomechanics, etiology, and clinical presentation of hallux limitus and hallux rigidus. 4.0
2. Describe joint preserving surgical procedures used to correct hallux limitus/rigidus including chielectomy, and osteotomy. 4.0
3. Describe procedures used for joint resection including arthroplasty, interposition arthroplasty, and replacement arthroplasty for hallux limitus/rigidus. 4.0
4. Identify the biomaterials used in joint replacement procedures, including design and function, surgical techniques, and complications due to material failure, design function, and host response. 4.0
5. Identify postoperative complications that may result from surgery for hallux limitus/rigidus. 4.0

H. Base Procedures of the First Metatarsal for the Correction of Hallux Valgus

1. Explain procedures, indications, and contraindications for performing base osteotomies of the First metatarsal to correct hallux valgus deformity, including the concepts of osteotomy design and use of axis guides. 4.0
2. Explain the hinge axis concept including the components of the hinge, the placement of the hinge the axis, the motion about the hinge, and the orientation of the axis. 4.0
3. Identify potential complications that arise from performing base osteotomies to correct hallux valgus deformity. 4.0

I. Juvenile Hallux Valgus

1. Explain etiologies for juvenile hallux valgus deformity and the mechanism of action. 4.0
2. Describe indications and contraindications for performing juvenile hallux valgus surgery, including muscle tendon balance procedures, base osteotomies, head osteotomies, epiphysiodeses, and ancillary procedures. 4.0
3. Identify postoperative complications following juvenile hallux valgus surgery. 4.0

J. First Metatarsal Cuneiform Arthrodesis for the Correction of Hallux Abducto Deformity

1. Describe indications and contraindications for performing first metatarsal surgery for the Lapidus type procedure. 4.0
2. Identify potential complications that arise from performing first metatarsal surgeries for the Lapidus type procedure. 4.0

VII. Lesser Digital Surgery

1. Identify, classify, and evaluate lesser (2–5) digital deformities and conditions. 4.0

2. Evaluate the pathophysiology or pathomechanics of digital deformity, including effects of equinus, pes cavus and extensor substitution; flatfoot and flexor stabilization; muscle weakness and flexor substitution; and first ray instability and load transfer on digital deformity. **4.0**
3. Discuss the normal and abnormal aspects of the history and physical examination, including any laboratory, diagnostic, or imaging studies or tests that would indicate or contraindicate the following:
 - a. soft tissue digital procedures: **4.0**
 - i. capsulotomy
 - ii. tenotomy
 - iii. tenectomy
 - iv. tendon Lengthening
 - a) "Z" type
 - b) extensor recession
 - b. MTPJ sequential release: **4.0**
 - i. Kelikian push-up test between step evaluation
 - ii. sequential steps: dorsal capsule, extensor brevis, collateral ligaments, flexor plate (plantar capsule release), extensor longus
 - c. tendon transfers: **4.0**
 - i. flexor tendon transfer FDB, FDL, combined
 - ii. extensor tendon transfer, Hibbs
 - d. syndactylyism **4.0**
 - e. osseous digital procedures: **4.0**
 - i. ostectomy/exostectomy/condylectomy
 - ii. phalangectomy: partial/complete
 - iii. arthroplasty (IPJ)
 - iv. PIPJ implant arthroplasty
 - v. diaphysectomy
 - vi. phalangeal osteotomy
 - vii. arthrodesis fusion (IPJ)
 - viii. amputation
 - a) partial:terminal Symes
 - b) complete
 - 1) transphalangeal
 - 2) MTPJ
4. Discuss the indications, contraindications, advantages, and disadvantages of each digital procedure. **4.0**
5. Discuss the risks and benefits of performing or not performing digital procedures. **3.0**
6. Discuss regional anatomy of the lesser digits. **4.0**
7. Explain appropriate incisional approach(es) and outline their respective procedural steps. **4.0**
8. Explain the instrumentation and material needs for performance of digital procedures. **4.0**
9. Explain fixation materials and techniques, including physical characteristics, advantages/disadvantages, indications/ contraindications, and applications. **4.0**
10. Explain the graft materials, including physical characteristics, advantages and disadvantages, indications and contraindications, and application of grafting techniques. **4.0**
11. Discuss the immediate perioperative care requirements and postoperative management of each digital procedure. **4.0**

12. Explain the potential complications of each digital procedure and its management. **3.0**
- A. Central Metatarsal Surgery (Surgery distal to the tarsometatarsal joints of rays 2, 3, and 4)**
1. Evaluate the central (2–4) metatarsal deformities and conditions **4.0**
 - a. shortened metatarsal **4.0**
 - b. elongated metatarsal (transverse plane digital deviation with Kelikian push-up test) **4.0**
 - c. plantarflexed metatarsal **4.0**
 - d. prominent plantar condyle **4.0**
 - e. MTPJ stress syndrome **4.0**
 - i. predislocation phase
 - ii. dislocation phase
 - f. dislocated MTPJ **4.0**
 - g. arthritic MTPJ **4.0**
 - h. rupture of flexor plate **4.0**
 2. Explain pathophysiology or pathomechanics of the metatarsal deformity, including the effect of equinus, pes cavus, and extensor substitution; flatfoot and flexor stabilization; muscle weakness and flexor substitution; and first ray instability and load transfer on digital deformity. **4.0**
 3. Discuss normal and abnormal aspects of the history and physical examination, including laboratory studies, diagnostic tests, or imaging studies that indicate or contraindicate the following central (2–4) metatarsal procedures: **4.0**
 - a. central metatarsal procedures: **4.0**
 - i. metatarsal shortening procedures
 - a) oblique shortening osteotomy (Weil)
 - b) step down osteotomy
 - c) chevron shortening osteotomy
 - d) cylindrical shortening osteotomy
 - ii. metatarsal lengthening procedures
 - a) sagittal “Z” lengthening osteotomy
 - b) cylindrical lengthening osteotomy with bone graft
 - c) callous distraction (refer to section on congenital deformity)
 - iii. metatarsal elevating procedures
 - a) vertical “V” osteotomy
 - b) dorsal wedge basal osteotomy
 - c) sagittal “Z” osteotomy
 - iv. metatarsal lowering procedures, including sagittal “Z” plantarflexing osteotomy
 - b. metatarsal abducting procedures, including multiple osteotomy management of metatarsus adductus **4.0**
 - c. metatarsal resection (eliminating) procedures: **4.0**
 - i. partial metatarsal head resection (MTPJ arthroplasty)
 - a) distal metatarsal head (hemi (4 mm) joint resection)
 - b) plantar condylectomy, including MTPJ implant arthroplasty

- ii. metatarsal head resection
 - a) single
 - b) multiple: pan metatarsal head resection
 - iii. amputation
 - a) isolated lesser ray amputation,
 - b) transmetatarsal amputation (TMA)
 - c) chopart amputation
 - d)
 - iv. partial ostectomy, including metatarsal cuneiform exostectomy
 - v. tarsometatarsal fusion (partial or complete)
 - d. MTPJ flexor plate repair 4.0
- 4. Discuss the indications, contraindications, advantages, and disadvantages of each metatarsal procedure. 4.0
- 5. Discuss the risks and benefits of performing or not performing metatarsal procedures. 4.0
- 6. Discuss the regional anatomy of the lesser metatarsals. 4.0
- 7. Discuss the appropriate incisional approach(es) and outline procedural steps related to each metatarsal procedure. 4.0
- 8. Explain the instrumentation and material needs for performance of metatarsal procedures. 4.0
- 9. Explain the fixation materials and techniques, including physical characteristics, advantages/disadvantages, indications/ contraindications. 4.0
- 10. Explain the graft materials, including physical characteristics, advantages and disadvantages, indications and contraindications. 4.0
- 11. Discuss the immediate perioperative care requirements and postoperative management of each metatarsal procedure. 4.0
- 12. Explain potential complications of each metatarsal procedure and its management. 4.0

B. Fifth Metatarsal Surgery (Surgery Distal to the Tarsometatarsal Joint of Ray 5)

- 1. Identify, classify, and evaluate level(s) of the following fifth metatarsal deformities and conditions:
 - a. Taylor's Bunionette deformity 4.0
 - i. soft tissue deformity: bursitis, neuritis lateral to fifth met head
 - ii. enlarged lateral condyle
 - iii. lateral bowing of distal metatarsal shaft (lateral deviation angle increased)
 - iv. lateral splaying of fifth metatarsal at metatarsal base (intermetatarsal angle increased)
- 2. Arthritis Fifth MTPJ 4.0
- 3. Discuss the pathophysiology or pathomechanics of the Taylor's bunionette Deformity including the effect on forefoot abduction when foot in neutral calcaneal stance position (NCSP). 4.0
- 4. Discuss normal and abnormal aspects of the history and physical examination including laboratory, diagnostic, or imaging studies or tests that would indicate or contraindicate the following procedures:
 - a. fifth ray procedures: Taylor's bunionette 4.0
 - b. fifth metatarsal 4.0
 - c. bunionectomy of the fifth metatarsal without osteotomy 4.0

- d. bunionectomy of the fifth metatarsal with osteotomy 4.0
 - i. distal shaft/head osteotomy
 - ii. proximal base/shaft osteotomy
 - e. metatarsal head resection 4.0
5. Discuss the indications, contraindications, advantages, and disadvantages of digital procedures. 4.0
 6. Discuss the risks and benefits of performing or not performing metatarsal procedures. 3.0
 7. Discuss regional anatomy. 4.0
 8. Explain incisional approach(s) and outline procedural steps related to each. 4.0
 9. Discuss the instrumentation and material needs for performance of fifth metatarsal procedures. 4.0
 10. Explain fixation materials and techniques to fifth metatarsal surgery, including physical characteristics, advantages/disadvantages, indications/ contraindications. 4.0
 11. Explain graft materials, including physical characteristics, advantages/disadvantages, indications/ contraindications. 4.0
 12. Discuss immediate perioperative care requirements and postoperative management of each fifth metatarsal procedure. 4.0
 13. Explain potential complications of each fifth metatarsal procedure and its management. 4.0

VIII. Flat Foot Surgery

1. Recognize that there is not universal terminology when referring to flatfoot deformity. 3.0
2. Recognize characteristic clinical findings associated with flatfoot of, including everted heel, abduction of the forefoot on the rearfoot, collapse of the medial column flexibility, and rigidity. 4.0
3. Recognize evaluate and diagnose ankle equinus as either a primary force or secondary adaptation with flat foot. 4.0
4. Identify etiological factors that require compensation and result in flatfoot deformity. 4.0
5. Explain planal dominance and determine the primary plane of compensation. 3.0
6. Perform a biomechanical evaluation for flat foot and correlate radiographic findings and determine planal dominance. 4.0
7. Recognize and evaluate a flat foot (pes valgus deformity) that is rigid and determine the etiology. 4.0
8. Identify the pathologic collapsing pes valgus foot that requires surgical treatment (deformity, instability, pain, progression). 4.0
9. Explain the pathology of ankle equinus and its surgical management. 3.0
10. Describe indications for medial column soft tissue procedures utilized for flat foot (pes valgus deformity). 3.0

- | | |
|--|------------|
| 11. Describe indications for medial column arthrodesis procedures utilized for flat foot (pes valgus deformity). | 3.0 |
| 12. Describe indications, techniques, and implants utilized for subtalar arthroereisis. | 3.0 |
| 13. Explain extraarticular calcaneal osteotomies with an arthroereisis effect on the subtalar joint. | 3.0 |
| 14. Describe indications and technique of Evans calcaneal osteotomy for transverse flat foot deformity (pes valgus deformity). | 3.0 |
| 15. Describe indications and techniques of posterior calcaneal osteotomies for frontal plane flat foot deformity (pes valgus deformity). | 3.0 |
| 16. Recognize severe hind foot degenerative joint disease and recommend hindfoot arthrodesis. | 4.0 |

IX. Cavus Foot Surgery

A. Perioperative Management of the Surgical Patient

- | | |
|--|------------|
| 1. Define, describe, and identify a cavus foot as primarily being a sagittal plane deformity of plantarflexion of the forefoot on the rearfoot, with secondary multiplane forefoot and rearfoot deformities. | 3.0 |
| 2. Classify cavus foot as flexible or rigid and evaluate its possible association with neuro-muscular disorders. | 4.0 |
| 3. Identify neurologic conditions associated with cavus foot as progressive or static. | 3.0 |
| 4. Classify pes cavus as congenital or acquired lesser tarsus cavus and forefoot cavus. | 4.0 |
| 5. Recognize transverse, frontal and sagittal plane (fore and hind foot) deformity associated with pes cavus. | 3.0 |
| 6. Recognize and understand pseudo equinus associated with pes cavus. | 3.0 |
| 7. Diagnose progressive neurologic pes cavus and recommend joint stabilization or arthrodesis procedure of the fore and hindfoot. | 3.0 |
| 8. Describe and interpret the Coleman block test for evaluation of pes cavus. | 4.0 |
| 9. Recommend radiographic views for pes cavus, draw and interpret angular measurements for surgical decision making. | 4.0 |
| 10. Delineate the flexible and rigid components of pes cavus for surgical decision making. | 4.0 |
| 11. Describe indications for and recommend plantar soft tissue release as a component of pes cavus surgery. | 3.0 |
| 12. Describe indications for and recommend specific tendon transfer procedures for muscle imbalance associated with pes cavus. | 4.0 |
| 13. Describe indications and role of metatarsal osteotomies in the surgical management of anterior pes cavus. | 4.0 |
| 14. Recognize and recommend midtarsal osteotomies for pes cavus with a mid-foot apex. | 4.0 |
| 15. Recognize and recommend calcaneal osteotomy for rigid frontal and sagittal hindfoot deformity. | 4.0 |
| 16. Recognize and recommend tarsal fusion procedures for rigid and or arthritic pes cavus. | 4.0 |
| 17. Evaluate digital deformity associated with pes cavus and recommend surgical treatment options based on etiology and muscular imbalance. | 4.0 |
| 18. Recognize and evaluate lateral ankle instability associated with pes cavus deformity. | 4.0 |

X. Equinus Conditions and Surgery

1. Describe the anatomy and function of the triceps surae and Achilles tendon. 4.0
2. Define equinus and differentiate muscular from osseous equinus or combined muscular-osseous equines. 4.0
3. Perform and interpret the Silverskiold test. 3.0
4. Identify proximal and distal compensations for equinus deformity. 4.0
5. Recommend conservative treatment modalities, when appropriate, for muscular equinus deformities. 3.0
6. Discuss spastic muscular equinus and surgical treatment of proximal recession. 3.0
7. Identify nonspasticgastrocnemius equinus and recommend distal gastrocnemius recession procedures. 4.0
8. Identify and diagnose spastic and nonspastic gastrosoleus equines. 4.0
9. Describe and recommend anterior advancement Achilles tendon procedures for spastic gastrosoleus equines. 4.0
10. Describe and recommend Achilles tendon tenotomies and lengthening procedures for nonspastic gastrosoleus equines. 4.0
11. Recommend talotibial exostosis or other osseous block resection for osseous equines. 4.0

XI. Traumatology

A. General Principles of Management of the Traumatized Patient

1. Describe the basic concepts of initial patient evaluation and emergency triage. 3.0

B. Nail Trauma

1. Discuss common mechanisms of injury associated with acute and chronic nail trauma. 3.0
2. Describe appropriate management of nail trauma, including subungual hematoma, nail bed laceration with and without fracture. 3.0

C. General Principles of Fracture management

1. Evaluate radiographs, CT, MRI, as well as other special imaging modalities to identify forefoot, midfoot, and rearfoot trauma. 4.0
2. Describe the concepts of closed reduction, percutaneous fixation, and external fixation. 3.0
3. Discuss the determination for a closed reduction versus an open reduction. 4.0
4. Explain the concepts of open reduction and internal fixation. 3.0

D. Open Fracture Management, Including Gunshot Wounds

1. Discuss basic management of soft tissue trauma, including imaging, wound care, tetanus and appropriate antibiotic prophylaxis. 3.0
2. Describe the Gustillo and Anderson classification and its significance in the treatment and management of soft tissue injuries involving bone. 3.0
3. Recognize the basic characteristics of particular soft tissue wounds. 3.0
4. Describe and select appropriate wound treatment and the types of closure techniques. 3.0

E. Digital Trauma

1. Discuss common mechanisms and configurations of digital fractures. 3.0
2. Describe the concepts of closed reduction and open reduction of digital fractures. 3.0
3. Describe the long-term complications of digital fractures. 3.0

F. First Metatarsal Fractures

1. Discuss the basic principles of closed reduction utilized in the treatment. 3.0
2. Recognize and evaluate the basic clinical and imaging characteristics to enable appropriate treatment in reference to closed versus open reduction. 4.0
3. Describe the advantages and disadvantages of closed versus open reduction in first metatarsal fractures. 4.0
4. Describe the external and internal fixation principals in reference to the first metatarsal. 3.0
5. Describe common metatarsal anatomical fracture types, including neck, midshaft, and base fractures; as well as joint dislocations, intra-articular fractures and avulsion fractures. 3.0
6. Describe common metatarsal fracture subtypes and discuss appropriate treatment and common long-term complications associated with such trauma. 4.0

G. Central Metatarsal Fractures (2, 3, 4)

1. Discuss the basic principles of closed reduction utilized in the treatment of metatarsals. 3.0
2. Recognize and evaluate the basic clinical and imaging characteristics to enable appropriate treatment in reference to closed versus open reduction. 4.0
3. Describe the advantages and disadvantages of closed versus open reduction in central metatarsal fractures. 4.0
4. Describe the external and internal fixation principals in reference to metatarsals. 3.0
5. Describe common metatarsal anatomical fracture types, including neck, midshaft, and base fractures; as well as joint dislocations, intra-articular fractures and avulsion fractures. 3.0
6. Describe common metatarsal fracture subtypes and discuss appropriate treatment and common long-term complications associated with such trauma. 4.0

H. Fifth Metatarsal Fractures

1. Differentiate between head, midshaft, proximal shaft, base, and avulsion fifth metatarsal fractures. 3.0
2. Recognize and evaluate the basic clinical and imaging characteristics to enable appropriate treatment in reference to closed versus open reduction. 4.0
3. Describe the advantages and disadvantages of closed versus open reduction in fifth metatarsal fractures. 4.0
4. Describe the external and internal fixation principals in reference to the fifth metatarsal. 3.0
5. Describe the complications and concerns with avascular nonunion of a Jones fracture. 3.0

I. Lis Franc's Fracture

1. Discuss the basic principles of closed reduction of Lis Franc's fractures. 3.0

2.	Recognize and evaluate the basic clinical and imaging characteristics to enable appropriate treatment in reference to closed versus open reduction.	4.0
3.	Describe the advantages and disadvantages of closed versus open reduction in Lis Franc's fractures.	4.0
4.	Describe external fixation and internal fixation principals in reference to metatarsals.	3.0
5.	Describe common Lis Franc fracture subtypes and discuss appropriate treatment and common long-term complications associated with such trauma.	3.0
J.	<u>Midfoot Fractures (Navicular, Cuneiforms, Cuboid)</u>	
1.	Discuss the basic classifications and mechanisms of midfoot fractures.	3.0
2.	Recognize and evaluate the basic clinical and imaging characteristics to enable appropriate treatment in reference to closed versus open reduction.	4.0
3.	Describe the advantages and disadvantages of closed and open reduction in midfoot fractures.	4.0
4.	Describe external fixation and internal fixation principals in reference to the midfoot.	3.0
K.	<u>Calcaneal Fracture</u>	
1.	Discuss common mechanisms of injury associated with calcaneal fractures and describe the most common classification schemes and incidence of associated injuries.	3.0
2.	Describe the most useful imaging modalities to ensure appropriate management.	3.0
3.	Evaluate common radiographic angles, such as Gissane's and Bohler's angle, and explain the implications of the normal and abnormal values of each.	3.0
4.	Describe and select appropriate conservative and surgical treatment options of intra- and extra-articular calcaneal fractures.	4.0
5.	Describe the common classifications of Rowe, Essex-Lopresti, and Saunders.	4.0
6.	Discuss contra-indications to surgical intervention, including advantages and disadvantages of internal and external fixation, in reference to the timing of surgical intervention.	4.0
7.	Discuss common long term pathology associated with calcaneal trauma.	3.0
L.	<u>Talar Fractures</u>	
1.	Describe normal talar anatomy, including vascular supply.	3.0
2.	Describe the pathophysiology of talar aseptic necrosis and explain clinical and imaging characteristics to aide in the diagnosis and treatment.	3.0
3.	Evaluate controllable and uncontrollable factors that can influence the normal bone healing process.	4.0
4.	Describe the Hawkin's talar fracture classification and the sequella of these injuries.	3.0
5.	Describe and select appropriate surgical and conservative treatment options of various talar fractures.	3.0
6.	Discuss the Berndt-Hardy classification with mechanism and long-term sequellae of osteochondral lesions and talar fractures.	4.0
J.	<u>Ankle Fractures</u>	
1.	Explain the Lauge-Hansen and Denis Weber ankle fracture classification schemes.	3.0

2. Describe advantages and possible disadvantages of conservative and surgical treatment options for ankle fracture types. 4.0
3. Recognize and categorize different ankle fracture types, using imaging modalities. 4.0
4. Describe basic principles of appropriate internal and external fixation. 3.0
5. Describe the common short-term and long-term complications associated with trauma and fracture of the ankle. 4.0

K. Pilon Fractures

1. Explain Lauge-Hansen and Denis Weber ankle fracture classification schemes. 3.0
2. Describe advantages and possible disadvantages of conservative and surgical treatment options for ankle fracture types. 4.0
3. Recognize and categorize different ankle fracture types, using imaging modalities. 4.0
4. Describe basic principles of appropriate internal and external fixation. 3.0
5. Describe the common short-term and long-term complications associated with trauma and fracture of the ankle. 4.0

L. Physeal Plate injuries

1. Discuss basic anatomical characteristics of pediatric anatomy associated with physeal injuries. 3.0
2. Describe the Salter-Harris classification schemes used to describe physeal injuries and evaluate imaging modalities used to classify such injuries. 3.0
3. Describe and select appropriate conservative and surgical treatment options for physeal injuries. 3.0
4. Discuss common pathological sequelae associated with physeal injuries. 4.0

M. Compartment Syndrome

1. Describe the mechanism of compartment syndromes (acute, traumatic or chronic, exertional). 3.0
2. Discuss physical evaluation and pressure testing of compartment syndromes. 3.0
3. Describe the treatment options of compartment syndromes. 3.0
4. Describe the challenges of nerve damage and muscle tissue loss defects. 4.0

N. Acute and Chronic Tendon Trauma

1. Discuss basic tendon anatomy and physiology, including tendo-Achilles, tibialis posterior, and peroneals. 3.0
2. Describe the normal phases of tendon healing and explain how local and systemic factors may augment the healing process. 3.0
3. Recognize the basic subjective and objective characteristics consistent with tendon trauma of the lower extremity including tendo-Achilles ruptures, tibialis posterior dysfunction, and subluxing peroneals. 3.0
4. Discuss the most appropriate imaging tools to aide in the evaluation and treatment of tendon trauma of the lower extremity. 3.0
5. Describe and select appropriate conservative and surgical treatment options in reference to tendon trauma in the lower extremity. 3.0

O. Ankle Sprains and Talar Dome Injuries, Lateral Ankle Instability

1. Describe normal ankle and subtalar joint anatomy. 3.0
2. Describe the biomechanics of ankle and subtalar joint dislocations. 3.0
3. Describe clinical and imaging characteristics to aid in the diagnosis and treatment. 3.0
4. Describe the common talar fracture classification schemes. 3.0
5. Describe and select appropriate surgical and conservative treatment options of talar fractures, including osteochondral lesions. 3.0
6. Discuss long-term sequelae of osteochondral lesions. 4.0
7. Describe ankle stabilization procedures. 3.0

P. Thermal Injuries

1. Describe the types and classifications of burns, thermal necrosis and frostbite. 3.0
2. Discuss the importance of host response, circulation, wound healing, risk factors, and infections. 4.0
3. Evaluate controllable and uncontrollable factors that can influence the normal wound healing process. 4.0
4. Describe the options and materials available for skin substitutes and grafting. 3.0
5. Describe the challenges of tissue loss defects. 4.0

Q. Puncture Wounds

1. Describe the complications of foreign body and marine puncture wounds and infections. 3.0
2. Discuss the importance of host response, risk factors in reference to the development, and management of postoperative infections. 4.0
3. Evaluate controllable and uncontrollable factors that can influence the normal wound healing process. 4.0
4. Recognize the basic characteristics of edema, hematoma, and infections and formulate appropriate evaluation and treatment options for each. 3.0
5. Describe the normal anatomical compartments of the lower extremity, including the foot. 3.0
6. Discuss common etiologies of compartment syndrome, as well as diagnostic and treatment options. 3.0
7. Discuss the pathophysiology of fracture blisters, as well as treatment options. 3.0
8. Describe the treatment of infected wounds and human, animal, and insect bites. 3.0

XII. Nerve Surgery

A. Nerves of the Lower Leg, Ankle, and Foot

1. Identify, classify, and evaluate nerve entrapments that affect the foot and ankle. 4.0
2. Discuss gross and microscopic lower extremity regional neuroanatomy. 4.0
3. Discuss the pathophysiology of mechanically and metabolically induced neuropathy and classification of nerve injury, specifically Seddon and Sunderland Classification. 4.0
4. Discuss the normal and abnormal aspects of history and physical examination, including laboratory studies, and diagnostic tests (electrodiagnostic testing and imaging studies) based upon the chief complaint. 4.0
5. Discuss neurological surgical procedures, including neurolysis, neurectomy, and neurectomy with implantation. 4.0
6. Discuss the indications, contraindications, advantages, and disadvantages, of neurolysis, neurectomy, and neurectomy with implantation. 4.0

7. Discuss the immediate perioperative care requirements and postoperative management of neurolysis, neurectomy, and neurectomy with implantation. 3.0
8. Discuss the potential complications of nerve surgery, such as amputation neuroma and complex regional pain syndrome, and its management. 4.0

XIII. Heel Surgery

1. Explain the etiology and pathogenesis of common heel deformities, including heel spurs and heel pain syndrome and plantar fasciitis. 4.0
2. Explain the etiology and classification of heel pain, including anatomical consideration, biomechanical and systemic causes. 3.0
3. Explain the incidence of heel pain syndrome and its clinical and radiographic evaluation. 4.0
4. Explain the surgical treatment of heel spur surgery, including indications, contraindications, procedures, and complications. 3.0
5. Explain the surgical approaches to the plantar fasciotomy, heel spur surgery, and the complications that can occur in both. 3.0
6. Discuss new forms of treatment, including low/high wave electromagnetic shock therapy, as well as autologous platelet concentration injections. 3.0

A. Haglunds Deformity

1. Explain the etiology of Haglund’s deformity, including biomechanical and systematic causes, as well as anatomical considerations. 4.0
2. Explain the evaluation of a patient with Haglund’s deformity, both clinically and radiographically, in a differential diagnosis. 4.0
3. Explain the surgical treatment including indications, contraindications, procedures, and complications of Haglund’s deformity. 3.0

B. Retrocalcaneal Extotosis and Tendo Achilles Calcifications

1. Explain the etiology and pathogenesis of the retrocalcaneal exostosis and the tendo achilles calcifications, including biomechanical and systematic causes. 4.0
2. Explain the clinical and radiographic evaluations of retrocalcaneal and tendo achilles calcifications. 4.0
3. Explain surgical treatment including indications, contraindications, procedures, and complications of the retrocalcaneal exostosis. 3.0

XIV. Soft Tissue Surgery

A. Principles

1. Discuss basic principles of soft tissue surgery, incision placement, healing, and basic postoperative management strategies. 4.0

B. Nail Surgery: Chemical and Non-chemical procedure

1. Identify and describe normal nail unit anatomy. 4.0
2. Explain indications for nail surgery, including identification of various types of nail pathology that may require surgical intervention. 4.0
3. Discuss basic contraindications, as well as risks associated with nail surgery. 4.0

4. Correlate appropriate nail procedure to underlying nail pathology. 4.0
5. Explain the difference between elective and nonelective nail procedures. 4.0
6. Identify various local anesthetic techniques, including type of anesthetic agent used for nail procedures. 4.0
7. Describe skin plasties used to address nail pathology. 4.0
8. Explain the terminology differences and between matrixectomy, I&D, and avulsion (partial and total). 4.0
9. Describe the surgical techniques for both partial and total nail avulsion. 4.0
10. Differentiate between chemical and nonchemical matrixectomy, and explain advantages and disadvantages of the various surgical matrixectomy techniques. 4.0
11. Identify the chemicals used for chemical matrixectomy. 4.0
12. Describe surgical technique and necessary instrumentation for both partial and total chemical matrixectomy. 4.0
13. List and describe the nonchemical matrixectomy procedures. 4.0
14. Explain indications for, as well as risks and benefits of, nonchemical matrixectomy procedures. 4.0
15. Explain and describe the clinical features of nail unit lesions that require biopsy. 4.0
16. Describe nail unit biopsy techniques. 4.0
17. Describe appropriate postoperative care following various nail procedures. 4.0
18. Explain complications that may occur following nail matrixectomy including recurrence, bleeding, extended healing times, scar formation, swelling, pain, infection, residual dystrophy, excessive granulation tissue, deformity of the nail bed. 4.0

C. Subungual Exostosis

1. Explain the pathoanatomy of subungual exostosis and the corresponding nail pathology associated with it. 4.0
2. Explain the origin of subungual exostosis. 4.0
3. Describe incisional approaches to subungual exostosis. 4.0
4. Explain surgical technique and instrumentation used to resect/remove the subungual exostosis. 4.0
5. Explain the role of pathology and microbiology with respect to surgical resection of subungual exostosis. 4.0
6. Describe postoperative care for surgery related to subungual exostosis resection. 4.0
7. Discuss complications associated with resection of subungual exostosis. 4.0

D. Verruca Surgery

1. Explain the etiology of pedal verruca, including specific viral origins. 4.0
2. List the differential diagnosis for both benign and malignant pedal verruca. 4.0
3. List of clinical characteristics of verruca, including divergent skin lines, pin-point bleeding with debridement, and pain with lateral pressure. 4.0
4. Explain the treatment options available and commonly used for pedal verruca. 4.0
5. Rationalize that no treatment works every time, but all treatments work some of the time. 4.0
6. Explain the role of curettage in the treatment of pedal verruca. 4.0
7. Explain the technique of curettage of verrucous lesions, including necessary instruments and the concept of avoidance of penetration of the basement membrane. 4.0
8. Explain why any excised verrucous tissue should be sent to pathology for examination. 4.0

9. Explain that other modalities can be used to augment surgical curettage of pedal verruca, including chemical ablation, electrocautery ablation, electrodesiccation ablation, and laser ablation. 4.0
10. Explain the use of various forms of laser in the treatment of pedal verruca, including carbon dioxide laser and pulse dye laser. 4.0
11. Explain the use of other forms of verrucous destruction, including electrocautery, electrodesiccation and cryoablation. 4.0
12. List postoperative management strategies for methods of surgical management of verruca. 4.0
13. List complications associated with surgical management of verruca to include scarring, recurrence, delayed healing, infection, pain, and swelling. 4.0

E. Ossicle/Sesamoid Surgery

1. Identify pathology requiring excision of a pedal ossicle. 4.0
2. Differentiate normal variants from pathologic ossicles or sesamoids and explain the cause of such pathology. 4.0
3. Explain the surgical approach, technique, postoperative management, and complications following ossicle excision. 4.0

XV. Specific Conditions Involving Surgery

A. Surgical Considerations and Surgery for the Rheumatoid Arthritic patient

1. Discuss the surgical considerations of medications and systemic disease. 3.0
2. Recognize the advantages and disadvantages of implants versus fusions. 4.0
3. Describe the procedure of pan metatarsal head resection. 3.0

B. Surgical Considerations and Surgery for the Diabetic Patient (Including Charcot Reconstruction)

1. Describe the basic indications and risks for diabetic patients. 3.0
2. Describe surgical options of muscular imbalance, including tenotomy and tendon transfers. 4.0
3. Discuss the advantages and disadvantages of internal and external fixation. 4.0
4. Describe the complications and management of diabetic reconstruction surgeries. 4.0

C. Surgical Infections (Soft tissue/Bone) and Amputations

1. Discuss diabetes and lower extremity healing. 3.0
2. Describe tests for wound healing including arterial, venous, and oxygenation. 3.0
3. Describe the surgical reconstruction of vessels. 4.0
4. Choose the appropriate surgical procedure for various foot or leg ulcers. 3.0
5. Discuss the diagnosis and treatment of osteomyelitis, including bone scan, MRI, biopsy, excision, and plastic reconstruction. 3.0

D. Neurologic Conditions Amenable to Surgery

1. Discuss the clinical presentation and examination of nerve degeneration, including gait. **4.0**
2. Describe muscle tendon imbalance and joint abnormalities. **3.0**
3. Recognize the advantages and disadvantages of tendon transfers and joint arthrodesis. **4.0**
4. Propose acceptable postoperative protocol and expectations for various procedures. **3.0**

XVI. Pediatric Surgery

A. General

1. Execute a thorough birth and developmental milestone history interview and perform a physical exam on a pediatric patient. **4.0**
2. Discuss the perioperative management of a pediatric patient including pain control. **3.0**

B. Juvenile Hallux Abducto Valgus

1. Be able to describe the etiology of juvenile hallux abducto valgus. **4.0**
2. Be able to describe the physical radiology exam findings for juvenile hallux abducto valgus. **4.0**
3. Be able to list and describe the surgical procedures for the correction of juvenile hallux abducto valgus. Also discuss the long term outcomes and potential complications. **4.0**

C. Digital Deformities

1. Be able to identify upon physical examination and radiographically: curly toe, congenital minimus digitus varus, congenital hallux varus, and macrodactyly deformities along with their possible surgical interventions. Also discuss the long term out comes and potential complications. **4.0**
2. Identify ectrodactyly, syndactyly, and polydactyly deformities along with their possible surgical interventions upon physical and radiographic examination. **4.0**
3. Discuss the long term outcomes and potential complications of ectrodactyly, syndactyly, and polydactyly deformities. **4.0**

D. Brachymetatarsia

1. Perform a history, physical examination, and radiographic evaluation as related to brachymetatarsia. **4.0**
2. Identify surgical options in the correction of brachymetatarsia including callous distraction or one step bone grafting and their potential complications. **4.0**

E. Metatarsus Adductus

1. Discuss the etiology of metatarsus adductus. **4.0**
2. Discuss the gait, physical, and radiographic findings of metatarsus adductus. **4.0**
3. Identify and describe procedures in the surgical correction of metatarsus adductus including soft tissue procedures (tendon releases/transfers, capsulotomies- Thompson, Heyman Herndon Strong), osteotomies, including etatarsal and cuboid and cuneiform osteotomies. **4.0**

F. Congenital Pes Planus

1. Discuss the etiology of pes planus is rigid or flexible including rigid etiologies (tarsal coalitions). 4.0
2. Detail the differences in gait and the physical exam findings, including planal dominance, in determining the rigidity o flexibility of the pes planus, including rigid etiologies (tarsal coalitions) and radiographic findings. 4.0
3. Discuss the surgical options for the treatment of rigid or flexible pes planus including the role of arthroeresis, soft tissue correction, and osseous correction. 4.0
4. Discuss the long term outcomes and possible complications of arthroeresis, soft tissue correction, and osseous correction. 4.0

G. Vertical Talus

1. Discuss the etiology of vertical talus. 4.0
2. Identify vertical talus upon physical examination and radiographically. 4.0
3. Discuss soft tissue releases and osseous surgical correction of vertical talus and their long term outcomes and potential complications. 4.0

H. Clubfoot

1. Discuss the etiology of clubfoot deformity. 4.0
2. Identify clubfoot deformity upon gait examination, physical examination and radiographically. 4.0
3. Discuss soft tissue release, including capsulotomies and Achilles tenotomies for the surgical correction of clubfoot deformities and their long term outcomes and potential complications. 4.0

XVII. General Surgical Principles

A. Instruments and Materials

1. List and describe methods of obtaining hemostasis including tourniquets, bovies, and hemostatic agents, and discuss the safety concerns of each. 4.0
2. List the types of surgical drains utilized in surgery. 4.0

B. Perioperative Management

1. List the elements of a preoperative history and physical and the implications if the patients has comorbidities, including diabetes, hypertension, renal disease, and heart disease. 4.0
2. Discuss the proper use and selection of fluids and electrolyte management in the perioperative patient. 4.0
3. Discuss blood typing, the various blood products, proper administration including adjunctive medications administration, and transfusion reactions. 4.0
4. Identify and discuss commonly prescribed medications, including narcotics and antibiotics in the management of the perioperative patient along with their indications, contraindications, and alternatives. 4.0

XVIII. Tarsal Coalitions

1. Differentiate between a fibrous, cartilaginous, and bony coalition. **4.0**
2. Describe the signs, symptoms, gait, and physical examination findings of talo-navicular, calcaneo-cuboid, calcaneo-navicular, and talo-calcaneal coalitions. **4.0**
3. Describe the radiographic, CT or MRI findings as related to each specific tarsal coalition. **3.0**
4. Describe the surgical approaches to the correction of tarsal coalitions. **4.0**

XIX. Arthroscopy and Endoscopy of the Foot and Ankle

A. Historical

1. Explain the historical developments associated with arthroscopic and endoscopic foot and ankle surgery. **3.0**

B. Principles

1. Explain the basic principles of arthroscopy and endoscopy. **3.0**
2. Explain arthroscope visualization concepts including field of view, inclination of view, and clarity. **3.0**
3. Explain why field of view is determined by lens angles. **3.0**
4. Explain basic concepts of arthroscopic movement including positioning, sweeping, angulation (obliquity), triangulation, and rotation. **3.0**

C. Preoperative Evaluation

1. Explain general indications for arthroscopic surgery, including (diagnostic) inability to make a specific diagnosis and (therapeutic) treatment of a known condition. **4.0**
2. Explain the absolute contraindications to arthroscopic surgery to include localized soft tissue infection, as well as other relative contraindications. **4.0**
3. Explain why intra-articular infection is not a contraindication to arthroscopy (I&D). **4.0**
4. Explain the importance of patient history and physical examination of the ankle and foot in the preoperative evaluation for arthroscopic/endoscopic procedures. **4.0**
5. Explain the basic concepts of a focused examination of the ankle and foot, including ROM, ligament testing, and correlative anatomical structure location with respect to foot and ankle arthroscopic surgery. **4.0**

D. Imaging

1. Explain the importance of weight bearing radiographic imaging of the foot and ankle with respect to preoperative evaluation for arthroscopic foot and ankle surgery. **4.0**
2. Explain the role of other ancillary forms of imaging of the foot and ankle such as stress radiographs, arthrography, nuclear medicine, ultrasound, CT, and MRI with respect to preoperative evaluation for arthroscopic/endoscopic foot and ankle surgery. **4.0**

E. Instrumentation

1. Identify and explain the different types of irrigation used in arthroscopic surgery. **3.0**
2. Differentiate between gravity driven inflow and pump assisted inflow. **3.0**

3. Identify various sizes of arthroscopes used in foot and ankle surgery. 3.0
4. Explain the uses of and interactions between the obturator, trochar, cannula, and the arthroscope. 3.0
5. Identify and explain the role of accessory instruments, including spinal needles, scissors, probes, dissectors, graspers, biopsy forceps, knives, curettes, osteotomes, rasps, retrieving instruments, rongeurs, and suture delivery systems. 3.0
6. Identify and explain the role of power instruments, including joint shaver systems, abraders, awls, debridors (mechanical, laser, radiofrequency), power reamers, and drills. 3.0
7. Explain the difference between noninvasive and invasive forms of distraction with respect of arthroscopy and the importance of distraction to the procedure. 3.0

F. Operating Room Technique

1. Explain anesthesia and hemostasis concepts with respect to foot and ankle arthroscopic/endoscopic procedures. 3.0
2. Describe positioning and preparation of a patient, including all equipment necessary to secure the operative leg. 3.0
3. Describe the layout of the OR with respect to equipment position and duties of all OR personnel. 3.0

G. Correlative Surgical Anatomy (Ankle Arthroscopy)

1. Explain be knowledgeable of the cross sectional anatomy of the ankle. 4.0
2. Identify osseous landmarks. 4.0
3. Identify tendon landmarks. 4.0
4. Identify the location of the DP and PT artery with respect to other landmark structures. 4.0
5. Describe the anatomic location of structures in the subcutaneous layer, including the superficial peroneal nerve, sural nerve, and saphenous nerve, as well as the venous network. 4.0
6. Describe the structures in the deep fascial layer, including the flexor and extensor tendons of the foot and ankle, the two deep neurovascular bundles. 4.0
7. Describe the ligamentous structures, including the tibiofibular syndesmosis, anterior inferior tibiofibular ligament, posterior inferior tibiofibular ligament, transverse tibiofibular ligament, the interosseous membrane, and ankle joint capsule (deltoid ligament, ATF ligament, CF ligament and PTF ligament). 4.0

H. Diagnostic Arthroscopic Examination (Ankle Arthroscopy)

1. Identify the anatomic location and underlying correlative anatomy of the anterior portals, including, anteromedial, antero-central, medial midline, anterolateral, and accessory anterior portals; transtalar portals (medial and lateral); posterior portals (including posteromedial, modified posteromedial, posterolateral, TransAchilles, coaxial, accessory posterior portals and endoscopic portals); and transmalleolar portals (medial and lateral). 3.0
2. Identify and order the steps of the surgical technique protocol for introduction of the arthroscopic equipment into the appropriate portals. 3.0
3. Explain the 21-point arthroscopic ankle examination. 3.0
4. Explain postoperative management strategies after various types of arthroscopic surgeries. 3.0

I. Soft Tissue Lesions

1. Explain the pathogenesis, identify the arthroscopic appearance, and describe the arthroscopic management techniques for forms of soft tissue ankle pathology, including congenital plicae, adhesions (fibroarthrosis), capsulitis, local synovitis, generalized synovitis (posttraumatic), infectious synovitis (pyarthrosis), various soft tissue impingements, rheumatoid synovitis, PVNS, synovial chondromatosis, hemophilia, and other inflammatory arthritides. **3.0**

J. Osteochondral Pathology

1. Explain the pathogenesis, identify the arthroscopic appearance, and describe the arthroscopic management techniques for forms of osteochondral pathology, including surface defects, osteochondritis dissecans, loose bodies, osteophytes, talardome cysts/lesions, arthritis. **3.0**

K. Other Pathology

1. Explain the indications, rationale, and methods for arthroscopic treatment of acute ankle fractures and post-fracture defects. **3.0**
2. Explain the indications, rationale, and methods for arthroscopic treatment of lateral ankle instability. **3.0**
3. Explain the indications, rationale, and methods for arthroscopic ankle arthrodesis. **3.0**
4. Explain the indication for arthroscopic foreign body removal. **3.0**

L. Other Joint Arthroscopy

1. Explain the indications, rationale and methods for arthroscopic subtalar joint surgery including subtalar arthroscopic arthrodesis. **3.0**
2. Explain the indications, rationale and methods for arthroscopic calcaneal cuboid joint surgery, and First metatarsophalangeal joint arthroscopy. **3.0**

M. Rehabilitation after Foot and Ankle Arthroscopy

1. Describe appropriate rehabilitation modalities following foot and ankle arthroscopic surgery and Explain the timing for implementation of each phase of rehabilitation. **4.0**
2. Explain the goals of the rehabilitation modalities and their effects on ROM/flexibility, strength, and coordination. **4.0**

N. Complications in Ankle and Foot Arthroscopy

1. Identify and discuss possible complications following foot and ankle arthroscopy, including neurovascular injury associated with portals, tendon injuries, ligament injuries, articular cartilage injury, accelerated DJD (related to direct cartilage injury), instrument breakage, fluid management complications, compartment ischemia, wound complications, infection, postoperative swelling, thrombophlebitis and PE, CRPS, and postoperative stress fractures. **4.0**
2. Explain techniques or measures to minimize or avoid surgical and postsurgical complications with respect to arthroscopic foot and ankle surgery. **4.0**

O. Endoscopic Procedures

1. Identify nonarticular soft tissue pathologies treatable with endoscopic surgical methods. **3.0**
2. Explain endoscopic procedures to treat nonarticular soft tissue pathology, including plantar fasciotomy, gastrocnemius recession, tarsal tunnel release, excision of a retrocalcaneal bursa, resection of Haglund's deformity, and external neurolysis. **3.0**

APPENDIX I: Bloom's Taxonomy

<p>Bloom's Taxonomy (1954) and the 6 levels of the cognitive domain - According to Kretchmar the intention of the taxonomy was to classify the change in a person created by an educational experience (2008). In this case we are focusing only on changes within the cognitive domain, which are in 6 different hierarchical levels. Although many researchers have agreed upon the hierarchical nature of the first four levels there continues to be debate around the last two levels synthesis and evaluation and whether they are in fact hierarchical or perhaps they are equal but different types of complex thinking. Many researchers have compared synthesis with creative thinking and evaluation with critical thinking. The revised taxonomy has placed these categories in the reverse order. Although it was noted by the original authors of the taxonomy that perhaps evaluation was not in fact hierarchal it is the last level in the original taxonomy, as seen below:</p>	
<p>Level 1—Knowledge The first level of Bloom's Taxonomy within the cognitive domain. At this level, instruction should focus in on enabling learners to remember, or recognize concepts, processes, procedures, theories, or facts. This level includes both factual knowledge and more abstract knowledge or knowledge of universals (e.g., theories) or ways and means of dealing with specifics (e.g., recognizing how our educational system has evolved) (Kretchmar, 2008).</p>	<p>Knowledge Verbs include: Arrange Define Describe Duplicate, Repeat Identify Label List Match Name Order Recall Recognize Record Relate Remember re-order Reproduce Select State</p>
<p>Level 2—Comprehension This is the second level of Bloom's Taxonomy within the cognitive domain. At this level, instruction should focus in on enabling learners to translate facts into their own words, understanding the interrelations enough to form opinions, make predictions, and make judgments because the information has been integrated into their "own frame of reference" and they can apply the knowledge as they have been shown (or</p>	<p>Comprehension Verbs Classify Convert Defend Describe Discuss Distinguish Examples Explain Generalize</p>

similarly to how they have been shown) to apply it (Reeves, p. 610).	Infer Paraphrase Predict Provide Review Rewrite Summarize Translate
<p>Level 3—Application</p> <p>This is the third level of Bloom’s Taxonomy within the cognitive domain. At this level, instruction should focus in on enabling learners to apply their new knowledge within situations beyond what they have seen in the classroom setting. This is the beginning of critical thinking through basic problem solving and the demonstration of transfer of learning.</p>	<p>Application Verbs</p> <p>Apply Change Compute Create Demonstrate Employ Illustrate Interpret Manipulate Modify Practice Prepare Produce Relate show Sketch Solve Use</p>
<p>Level 4—Analysis</p> <p>This is the fourth level of Bloom’s Taxonomy within the cognitive domain. At this level, instruction should focus in on enabling learners to breakdown their acquired knowledge into parts through the consideration of elements, the relationships of those elements, and the organizing principles. Key to this level within the cognitive domain is the act of deductive and inductive thought processes.</p>	<p>Analysis Verbs</p> <p>Analyze Appraise Breakdown Calculate Categorize Compare Contrast Diagram Differentiate Distinguish Examine Experiment Illustrate Model Question Relate Separate Subdivide</p>
<p>Level 5—Synthesis (Creative Thinking)</p> <p>This is the fifth level of Bloom’s Taxonomy within the cognitive domain. Many researchers have</p>	<p>Synthesis Verbs</p> <p>Arrange Assemble</p>

<p>compared this level of the cognitive domain to creative thinking. Therefore, at this level, instruction should focus in on enabling learners to be able to take the breakdown of parts from the analysis phase and form new relations, a new whole resulting in a creative solution to a proposed problem, which was not covered within the classroom setting.</p>	<p>Combine Compose Construct Create Design Develop Formulate Generate Rearrange Reconstruct Relate Reorganize Revise Re-write Solve synthesize</p>
<p>Level 6—Evaluation (Critical Thinking) This is the six level of Bloom’s Taxonomy within the cognitive domain. Many researchers have compared this level of the cognitive domain to critical thinking. Therefore, at this level, instruction should focus in on enabling learners to be able to take the breakdown of parts from the analysis phase and form new relations through the process of evaluation by using a set of content specific criteria.</p>	<p>Evaluation Verbs Appraise Argue Assess Compare Conclude Contrast Defend Evaluate Judge Justify Interpret Support</p>

Sources:

Kretchmar, J. (2008). Taxonomy of Educational Objectives - The Cognitive Domain. In, *Taxonomy of Educational Objectives-Cognitive Domain -- Research Starters Education* (p. 1). Great Neck Publishing. Retrieved from EBSCOhost.

Reeves; M, F. (n.d). An Application of Bloom's Taxonomy to the Teaching of Business Ethics. *Journal of Business Ethics*, 9(7), 609. Retrieved from EBSCOhost.

***Table provided by Sarah S. Wormwood, ©2012.

APPENDIX II: Ranking Key

The following key was used by the content area groups when developing their sections:

- 4 = Absolutely essential for preparation for podiatric medical residency
- 3 = Requires significant emphasis for preparation for residency
- 2 = Requires moderate emphasis for preparation for residency
- 1 = Requires marginal emphasis for preparation for residency
- 0 = Does not require emphasis for preparation for podiatric medical residency

APPENDIX III: AACPM Council of Faculties

Arizona School of Podiatric Medicine at Midwestern University (AZPod)

Glendale, Arizona

Denise B. Freeman, DPM, MSE
Associate Program Director

Pamela E. Potter, PhD
Professor and Chair, Department of Pharmacology

Barry University School of Podiatric Medicine (BUSPM)

Miami Shores, Florida

Sanjay Sesodia, PhD
Chair of Basic Medical Sciences Professor of
Anatomy/Neurophysiology

Shanika Hill, DPM **Chair Elect**
Assisant Professor Podiatric Medicine
Director of Clinical Education

California School of Podiatric Medicine at Samuel Merritt University (CSPM)

Oakland, California

Rowan Reed, PhD
Assistant Professor Preclinical Affairs

Chuck Starrett, DPM
Associate Dean, Biomechanics

College of Podiatric Medicine and Surgery at Des Moines University (CPMS)

Des Moines, Iowa

James A. Mahoney, DPM
Associate Dean for Academic Affairs

Donald G. Matz, PhD
Chair and Professor, Department of Anatomy

Kent State University College of Podiatric Medicine (KSUCPM) (formerly Ohio College of Podiatric Medicine)
Independence, Ohio

Marie M. Blazer, DPM
Assistant Professor, Department of Podiatric Medicine

Jill Kawalec, PhD
Associate Professor and Research Director

New York College of Podiatric Medicine (NYCPM)
New York, New York

Eileen D. Chusid, PhD **Chair**
Dean of Pre-Clinical Sciences

Ronald Soave, DPM
Dean of Clinical Education

**Dr. William M. Scholl College of Podiatric Medicine at Rosalind Franklin University of
Medicine and Science (SCPM)**
North Chicago, Illinois

Derek Talbot, DC
Professor of Basic Biomedical Sciences

Karona Mason, DPM
Assistant Dean of Clinical Sciences

Temple University School of Podiatric Medicine (TUSPM)
Philadelphia, Pennsylvania

Nicole Griffin, PhD
Associate Professor, Department of Anatomy and Cell Biology

Laura Sansosti, DPM
Clinical Assistant Professor, Departments of Biomechanics and Surgery

Western University of the Health Sciences College of Podiatric Medicine (WUCPM)
Pomona, California

Jacqueline Truong, DPM
Associate Professor and Chair, Department of Medicine, Surgery and Biomechanics

Mathew Wedel, PhD
Assistant Dean for Pre-Clinical Curriculum Assistant
Professor of Anatomy