TEXAS CHIROPRACTIC COLLEGE
Department of Chiropractic Principles, Technique, and Biokinetics

Summer 2010

COURSE TITLE: Lower Extremity Biomechanics

COURSE NUMBER: CH3220

COURSE HOURS: 2 Lecture hours per week (Tuesday (2pm, L-206) and Thursday (1pm, L-206))

COURSE CREDITS: 2

PRE-REQUISITES: General Human Anatomy

CONTACT INFORMATION:

Course Professor: Shari Wynd, DC, PhD
Office: Iwama Building, Room 220
Office Hours: Mon – Thurs, 9 – 12pm
Phone: (281)998-5717
E-mail: swynd@txchiro.edu

Scholar 360:
http://scholar360.com/txchiro

Course Packs:
Required journal readings will be posted on Scholar 360 in the course "Resources" folder.

COURSE MATERIALS:
Students will be responsible for all material covered in lecture. Lecture notes will be made available before the scheduled class. In addition to lecture material, students will be responsible for the information contained within the assigned readings from the required text and journal articles (available in the library). While this material may not be covered specifically in lecture, the information is considered important background information and as such students will be expected to learn this material and be tested on this material. All material taught in this course is cumulative. For example, a student must remember the origins and insertions of specific muscles in order to understand the biomechanical effect of an injury to a muscle.

Required Text:

Kapandji IA. The Physiology of the Joints, Vol.2 (5th Ed), New York: Churchill Livingstone, 2008.

Peterson, DH and Bergmann, TF. Chiropractic Technique: Principles and Procedures, (2nd Ed). St. Louis, MS: Mosby, 2002.

Recommended Texts:

Norkin CC and Levangie PK. Joint Structure and Function: A comprehensive Analysis (2nd Ed). Philadelphia, PA: FA Davis Company, 1992.

Magee, DJ. Orthopedic Physical Assessment (3rd Ed). Philadelphia, PA: WB Saunders Company, 1997.

Required Readings:

Buist I, Bredeweg SW, Lemmink KA, van Mechelen W, Diercks RL. Predictors of Running-related injuries in novice runners enrolled in a systematic training program: A prospective cohort study. Am J Sports Med. Dec 4. [Epub ahead of print] 2009

DeSouza MV, Venturini C, Teixeira LM, Chagas MH, DeResende MA. Force-displacement relationship during anteroposterior mobilization of the ankle joints. *J Manipulative Physiol Ther*. 2008 May;31(4):285.

Venturini C, Penedo MM, Peixoto GH, Chagas MH, Ferriera ML, DeResende MA. Study of the force applied during anteroposterior articular mobilization of the talus and its effect on the dorsiflexion range of motion. *J Manipulative Physiol Ther*. 2007 Oct;30(8):593.

Hamill J, Van Emmerik RE, Heiderscheit BC, Li L. A dynamical systems approach to lower extremity injuries. *Clinical Biomechanics*. 1999 Jun;14(5):297-308.

Irish SE, Millward AJ, Wride J, Haas BM, Shum GL. The effect of closed-kinetic chain exercises and open-kinetic chain exercises on the muscle activity of vastus medialis oblique and vastus lateralis. J Strength Cond Res. 2010 Apr 7. [Epub ahead of print]

Ball KA, Afheldt MJ. Evolution of Foot Orthotics-Part I: Coherent Theory or Coherent Practice? *J Manipulative Physiol Ther*. 2002 Feb;25(2):116-24.

Ball KA, Afheldt MJ. Evolution of Foot Orthotics-Part II: Research Reshapes Long-Standing Theory. *J Manipulative Physiol Ther*. 2002 Feb;25(2):115-34.

Sims EL, Carland JM, Keefe FJ, Kraus VB, Guilak F, Schmitt D. Sex differences in biomechanics associated with knee osteoarthritis. J Women Aging. 2009 Jul;21(3):159-70.

Kuhn DR, Shibley NJ, Austin WM, Yochum TR. Tadiographic Evaluation of Weight-bearing

Orthotics and Their Effect on Flexible Pes Planus. *J Manipulative Physiol Ther*. 1999 May;22(4):221-6.

Matjacić Z. Gait analysis and synthesis: biomechanics, orthotics, prosthetics. Stud Health Technol Inform. 2010;152:323-42.

Cruz TH, Dhaher YY. Impaired lower limb muscle synergies post-stroke. Cruz TH, Dhaher YY. Conf Proc IEEE Eng Med Biol Soc. 2009;2009:3956-9.

COURSE DESCRIPTION:

Diagnosis and treatment of conditions of the lower extremity depends on an intimate knowledge of its structure and function. The course will take an in depth look at the structures and functions of the lower extremities and how they relate to common lower extremity conditions.

COURSE COMPETENCIES:

CCE Clinical Competencies		*TCC Clinical Competencies*	
Physical Examination	Diagnosis	Communication	Special Populations
Neuromusculoskeletal Examination	Chiropractic Adjustment or Manipulation	Physical Therapeutic Procedures	

LEARNING OUTCOMES:

This course in Biomechanics is designed to help the student acquire the knowledge of lower extremity biomechanics and integrate that knowledge with different clinical presentations. The specific student learning outcome that this course will address is the development of the student's clinical reasoning skills.

LEARNING OBJECTIVES:

1. Describe the functional anatomy of the hip and pelvis
2. Explain the osteokinematics of the hip and pelvis
3. Explain the arthrokinematics of the hip and pelvis
4. Relate pathological osteo- and arthrokinematics to clinical conditions of the hip and pelvis
5. Describe the functional anatomy of the knee
6. Explain the osteokinematics of the knee
7. Explain the arthrokinematics of the knee
8. Relate pathological osteo- and arthrokinematics to clinical conditions of the knee
9. Describe the functional anatomy of the foot and ankle
10. Explain the osteokinematics of the foot and ankle

11. Explain the arthrokinematics of the foot and ankle
12. Relate pathological osteo- and arthrokinematics to clinical conditions of the foot and ankle
13. Describe the phases and subdivisions of gait
14. Relate the time and distance variables of gait to normal gait patterns
15. Analyze gait for normal gait variables
16. Diagnose pathological gait patterns

TEACHING PHILOSOPHY:

My job as a professor is to help students develop a comprehensive understanding of lower extremity biomechanics. I will endeavor to provide the students with up-to-date material that is relevant to their development as clinicians. Understanding biomechanics is essential to the art and science of chiropractic. In this second course in biomechanics course, students will be required to integrate the basic biomechanical concepts that were presented in their previous Spinal Biomechanics course with clinical reasoning skills. My lectures will be based on my expertise in the area of biomechanics and from the required readings. My goal as a professor is to encourage students to be lifelong learners. As such, I will expect students to read all required chapters and journal articles. Examinations will include questions from these readings. To assist the student in developing their clinical reasoning skills, I will pose clinical questions throughout my lectures. The answers to these questions will not be given directly to the student, but rather the student is expected to research the answers and be prepared to answer these questions (or similar questions) on examinations. Answers can be found directly in the required reading or the lecture notes.

TEACHING METHODS:

Interactive lectures and
Case presentations during lecture to show the relevance between the basic and clinical sciences
Small group activities (End-of-term project)
Independent learning (required reading from current literature)

STUDENT RESPONSIBILITIES

It is your responsibility to attend at least 90% of the lectures (as per school policy); however, missing lectures may mean a missing a pop-quiz or a key concept that I will highlight in the lecture that may not be in your textbook and/or required readings. Attendance will be taken at the beginning of the class. If you are late to class, it is your responsibility to let the professor know of your attendance after class. If you think that you are close to missing 10% of your classes, you should check with the professor to see how many absences you have accrued. I have outlined the chapters you will be responsible for in the following course outline. You will be responsible for all assigned readings – this means that this material will be covered in midterms and/or finals. To enhance your learning experience, you should prepare before class. Class participation in small group activities and in-class discussions is expected. Participation should be done in a positive manner for the learning process. At all times the students will be expected to demonstrate respect for your peers and your instructor. If at any time you do not understand the material that is being presented, or you need to review quiz

or test material, please contact me during my office hours, immediately after class, or by email to set up an appointment.

Participation:	90% Attendance
Homework:	Review notes, required readings, assigned textbook chapters
Quizzes/Exams:	Three Exams (Two in-class tests, one final)
	Best two out of three quizzes (10 points each)
	Participation in final group project (individually graded)

GRADING METHOD AND SCALE (pg 49):

Statement on the Assessment Process and Measurements:
Exams will contain short answer, multiple choice, true/false, and/or matching questions, and each grade to the school standard:

90 - 100	= A
80 - 89	= B
70 - 79	= C
BELOW 70	= F

COURSE GRADING SCHEMA:		**Total Points**	
Student Group Project (presentation and exam questions)		25	(11%)
*Quizzes (three "pop" quizzes, 8.33 points each)		25	(11%)
Midterm exams (Three tests, 25 points each)		75	(33%)
Final Exam (Cumulative)		100	(44%)
	Total	225 points	(100%)**

* A total of 5 quizzes will be given, the best 3 will be used to calculate your final grade.
**Please note that final grades will be rounded to the nearest whole number. For example, a final score of 157 points out of 225 is 69.6%, which will be rounded up to 70% (the minimum score required to pass the course).

METHOD OF ASSESSMENT

Students will be assessed in several different manners. Quizzes will be short answer and/or descriptive essay questions. Midterms and final exams will be a composite of multiple choice, extended matching, short answer, and essay questions. The midterms and final are cumulative. Material from lectures, assigned readings, and student presentations will be considered "testable" material.

Example Test Questions:

Describe the gait cycle. Please discuss joint kinematics of the hip, knee, and ankle during each of the phases. To assist in your discussion, you may use diagrams. Also, discuss the muscle activity that occurs through the gait cycle. (Essay question)

Outline the sub-talar movements associated with normal gait. (Short answer)

Which of the following muscles act create stability in the hip? Please select all that apply.

a) piriformis
b) gamelli
c) obturator externus
d) gluteus minimus
e) gluteus maximus
f) gluteus medius
g) adductor magnus
h) Sartorius

TEST BLUE PRINT:

Test blue prints are provided for the student so that they may allocate the appropriate amount of time to understanding the key concepts that they are expected to learn for the test. Students should be advised that all lecture material is testable material.

Total Available Test Points: 25

1. ***Definitions (as provided in the lecture and/or required readings): 10 points (40%)***

   Skill level: Basic (memorization)

   Example question: Define kinematics. (2 points)

   Answer: Kinematics is the study of the movement of a body without reference to the forces that created the motion.

   Rubric:

   0 points: No reference or incorrect reference to the requested definition.

   1 point: Correct reference to the requested definition but missing some key component of the question.

   2 points: Correct reference to the requested definition including all key elements presented in the reading and/or lecture material.

   Total questions of this type on the test: 5

2. **Contrast and compare: 10 points (40%)**

   Skill level: Intermediate (utilization of knowledge)

   Example: What is the difference between osteokinematics and arthrokinematics?

   Answer: Osteokinematics is the study of the relative motion between two body parts. Joint shape, muscle length and strength, and ligament structure will have an influence on the observed motion. An example of this type of

study would be the range of motion tests used during orthopedic assessment of the knee. Arthrokinematics is the study of the movement between two joint surfaces. Joint shape and ligament integrity are considered the primary determinants of the observed motion. An example of this type of study would be the assessment of movement between two vertebrae during motion palpation.

Rubric:

0 points: Incorrect explanations and/or inability to compare items.
1 point: Partially correct explanations with no demonstration of the ability to compare items.
2 points: Partially correct explanations with poor demonstration of ability to compare items. (Lack of detail and/or examples)
3 points: Correct explanations with moderate demonstration of the ability to compare items. (Details present but lacking accuracy and/or no examples)
4 points: Correct explanations with good demonstration of the ability to compare items. (Details present and accurate but no examples)
5 points: Correct explanations with excellent demonstration of the ability to compare items. (Details present and accurate with examples)

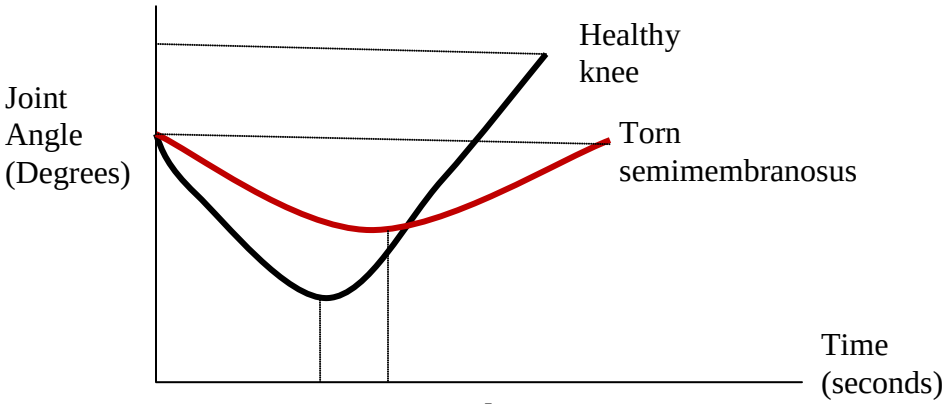
Total questions of this type on the test: 2

3. Analyze/derive and explain your answer: 5 points (20%)

Skill level: Advanced (integration of knowledge)

Example: Draw a joint-angle displacement curve for a healthy knee during the swing phase (from toe-off to heel strike) of the gait cycle. (3 points) Draw a second joint angle-displacement curve demonstrating what would be expected to occur if the semimembranosus tendon was torn. Explain your answer. (2 points)

Answer:



During the swing phase, the healthy knee flexes maximally to approximately 60 to 85 degrees (at approximately mid-stance for the opposite leg). At toe off, the healthy knee is flexed to approximately 130 degrees; however, at heel strike, the knee is fully extended (at approximately 180 degrees). Concentric contraction of semimembranosus is required to flex the knee during the swing phase. When the semimembranosus is torn, the ability of the hamstrings to generate the required knee flexion is impaired, resulting in a decreased maximal flexion angle. The pain associated with stretching of the injured hamstrings will also cause inhibition of extension, so the knee will likely not extend completely at heel strike. Finally, since the muscle is injured, it will likely be unable to generate sufficient power to move the knee as quickly when compared to the healthy knee. This will result in a slower swing phase (as indicated by the shift of the curve to the right).

Rubric:

0 points: Incorrect analysis.
1 point: Analysis incomplete/inaccurate and no explanations provided.
2 points: Analysis incomplete/inaccurate and some explanations provided.
3 points: Correct analysis with marginal or inaccurate explanations
4 points: Correct analysis with some explanation; however, key elements remain unexplained.
5 points: Correct analysis with complete and accurate explanations

Total questions of this type on the test: 1

A written examination requires a different type of studying. Clearly, biomechanical concepts must first be memorized before they can be used in higher order thought processes. Course concepts should be reviewed regularly so that they are not new concepts at the time of the examination.

The written examinations are designed such that is should be possible to get 80% by memorization and utilization of the course key concepts. The remaining 20% of the test score will require a deeper understanding of the course material and therefore will represent a significant challenge to students who still struggle with the key concepts. Students who comprehend the key concepts will also be challenged; however, through logical thought processes, the correct answer will be possible. Written examinations help the student to develop the clinical reasoning skills that they will need for practicing as a Doctor of Chiropractic.

Written examinations are a new concept for students so it is imperative that students practice the sample questions that are provided by the instructor. These questions will be interspersed throughout the lectures. Answers to these questions will not be provided; however, the answers will be readily available in either the lecture notes or assigned readings. Students are encouraged to

answer these questions completely (as if they would answer them in an examination). Completed questions can be submitted to the instructor for verification of correctness and/or suggestions for completeness.

COURSE OUTLINE BY WEEK:

Week	Date	Topic	Reading Assignment
1	05/11	• Introduction to course; syllabus, course objectives, reading assignments, tests, grading etc. • Divide into groups of 4 to 5 people. Submit names of group members.	• Chapter 1 (Kapandji) • Chapter 2 (Peterson and Bergman)
	05/13	• Basic Biomechanics (review)	• Chapter 2 (Peterson and Bergman)
2	05/18	• Hip joint: Functional anatomy (review)	• Chapter 1 (Kapandji)
	05/20	• Hip joint biomechanical assessment (osteo- and arthrokinematics)	Chapter 6, pg 402-415 (Peterson and Bergmann)
3	05/25	• Hip joint pathomechanics	• Hamill et al. • Buist et al.
	05/27	• Biomechanics of hip joint manipulative procedures	• Chapter 6, pg 402-415 (Peterson and Bergmann)
4	06/01	• **TEST I – Format: Short answer. Total points = 25.**	
	06/03	• Knee joint: Functional anatomy (review)	• Chapter 2 (Kapandji)
5	06/08	• Knee joint biomechanical assessment (osteo- and arthrokinematics)	• Chapter 2 (Kapandji) • Chapter 6, pg 415- 432 (Peterson and Bergmann)

	06/10	• Knee joint pathomechanics	• Hamil et al. • Irish et al.
6	06/15	• Biomechanics of knee joint manipulative procedures.	• Chapter 6, pg 415- 432 (Peterson and Bergmann)
	06/17	• **TEST II: Format: Short answer. Total Points = 25**	
7	06/22	• Foot and ankle joints: Functional anatomy (review)	• Chapter 3 and 4 (Kapandji) • Chapter 6, pg 432 - 447 (Peterson and Bergmann).
	06/24	• Foot and ankle biomechanical assessment (osteo- and arthrokinematics)	•
8	06/29	• Foot and ankle pathomechanics	• Ball and Afheldt (Part I and II) • Kuhn et al • DeSouza et al • Venturini et al
	07/01	• Biomechanics of foot and ankle manipulative procedures	• Chapter 6, pg 432 - 447 (Peterson and Bergmann).
9	07/06	• **TEST III: Format: Short answer. Total Points = 25**	
	07/08	• Introduction to gait analysis	• Chapter 3, pg 57-60 (Peterson and Bergmann).
10	07/13	• The biomechanics of gait	• Sims et al.
	07/15	• The biomechanics of gait	• Matjacić
11	07/20	• Pathological gait biomechanics	• TBA
	07/22	• In class activity – gait analysis	• Chapter 5, pg 190- 209 (Kapandji)
12	07/27	• In class activity – gait analysis	•
	07/29	• Special topics o Biomechanical analysis of the lower	• TBA

		limb during various sports	
13	08/03	• **Group Presentations.** Individually graded. Each member of the group must present their contribution to the project. Students are responsible for all material covered in the presentations. Total Points = 25	•
	08/05	• **Group Presentations (cont'd)**	•
14	TBA	**FINAL EXAM – Cumulative. Total points = 100**	

POLICY INFORMATION:

All policy information below can be found in your student handbook. For specific procedures on how each policy is enforced, see the Student Handbook.

Attendance Policy (pg 55)*:*

Regular and punctual attendance of all scheduled classes and laboratories is expected. A student is subject to academic penalty if absences exceed 10%. Absences exceeding 20% subject a student to dismissal from a course. Three incidences of tardiness may constitute an absence. If justifiable cause can be shown for the absenteeism, the student may be permitted to make up missed assignments and maintain enrollment in the class. During the course of their internship, students will be required to be in attendance at the clinic throughout the normal trimester vacation periods unless the clinic is closed. The hours from these periods will be added to the student's clinic requirements.

This course is 13 weeks with two contact hours each week and a final two hour exam in the 14th week. A total of three absences constitute 10% of this course's allotted time. While efforts to notify students about their attendance status will be made, it is the student's responsibility to keep track of their own attendance. The fourth absence will be subject to academic penalty. On the 5th absence, a student will be dismissed from the course. Attendance will be taken at the beginning of class. The student will be responsible for signing the attendance sheet at the front of the class prior to class commencing. Once class has commenced, the sign-in sheet will be removed. Students who enter the classroom after the sign-in sheet has been removed are considered "tardy". A second sheet will be available for tardy students to sign before leaving class. It is the student's responsibility to ensure that their signature is on either sign-in sheet. Failure to sign in constitutes an absence.

Missed Examinations (pg 54):
Students must notify faculty before missing any examination. If an examination is missed for good and sufficient reason and the student has notified the faculty member in advance, a make-up examination may be given subject to a fee of $40.00. The fee for the make-up examination is a minimum of $75.00 if a standardized patient is required for the exam. Additional required standardized patient hours may increase this $75.00 minimum fee. All intra-term examination must be made up prior to final examinations. Missed final examinations must be made up within the first week of the next semester. A student may be allowed a maximum of two missed examination dates for good and sufficient reason per trimester. These two missed examination dates are for all enrolled courses in a trimester, not for each individual course. Any request for additional make-up examinations will require documentation substantiating the absence and must be approved by the Dean of Academic Affairs.

In-class "pop-quizzes" are not subject to this make-up policy. Students who wish to obtain a grade for a missed "pop-quiz" will be asked to write an essay.

Other Classroom Policies
Professional behavior is expected while the student is in the classroom. As such, the following classroom policies will be in effect:

1) Cell phone use is prohibited during class. This includes the sending and receiving of voicemail and/or text messages. Cell phones should be turned off during class.
2) Class will begin on the hour and end 10 minutes before the next hour. Sufficient time is therefore allotted for the student to prepare for the next class. Leaving early and/or wandering in and out of class is considered unprofessional and demonstrates disrespect for the learning environment.
3) The classroom dress code is casual except for presentations. Students should wear business attire for presentations.
4) Many students like to write their notes directly into their laptop during lecture. This will be tolerated. However, the use of the computer should be strictly for taking notes during class time. Surfing the web, completing assignments from other classes, and/or other personal use of the computer is not permitted. Using a computer in class is a privilege. If it becomes apparent that this privilege is being abused, computers will not be allowed during class time.
5) The lectures presented to the students during class time are the property of the professor and of TCC. Digital recording of the lectures will be allowed; however, the recorded lecture material **must** be for personal use. No posting of the recorded lecture is permitted on any web-based community. Sale and/or unauthorized distribution of lecture material will result in disciplinary action.
6) Midterms will be held during classroom hours. Students will be expected to leave all of their personal affects at the front of the classroom. Items that are permitted during the examination will be: a pencil, an eraser, a pen, a watch or other time piece. Cell phones

will not be permitted on your person during exams.

7) If you require a dictionary for English translation, you must present it to the professor prior to commencing the exam. The dictionary must not have ANY personal markings or writing in it. No electronic translators will be permitted.
8) Student grievances will be dealt with according to the Students Code of Conduct (pg 35).

Confirmation of Receipt and Understanding of Course Syllabus
Lower Extremity Biomechanics
(CH3220)

Summer 2010

I, _____ have received a copy of the course syllabus and have read and understand its contents.

The professor (Dr. S. Wynd, DC, PhD) has reviewed the key points contained within the syllabus during class time and acknowledge that the verbal review of the syllabus is not meant to replace my own personal review of its contents.

I agree that it is my responsibility to refer to the syllabus for information regarding the test dates and project dates.

I understand that the lecture schedule, as written in the syllabus, may be altered to accommodate the needs of the class to spend more or less time on specific objectives.

_____	_____	_____
Printed Name	Signature	Date

Student Honor Code

Faculty Name: Shari Wynd, DC, PhD

Course: Lower Extremity Biomechanics, CH3220

I have read Texas Chiropractic College's policy on Academic Dishonesty as published in the 2008-2010 Student Handbook, understand its provisions, and pledge my honor that I will not violate it.

_____	_____	_____
Printed Name	Signature	Date