School of Physical Education and Sports Science (Serres), Aristotle University of Thessaloniki (AUTH)

MSc “Kinesiology”

Postgraduate studies Program in “Kinesiology”

Courses Outlines

Contents

1. Courses Outlines

1.1 First Semester

1.1. 1 Neural adaptcjations and exercise control

The purpose of this course is (i) to deepen and understand the fundamental principles of Neuromechanics and Training, (ii) to explore and study concepts and phenomena related to the structure and function of the nervous and muscular systems after exercise intervention, (iii) to familiarize students with the design and implementation of exercise prescriptions with specific goals and the use of Neuromechanics and Training principles, (iv) to understand the specificities of different age groups in designing training programs for optimal neural adaptations, and (v) to educate students in methods of assessing motor performance and exercise guidance.

Learning Outcomes

Upon successful completion of the course, the student will be able to:

1. Understand the structure and function of the nervous and muscular systems.
2. Identify central and peripheral adaptations after exercise intervention (e.g., training unit, long-term training, etc.).
3. Understand the specificities of different age groups (childhood, elderly).
4. Use methods to assess the function of the neuro-muscular system.
5. Design appropriate protocols and apply these methods, e.g., record, process, and present electromyographic data.
6. Present methods and research findings in a 2-minute poster teaser format.

Course Content

• Basic principles of muscle mechanics: Reminder of basic knowledge of neuroanatomy and muscle mechanics. Contents include the structure of motor units, classification based on their characteristics, recruitment of motor units, and the Henneman principle. Types of muscle function. Myosin dynamics and non-dynamic relationship of the muscle.

• Neuro-mechanical basis of kinesiology: Analysis of the role of motor neurons and sensory receptors. Contents include alpha-motor neurons, the muscle spindle, Golgi tendon organs, and sensory-articular receptors. Who "reads" length and who produces muscle tension.

• Mechanism of muscle function: Detailed analysis and description of the chemical processes of Excitation and the mechanical result of Contraction. Contents include the role of calcium, sliding of myofilaments, excitability of the cell membrane, and its dependence. Neuromuscular junction.

• Muscle activation – Electromyography: Analytical description of muscle activation and factors affecting it. Contents include recording electrical signals with surface and intramuscular electrodes, signal analysis and processing, and the relationship of EMG to produced tension.

• Muscle modeling and elastic energy: Familiarization and first contact with muscle models. Contents include the 3-component model, Contractile component, Series elastic component, Parallel elastic component. Storage and reuse of elastic energy.

• Muscle stiffness, alignments, and stable force application: Measurement of stiffness, effects of alignments, and stability training. Contents include increased stiffness of the myotendinous complex after plyometric training, consequences of passive alignments, isometric stability, dynamic accuracy, and accuracy of athletic movement.

• Muscle fiber architecture: Analysis of mechanical performance in relation to the angle of muscle fiber pennation. Contents include the pennation angle of fast and slow muscle fibers, ultrasound and the localization of muscle fiber pennation. The effects of training on the pennation angle.

• Co-activation of agonists and the mechanism of muscle tension regulation: Understanding the function of agonistic and antagonistic motor neurons during maximum and submaximum muscle function. Contents include the role of Golgi tendon organs and the muscle spindle in controlling muscle integrity and joint protection.

• Spinal reflexes: Learning the central pathways of reflexes and their effects on muscle activation. Contents include H-reflex and M-wave, reflex excitability in trained and untrained individuals, feedback from proprioceptors.

• Fatigue: Analysis of central and peripheral fatigue phenomena and assessment of indicators. Contents include changes in EMG during fatigue, neuromuscular transmitters, the concept of overtraining.

• Static and dynamic balance: Analysis of upright posture and walking. Parameters influencing balance. Contents include upright posture, balance strategies, rate of force development, the role of proprioception.

• Aging and neuromuscular adaptations: Recording the effects of training in elderly individuals. Contents include strength training and neuromuscular adaptations, stability, and tremor. Elimination of motor units and its effects on movement stability.

• Neuromuscular electrical stimulation: Involuntary muscle function and contraction with electrical stimulation. Contents include the reversal of the recruitment principle of motor units, isometric strength training with neuromuscular electrical stimulation.

Course Assessment

A. Written final exam including (60%):

1. Multiple-choice test
2. Short-answer questions
3. Essay questions

B. Completion and presentation of group work: 25%

C. Individual quizzes: 15%

1.1.2 Sports Psychology and Exercise Psychology

The purpose of the course is to deepen the understanding of psychological factors influencing the behaviors and athletic performance of athletes and exercisers, and to understand the application of strategies for managing the psychology of athletes for supporting their athletic performance and exercisers for tactical and long-term participation in exercise.

Learning Outcomes

Upon successful completion of the course, students will be able to: (a) Explain the complexity of the psychology of athletes in sports and exercisers in exercise, (b) Formulate basic psychological theories and practices of sports psychology in the field of sports and exercise, (c) Interpret psychological factors that aim to enhance the motivation of athletes for athletic performance, (d) Describe psychological factors aimed at supporting athletic performance and motivation for exercise, and (e) Develop strategies for managing the psychology of athletes to improve their athletic performance and exercisers for tactical and long-term participation in exercise.

Course Content

• Introduction to Exercise and Sport Psychology

• The Psychology of Exercise Participation

• Self-determination theory and exercise

• Motivation for achievement and participation in sports

• Anxiety, positive psychology, and athletic performance

• Concentration and attention in sports

• Overtraining, psychological burnout, and weight management in sports

• Psychology of recovery from sports injuries

• Communication, psychological dynamics of sports teams, and sports leadership

• Applied psychology for maximizing athletic performance.

Course Assessment

Written exams (70%) Presentation of research work (30%)

Methods of Student Evaluation:

• Written Exam with Short Answer Questions (Conclusive)

• Written Exam with Extended Answer Questions (Conclusive)

• Public Presentation (Conclusive)

1.1.3 Practical Applications of Exercise Physiology – Exercise Testing

The purpose of the course is to provide postgraduate students with specialized knowledge regarding the latest research findings in Exercise Physiology and Exercise Testing. Topics include (i) a deeper understanding of the collaboration of energy systems during exercise, (ii) adaptations of the cardiorespiratory and neuromuscular systems and the oxygen transport and consumption system with exercise, and (iii) the study of the positive effects of exercise and nutrition on health indicators and athletic/physical performance in healthy individuals and those with chronic diseases. The course aims to create conditions for scientific thinking and research in Exercise Physiology and Exercise Testing in line with modern trends and international literature.

Learning Outcomes

Upon successful completion of the course, students will be able to:

- Understand the biological adaptations caused by exercise to maximize human performance
- Recognize the contribution of measurement and evaluation to achieving specific educational goals and objectives in physical education
- Apply the basic principles of exercise physiology and exercise testing in sports and physical education
- Describe the mechanism of oxygen transport and consumption with training
- Highlight the scientific application of exercise for health improvement and physical performance
- Design exercise programs for the general and specific population and training programs for athletes based on the principles of exercise physiology.

Course Content

• Energy sources - Energy phases of muscle work

• Oxygen transport and consumption system

• Exercise-induced effects and adaptations of respiratory muscles

• Exercise-induced hypoxemia. Hemoglobin saturation curve

• Muscle contraction - electromechanical coupling

• Cardiovascular system and exercise (theory)

• Cardiovascular system and exercise – fatigue test (practice)

• Ergogenic aids

• Free radicals – Antioxidants

• Exercise in patients with chronic diseases I

• Exercise in Patients with Chronic Diseases II

• Student Presentations

• Student Presentations

Course Assessment

Written final exams (70%) Written assignment (15%) Presentation of assignment (15%)

Methods of Student Evaluation:

• Written Exam with Multiple-Choice Questions (Formative, Summative)

• Written Exam with Short Answer Questions (Formative, Summative)

• Written Assignment (Formative, Summative)

• Public Presentation (Formative, Summative)

1.1.4 Statistics

The purpose of the course is to understand and apply the fundamental principles of descriptive and inductive statistics. Topics to be discussed include (i) organization and presentation of data, (ii) types of data/variables, (iii) types of distributions and normality testing, (iv) hypothesis testing, (v) inductive parametric (t-tests, one-way and two-way ANOVA, post-hoc tests) and non-parametric statistical tests, (vi) correlation and linear regression, and (vii) principles of qualitative analysis. Students will gain experience using statistical software and technology for data analysis and drawing statistical conclusions.

Learning Outcomes

Within the course, students are expected to:

- Organize and summarize data numerically and through graphical representations (data/variable categories, measurement scales, histograms, tables, measures of central tendency and dispersion, frequency distribution description, distribution types).
- Demonstrate the ability to examine the relationship between quantitative data (direction and strength of correlation, differences of relationship and causation, linear regression).
- Understand the connection between probability and inductive statistics (research and null hypotheses, testing and interpreting the null hypothesis).
- Recognize when to use parametric and non-parametric statistical tests, and which statistical test to use for quantitative and qualitative data to examine the relationship between two and more variables (creation of simple and multiple regression equations, comparison of two samples, comparison of three and more samples with one and two factors, post-hoc comparisons).
- Practice statistical analyses using software and interpret the results (descriptive statistics, correlation, regression, comparison of two or more samples with parametric and non-parametric tests).
- Understand fundamental principles and practice the analysis and interpretation of qualitative data.
- Apply the knowledge acquired in the tasks they undertake (e.g., master's/doctoral thesis).

Course Content

• Introduction to Statistics, Introduction to the research process

• Basic statistical concepts

• Central tendency and dispersion statistical indices, Normal distribution, Introduction to SPSS

• Hypothesis testing, Types of errors, Statistical power, Significance level, Critical value, Standard normal distribution, SPSS basic functions

• Parametric tests / Comparison of 2 groups: Independent samples

• Parametric tests / Comparison of 2 groups: Dependent samples

• Parametric tests / Comparison of >2 groups: One-Way Analysis of Variance (ANOVA)

• Analysis of Variance for Dependent Samples (One-WAY ANOVA)

• Two-Way Analysis of Variance (TWO-WAY ANOVA)

• Non-parametric tests / Comparison of 2 groups: Dependent and Independent samples

• Correlation

• Regression

• Social Research

Course Assessment

Written exams at the end of the semester.

Methods of Student Evaluation**:**

• Written Exam with Multiple-Choice Questions (Summative)

• Written Exam with Short Answer Questions (Summative)

1.2. Second Semester

1.2.1. Research Methods

The purpose of the course is for students to understand the fundamental principles of research methodology, distinguish the stages of the research process, and learn how to design and implement a quantitative or qualitative research study. Additionally, the course aims for students to become familiar with experimental designs, critically evaluate a published article, write a scientific text, and recognize important ethical issues in research.

Learning Outcomes

Upon successful completion of the course, students will be able to:

- Understand the fundamental principles of research methodology.
- Know how to design a research study.
- Write a scientific article.
- Critically review a scientific article.
- Recognize basic ethical issues in research.

Course Content

• Introduction to research methods

• Stages of the research process

• Sampling techniques

• Validity and reliability

• Searching databases

• Types of studies

• Systematic review and meta-analysis

• Qualitative research

• Non-experimental studies

• Ethical issues in research

• Writing a scientific article/thesis

• Evaluation of a scientific article

• Interpretive issues in scientific research

Course Assessment

Written exams.

Methods of Student Evaluation:

• Written Exam with Multiple-Choice Questions (Summative)

• Written Exam with Short Answer Questions (Summative)

1.2.2. Experimental Design and Analysis in Kinesiology

The aim of this course is to comprehend the principles governing the methods of industrial analysis in the fields of kinematics, kinetics, electromyography, and ultrasound investigation of motion. Additionally, it focuses on identifying the fundamental variables that can arise from the aforementioned analyses. Furthermore, the course aims to organize an experiment, select the relevant methodology with appropriate industrial analysis, and choose the right measurement tools. It also aims to determine the independent and dependent variables necessary to answer specific research questions. Finally, within the course, there is a hands-on application of the experiment with the participation of students.

Learning Outcomes

Within the course, students are expected to:

- (a) Understand the principles and process of Experimental Design and Analysis in Kinesiology,
- (b) Grasp the principles governing the methods of industrial analysis in kinematics, kinetics, electromyography, and ultrasound analysis and recognize the basic variables that can be extracted from each corresponding analysis,

- (c) Search international literature for research questions arising from the conduct of an experiment and the discussion of its results,
- (d) Organize an experiment, formulating their own research question, combining the relevant industrial analysis to solve it,
- (e) Define the methodology, choosing the right measurement tools to evaluate and collect the independent and dependent variables necessary to answer the research question,
- (f) Demonstrate the ability to define the purpose, research, and null hypotheses, and control and interpret the null hypothesis of the research question,
- (g) Recognize the statistical test to be used to examine the relationship between quantitative data,
- (h) Apply the knowledge gained in the course through their participation.

Course Content

- Lecture: Basic Principles of Kinesiology - Methods of Kinematic Analysis,
- Laboratory: Acquisition of 2D kinematic data
    - Walking
    - Rising from a chair
    - Static Jump
    - Depth Jump
    - Ball throwing
    - Kicking in soccer
- Computer Laboratory: Analysis of kinematic data with APAS and Maxtraq,
- Lecture: Principles of dynamic analysis / The force platform,
- Analysis of vertical jumps,
- Analysis of walking and rising from a chair,
- Analysis of multi-joint sports techniques,
- Analysis of isometric force,
- Shortening stretch cycle,
- Analysis of plantar pressures and balance,
- Electromyography / Biopac software demonstration,
- Muscle architecture,
- Laboratory for the analysis of electromyographic data and stretching of the patellar tendon with Biopac and MaxTraq.

Course Evaluation

The final written exams will assess problem-solving using specific scientific tools.

Student Evaluation Methods:

- Written Exam with Multiple-Choice Questions (Summative)
- Written Exam with Short Answer Questions (Summative)
- Written Exam with Problem Solving (Summative)

1.2.3. Functional Anatomy

The purpose of this course is to understand and consolidate knowledge of the descriptive anatomy of the musculoskeletal system. The course will analyze movements and the functionality of various joints of the human body, either as isolated movements (degrees of freedom) of each joint or as complex movements (modeling) by reducing them to various sports movements and activities.

Learning Outcomes

During the course, students are expected to:

- (a) Acquire fundamental principles and terminology of functional anatomy and understand the relationship between theoretical anatomical knowledge and practice,
- (b) Understand the importance of functional anatomy in exercise and maximizing athletic performance,
- (c) Become familiar with the conduct of specific laboratory tests and field tests of motor problems due to musculoskeletal disorders,
- (d) Be able to interpret and evaluate intervention methods aiming at designing specialized exercise programs to improve functionality,
- (e) Use measurement results in designing training programs.

Course Content

- Introduction to Functional Anatomy
- Musculoskeletal System: Levels and axes of movement. Terminology. Research methods in human movement
- Functional anatomy of the joints of the Spinal Column and Thorax
- Functional anatomy of the joints of the Shoulder Girdle and Elbow
- Functional anatomy of the joints of the Pelvis and Hip
- Functional Anatomy of the Knee and the Joints of the Ankle and Foot
- Kinesiological analysis of posture and gait – Foot arch
- Kinesiological analysis of complex Athletic Movements

- Physiology of the Neuromuscular Junction
- Presentation of research articles, submission of review papers.

Course Evaluation

Following relevant information to the students at the beginning of the course, a written test is conducted during the examination period, including thematic questions requiring sufficient development and commentary. This evaluation also includes the joint assessment of the written submission of a review paper throughout the course, the presentation of the review paper, and the overall active presence and participation of the student in the course.

Student Evaluation Methods:

- Written Exam with Extended Answer Questions (Summative)
- Written Assignment (Summative)

Course Evaluation

- The final written exams will assess problem-solving using specific scientific tools. Student Evaluation Methods:
- Written Exam with Multiple-Choice Questions (Summative)
- Written Exam with Short Answer Questions (Summative)
- Written Exam with Problem Solving (Summative)

11.2.4. Topics in Kinesiology in Adapted Physical Activity

The aim of this course is to deepen the understanding and consolidation of the principles of the science of Adapted Physical Activity and how they contribute to the health and well-being of individuals with disabilities. Throughout the course, students will be taught and analyze the motor, cognitive, sensory, and emotional situations experienced by individuals with disabilities. They will also explore the adaptations required for their successful participation in physical activity and various sports. Students will learn to connect scientific principles with Adapted Physical Education and Kinesiology, such as Biomechanics, Neuro-mechanics, Nutrition, Coaching, to assist in the smooth rehabilitation and maximization of performance for individuals with disabilities. Furthermore, they will demonstrate the ability to categorize athletes and organize and implement personalized exercise programs.

Learning Outcomes

Upon successful completion of the course, students are expected to:

- (a) Understand the principles of Adapted Physical Education - Adapted Physical Activity,

- (b) Delve into the principles of Kinesiology and its relationship with changes in human movement affected by disability,
- (c) Understand the motor, cognitive, sensory, and emotional conditions that require adjustments in physical education and exercise programs,
- (d) Demonstrate the ability to design personalized Physical Education and exercise programs,
- (e) Apply modern training methods to high-level athletes with disabilities.

Course Content

- Introduction to Adapted Physical Education/Activity
- Motor development and assessment of individuals with normal development and individuals with disabilities in the educational process and in sports
- Motor disabilities - Cerebral Palsy (2 sessions)
- Nutritional support for athletes with spinal cord injury (2 sessions)
- Motor disabilities - Cerebral Palsy
- Functional assessment of cerebral palsy
- Motor disabilities - Amputation
- Biomechanical analysis of running with lower limb prosthetics (2 sessions)
- Presentations
- Presentations

Course Evaluation

- Participation in lectures (20%)
- Assignment (30%)
- Final exams (50%)

Student Evaluation Methods:

- Written Exam with Short Answer Questions (Summative)
- Written Exam with Extended Answer Questions (Summative)
- Written Assignment (Summative)
- Public Presentation (Summative)

1.2.5. Performance Assessment and Training Guidance

The purpose of this course is twofold: (i) to deepen the understanding of the theoretical principles and practices of coaching, with an emphasis on performance assessment and guidance, and (ii) to

create conditions for scientific reflection and research, following contemporary trends and international literature. Based on these objectives, students will participate in laboratory and field measurements and will subsequently be required to use the information from assessments and measurements in practice and in the coaching process.

Learning Outcomes

Upon successful completion of the course, students are expected to:

- (a) Understand the fundamental principles of coaching,
- (b) Comprehend the fundamental principles of assessing physical abilities,
- (c) Understand the fundamental principles of coaching guidance in the training process,
- (d) Understand the fundamental principles of applying the coaching process,
- (e) Acquire knowledge of the biological and physiological factors that influence physical abilities,
- (f) Familiarize themselves with laboratory and field tests for measuring and assessing endurance, aerobic capacity, speed, strength, flexibility,
- (g) Be able to transfer the results of measurement and assessment of physical abilities into the design, evaluation, and implementation of exercise programs.

Course Content

- Introduction - Coaching Theory,
- Training Load - Principles of Training,
- Assessment and guidance of strength training,
- Assessment and guidance of endurance training,
- Assessment and guidance of speed training,
- Assessment and guidance of agility-flexibility training,
- Assessment and guidance of coordination abilities training,
- Assessment and guidance of technical training,
- Assessment and guidance of tactical training,
- Training design,
- Practical applications of training programs,
- Presentations
- Presentations

Course Evaluation

Methods of Student Evaluation:

- Multiple-Choice Written Exam (Summative)
- Written Exam with Short Answer Questions (Summative)
- Written Exam with Extended Answer Questions (Summative)
- Written Assignment (Formative)
- Public Presentation (Formative)

1.2.6. Practical Applications of Sports Biomechanics

The aim of this course is to provide students with both theoretical knowledge and practical skills to (i) design a biomechanical experiment, (ii) conduct biomechanical measurements, (iii) analyze biomechanical data, and (iv) present a comprehensive experiment both in written and oral form.

Learning Outcomes

Upon successful completion of the course, students are expected to:

- (a) Design a biomechanical experiment,
- (b) Analyze the results of an experiment,
- (c) Interpret the results and correlate them with findings from other studies,
- (d) Write a scientific paper based on data collected during the semester,
- (e) Present an experimental work to a wider audience.

Course Content

- Introduction. Group formation. Assignment of groups to various topics,
- Organization and conduct of research work,
- Review of laboratory methods (3 sessions),
- Isometry,
- Force platform,
- 2D and 3D cameras,
- Architectural Analysis of the Muscle-Tendon Unit - Contraction-Lengthening Cycle,
- Electromyography and electrical stimulation,
- Measurements - Group 1,
- Measurements - Group 2,
- Measurements - Group 3,
- Measurements - Group 4,
- Measurements - Group 5,

- Supplementary Measurements,
- Writing a research paper,
- Group support.

Course Evaluation

- Laboratories and Practical Exercise: Students are divided into groups. Each group aims to conduct a small-scale experiment using at least 3 out of the 5 available laboratory instruments/techniques. They analyze the results and write the corresponding paper, which they submit and present at the end of the semester. Evaluation is based on the final (a) written assignment (70%) and (b) presentation of their group work at the end-of-semester special seminar (30%).

Methods of Student Evaluation:

- Written Assignment (Formative, Summative)
- Public Presentation (Formative, Summative)
- Laboratory Work (Formative, Summative)

1.3. Third Semester - Master's Thesis

The completion of a master's thesis is mandatory, primarily during the third semester of study. Upon successful completion of at least 22 ECTS, the master's student can apply to undertake the Master's Thesis (November for the winter semester and April for the spring semester). The application includes the declaration of the thesis topic and the proposal of the supervisor for the appointment of the three-member advisory committee. The Supervisor is a faculty member of the Department. While the master's thesis is mainly written in Greek, the Department's Assembly may allow writing it in another language with justified decision. Detailed information regarding the extent, font, writing style, and other structural aspects is provided in the Department's Thesis Writing Guide.

The presentation of the Master's Thesis is supported before the Three-Member Examination Committee on a date and location determined by the Department's Assembly. The evaluation of the master's thesis is exclusively conducted by the three-member examination committee. The process of completing the Master's Thesis involves the following stages:

- Public Presentation of the Thesis Proposal: This includes the literature review and the experimental protocol (2nd fortnight of December or May).
- Submission of the Written Thesis Proposal: The thesis proposal must be submitted to the postgraduate secretariat one month after the public presentation. Failure to submit the proposal within this timeframe cancels the public presentation, and the process is repeated in the next semester (winter or spring). The proposal must be signed by the three-member committee.
- Thesis Defense: The defense takes place in the first fortnight of June or November or February. It can occur during the 6th month from the date of the thesis proposal presentation, only if the candidate submits the written thesis to all committee members at least fifteen days before the defense. At the end of the defense, the committee completes

the Assessment Report, which remains with the supervisor and is handed over to the candidate upon completion of thesis corrections.

- Submission of Documents: The candidate must submit the Assessment Report to the postgraduate secretariat along with one printed copy and one electronic copy (PDF) of the thesis on a CD. A copy of the thesis in electronic form must also be submitted to the Information Services (PE8) of the Central Library of AUTH.

The exact dates of the thesis proposal presentation and defense are announced by the postgraduate secretariat. The invitation and required documents for the public presentation and defense must be submitted to the secretariat at least fifteen (15) days before the presentation. The award of the Master's Degree takes place after the approval of the Assessment Report by the Department's Assembly.

The necessary forms for the thesis proposal, final presentation, and the Thesis Writing Guide are available on the program or department's website.