

Republic of Yemen

Ministry of Higher Education & Scientific Research
21 SEPTEMBER UNIVERSITY for MEDICALS &

APPLIEED SCIENCES



Faculty of Engineering and Computer
Department of Biomedical Engineering

Course Specification of
Biomechanics
Course No. (07.12.714)

2022/2023

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
Dr. Abdulsalam Al-Absi	Dr. ----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-shamahi	Dr. Abdulrahman Obaid

the mechanics of human joints, Using the science of biomechanics to design mechanical components, systems, and instruments, for people with disabilities, and processes. This course covered musculoskeletal system and Nervous system, Newton's laws of motion, applications of biomechanics and types and properties of biomaterials. This course focuses on : analyze the stresses and strains in biological tissues, given the loading conditions and material properties. Use the principles of mechanical for objects that can configurable to get the necessary tools for the development of biological systems. At the end of this course students will be have a clear idea of the function and application of the biomechanics.

III. Course Intended Learning Outcomes (CILOs) : (مخرجات تعلم المقرر)		Referenced PILOs (مخرجات تعلم البرنامج)		
A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:				
a1	Identify relationships between musculoskeletal system and Nervous system and the importance of these relationships	I	A2	Clarify the biomedical devices maintenance principles and how these are important for solving biomedical devices and equipment's problems in health environment
a2	Remind the general characteristics, for bio-materials that used in making of artificial limbs	I	A2	Recognize the user and healthcare needs to provide based solutions on a high level of management, professional and ethical behavior, responsibility, standards, health and safety requirements in biomedical systems to real-healthcare problem
B. Intellectual Skills: Upon successful completion of the course, students will be able to:				
b1	Analyze the stresses and strains in biological tissues, given the loading conditions and material properties	P	B1	Analyze the impacts of problems related to the Biomedical equipments and its solution principles in a creative manner by using a systematic and analytical thinking methods
b2	Classify types of Joint Motions	P	B4	Apply the principles of biomedical
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				devices maintenance and its various methods to work professionally in biomedical engineering field
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:				
c1	Relate the applications of biomechanics to human movement	P	C2	Relate integrally knowledge of life science, biomedical engineering technology practice concepts, principles of engineering and techniques evaluation to solve problems relevant to biomedical engineering
c2	Evaluate principles of mechanical for objects that can configurable to get the necessary tools for the development of biological systems	P	C3	Evaluate an engineering technique, modern analytical tools and required computer programs to analyzing and solve the problems of medical devices
D. Transferable Skills: Upon successful completion of the course, students will be able to:				
d1	Engage in continuing development and lifelong learning as an biomedical engineering technology professional.	P	D4	Pursue ongoing professional development and lifelong learning in the biomedical engineering filed

(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:			
	<u>Course</u> Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
a1	Identify relationships between musculoskeletal system and Nervous system and the	<ul style="list-style-type: none"> ▪ Interactive class ▪ Discussions ▪ Self-study 	<ul style="list-style-type: none"> ▪ Written tests(mid and final terms and quizzes),

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	importance of these relationships		
a2	Remind the general characteristics, for bio-materials that used in making of artificial limbs	<ul style="list-style-type: none"> Problem Solving 	
(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1	Analyze the stresses and strains in biological tissues, given the loading conditions and material properties	<ul style="list-style-type: none"> Interactive class Discussions Self-study Problem Solving 	<ul style="list-style-type: none"> Written tests(mid and final terms and quizzes), Home work
b2	Classify types of Joint Motions		
(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
c1	Relate the applications of biomechanics to human movement	<ul style="list-style-type: none"> Interactive class Discussions Self-study Problem Solving 	<ul style="list-style-type: none"> Written tests(mid and final terms and quizzes), Home work
c2	Evaluate principles of mechanical for objects that can configurable to get the necessary tools for the development of biological systems		
(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1	Engage in continuing development and lifelong learning as an biomedical	<ul style="list-style-type: none"> Self-Study Presentation 	<ul style="list-style-type: none"> Presentation

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engineering technology
professional.

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CLOs)
1	Introduction	<ul style="list-style-type: none"> Course syllabus Introduction to biomechanics. What is biomechanics? The applications of biomechanics Biomechanics importance Biomechanics aspects Mechanics Newton's laws, systems of units Basic concepts, conversion of units.... 	1st	2	a1
2	Force vector (Theory lecture and discussion)	<ul style="list-style-type: none"> Scalars and vectors Definition of force Properties of force as a vector quantity Tensile and compressive forces Coplanar forces, collinear forces Frictional forces, parallel force Gravitational force or weight Distributed force systems and pressure 	2nd	2	a1,a2

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3	<p>Overview of human skeletal anatomy and physiology</p> <p>(Theory lecture and group work)</p>	<ul style="list-style-type: none"> The skeletal system Anatomical terms Joints (articulations) Types of synovial joint Body planes Joint motions 	3ed	2	a1,b1
4	<p>Moment and Torque Vectors</p> <p>(Theory lecture and discussion)</p>	<ul style="list-style-type: none"> Definitions of moment and torque vectors Magnitude direction of moment Dimension and units of moment The net or resultant moment The couple and couple-moment Translation of forces Moment as a vector product 	4th	2	a1,a2,b1
5	<p>Statics: Systems in Equilibrium</p> <p>(Theory lecture and group work)</p>	<ul style="list-style-type: none"> Overview Newton's laws of mechanics Conditions for equilibrium Free-body diagrams Procedure to analyze systems in equilibrium Notes concerning the equilibrium equations Constraints and reactions 	5th	2	b1,b2
6	<p>Statics: Systems in Equilibrium</p> <p>(Theory lecture and group work)</p>	<ul style="list-style-type: none"> Cable-pulley systems and traction devices Built-in structures Systems involving friction Center of gravity determination 	6th	2	a1,a2,b2,c 1

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7	Applications of Statics to Biomechanics. (Theory Lecture and Group Work)	<ul style="list-style-type: none"> Skeletal joints Skeletal muscles Basic considerations Mechanics of the elbow Mechanics of the shoulder 	7th	2	b2,c1,c2
8	Mid-Term Theoretical Exam	<ul style="list-style-type: none"> Mid-Term 	8th	2	a1,a2, b1,b2,c1,c 2
9	Applications of Statics to Biomechanics. (Theory lecture and group work)	<ul style="list-style-type: none"> Mechanics of the Spinal Column Mechanics of the hip Mechanics of the knee Mechanics of the Ankle 	9th	2	a2,c2,d1
10	Linear Kinematics (Theory lecture and discussion)	<ul style="list-style-type: none"> Introduction to Dynamics Uniaxial motion Position, displacement, velocity, and acceleration Measured and derived quantities Uniaxial motion with constant acceleration Examples of uniaxial motion Biaxial motion 	10th	2	a1, b1,c1,c2,d 1
11	Linear Kinematics (Theory lecture and discussion)	<ul style="list-style-type: none"> Position, velocity, and acceleration vectors Biaxial motion with constant acceleration Projectile motion Applications to athletics 	11th	2	a1,a2, c1,c2,d1
12	Linear Kinetics (Theory lecture and group work)	<ul style="list-style-type: none"> Equations of motion Special cases of translational motion Procedure for problem 	12th	2	b1,b2,c1,d 1

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		<p>solving in kinetics</p> <ul style="list-style-type: none"> • Work and energy methods <p>Mechanical work</p>			
13	<p>Linear Kinetics. (Theory lecture and group work)</p>	<ul style="list-style-type: none"> • Mechanics energy • Work–energy theorem • Conservation of energy • Principle • Power <p>Applications of energy methods</p>	13th	2	a2, b1,b2,c2
14	<p>Introduction to Deformable Body Mechanics (Theory lecture)</p>	<ul style="list-style-type: none"> • Applied force and deformations • Internal forces and moments • Stress and Strain • General procedure <p>Mathematics involved</p>	14th	2	a1,c1,c2,d 1
15	Review	<ul style="list-style-type: none"> • all previous lessons presentation 	15th	2	b1,b2,d1
16	Final Theoretical Exam	All topics	16th	2	a1,a2, b1,b2,c1,c 2
Number of Weeks /and Units Per Semester			16	32	

V. Teaching Strategies of the Course:

- Interactive class
- Discussions
- Self-study
- Problem Solving
- Presentation

VI. Assessment Methods of the Course:

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- Written tests (mid and final terms and quizzes),
- Home work
- Presentation

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Class discussions	3-13	5	a1,a2,b1, b2,c1, c2
2	Presentations	3-13	5	d1
Total			10	

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Assignments	3-13	5	5%	d1
2	Quiz 1	6	5	5%	a1,a2,b1,
3	Midterm Theoretical Exam	8	20	20%	a1,a2,b1, b2,c1, c2
4	Quiz 1	12	5	5%	b2,c1, c2
5	Presentation	3-13	5	5%	d1
6	Final Theoretical Exam	16	60	60%	a1,a2,b1, b2,c1, c2

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3	Exam Attendance/Punctuality: No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	Assignments & Projects: Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	Cheating: Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	Forgery and Impersonation: Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	Other policies: The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.

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I. Course Identification and General Information:

	Course Title:	Biomechanics			
2	Course Code & Number:	07.12.714			
3	Credit Hours:	Credit Hours	Theory Hours		Lab. Hours
			Lecture	Exercise	
		2	2	--	--
4	Study Level/ Semester at which this Course is offered:	3 Level / 1 Semester			
5	Pre -Requisite (if any):	None			
6	Co -Requisite (if any):	None			
7	Program (s) in which the Course is Offered:	Bachelor in Biomedical Engineering Technology			
8	Language of Teaching the Course:	English			
9	Study System:	Regular Semester system (full-time)			
10	Mode of Delivery:	Regular, minimum attendance 75%			
11	Location of Teaching the Course:	University Campus			
12	Prepared by:	Dr. Abdulsalam Qasem Abdo Alabsi			
13	Date of Approval:				

II. Course Description:

This course aims to give students a clear idea and sufficient for human movement in general and the movement of all parts and the application of the principles of biomechanics to solve the problems of human movement, as well as linking this movement with the forces that caused it, and that need to measuring the forces of the reactions between the foot and the ground and measure the movement of the joints in an air, and then finding the forces and moments that effect on the joints of the lower limbs. And train students at the expense of the forces and moments and the centre of pressure (CP) and the missing energy during walking and by solving exercises about

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that the biomechanics connects the field of mechanics and engineering fields of biology (biology) and Anatomy and Physiology (Anatomy & Physiology) and it is the basis for the material prostheses (Prosthesis),It has provided a way for the design and manufacture of medical equipment and devices, tools and technology helping devices for persons with disabilities, and the replacement of industrial an agricultural.

III. Course Intended Learning Outcomes (CILOs): (مخرجات تعلم المقرر)

A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:

a1 Identify relationships between musculoskeletal system and Nervous system and the importance of these relationships

a2 Remind the general characteristics, for bio-materials that used in making of artificial limbs

B. Intellectual Skills: Upon successful completion of the course, students will be able to:

b1 Analyze the stresses and strains in biological tissues, given the loading conditions and material properties

b2 Classify types of Joint Motions

C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:

c1 Relate the applications of biomechanics to human movement

c2 Evaluate principles of mechanical for objects that can configurable to get the necessary tools for the development of biological systems

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d1 Engage in continuing development and lifelong learning as a biomedical engineering technology professional.

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	Introduction	<ul style="list-style-type: none"> Course syllabus Introduction to biomechanics. What is biomechanics? 	1st	2

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		<ul style="list-style-type: none"> The applications of biomechanics Biomechanics importance Biomechanics aspects Mechanics Newton's laws, systems of units Basic concepts, conversion of units.... 			
2	Force vector (Theory lecture and discussion)	<ul style="list-style-type: none"> Scalars and vectors Definition of force Properties of force as a vector quantity Tensile and compressive forces Coplanar forces, collinear forces Frictional forces, parallel force Gravitational force or weight Distributed force systems and pressure 	2nd	2	
3	Overview of human skeletal anatomy and physiology (Theory lecture and group work)	<ul style="list-style-type: none"> The skeletal system Anatomical terms Joints (articulations) Types of synovial joint Body planes Joint motions 	3ed	2	
4	Moment and Torque Vectors (Theory lecture and discussion)	<ul style="list-style-type: none"> Definitions of moment and torque vectors Magnitude direction of moment Dimension and units of moment The net or resultant moment The couple and couple-moment Translation of forces Moment as a vector product 	4th	2	
5	Statics: Systems in Equilibrium	<ul style="list-style-type: none"> Overview Newton's laws of mechanics Conditions for equilibrium 	5th	2	
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	(Theory lecture and group work)	<ul style="list-style-type: none"> Free-body diagrams Procedure to analyze systems in equilibrium Notes concerning the equilibrium equations Constraints and reactions 		
6	Statics: Systems in Equilibrium (Theory lecture and group work)	<ul style="list-style-type: none"> Cable-pulley systems and traction devices Built-in structures Systems involving friction Center of gravity determination	6th	2
7	Applications of Statics to Biomechanics. (Theory Lecture and Group Work)	<ul style="list-style-type: none"> Skeletal joints Skeletal muscles Basic considerations Mechanics of the elbow Mechanics of the shoulder 	7th	2
8	Mid-Term Theoretical Exam	<ul style="list-style-type: none"> Mid-Term 	8th	2
9	Applications of Statics to Biomechanics. (Theory lecture and group work)	<ul style="list-style-type: none"> Mechanics of the Spinal Column Mechanics of the hip Mechanics of the knee Mechanics of the Ankle 	9th	2
10	Linear Kinematics (Theory lecture and discussion)	<ul style="list-style-type: none"> Introduction to Dynamics Uniaxial motion Position, displacement, velocity, and acceleration Measured and derived quantities Uniaxial motion with constant acceleration Examples of uniaxial motion Biaxial motion 	10th	2

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11	Linear Kinematics (Theory lecture and discussion)	<ul style="list-style-type: none"> Position, velocity, and acceleration vectors Biaxial motion with constant acceleration Projectile motion Applications to athletics 	11th	2
12	Linear Kinetics (Theory lecture and group work)	<ul style="list-style-type: none"> Equations of motion Special cases of translational motion Procedure for problem solving in kinetics Work and energy methods Mechanical work	12th	2
13	Linear Kinetics. (Theory lecture and group work)	<ul style="list-style-type: none"> Mechanics energy Work–energy theorem Conservation of energy Principle Power Applications of energy methods	13th	2
14	Introduction to Deformable Body Mechanics (Theory lecture)	<ul style="list-style-type: none"> Applied force and deformations Internal forces and moments Stress and Strain General procedure Mathematics involved	14th	2
15	Review	<ul style="list-style-type: none"> all previous lessons presentation 	15th	2
16	Final Theoretical Exam	All topics	16th	2
Number of Weeks /and Units Per Semester			16	32

V. Teaching Strategies of the Course:

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- Interactive class
- Discussions
- Self-study
- Problem Solving
- Presentation

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Home work
- Presentation

VII. Assignments:

No.	Assignments	Week Due	Mark
1	Class discussions	3-13	5
2	Presentations	3-13	5
Total			10

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	Assignments	3-13	5	5%
2	Quiz 1	6	5	5%
3	Midterm Theoretical Exam	8	20	20%
4	Quiz 1	12	5	5%
5	Presentation	3-13	5	5%
6	Final Theoretical Exam	16	60	60%
Total			100	100%

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