

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
Artificial Organs and Extremities
Course No. (07.02.733)

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

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:				
a2	Describe the role of the orthotist, prosthetist, physical therapist, and other professionals in the rehabilitation of persons with movement dysfunction.	P	A1	Explain the appropriate models, theories, mathematical foundations, and techniques related to biomedical engineering technology context.
a3	Identify user and healthcare needs to provide prosthesis and orthotic technology maintenance based solutions to real-world problem.	P	A2	Clarify the biomedical devices maintenance principles and how these are important for solving biomedical devices and equipment's problems in health environment.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:				
b1	Analyze the motion in biological tissues, given the loading conditions and material properties	M	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	Appropriately use augmented feedback in therapeutic situations with individuals using orthoses ,prostheses or artificial organs	M		
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:				
c1	Relate the knowledge of mathematics, science, information technology and design to solve engineering problems.	M	C1	Relate integrally knowledge of life science, biomedical engineering technology practice concepts, principles of engineering and techniques evaluation to solve problems relevant to biomedical engineering
Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
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c2	Develop the concepts of kinematics to analyze human motion	M	C3	Develop an engineering approach, engineering equipment, instruments to maintenance and conduct experiments, and present results in the biomedical engineering practice
D. Transferable Skills: Upon successful completion of the course, students will be able to:				
d1	Communicate effectively in writing and orally in a variety of professional contexts.	A	D3	Function effectively as an individual, team member, or leader in activities relevant to biomedical engineering, and collaborating to achieve a shared objective
d2	Ensure clear and precise communication, international standards for terminology should be used to describe orthoses, prostheses, properties of materials, units of measure (whether imperial or metric) as well as the engineering principles for describing the various effects of loading on these materials.	A	D4	Pursue ongoing professional development and lifelong learning in the biomedical engineering field.

(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	Understanding these fundamentals enables the practitioner to assess designs, materials, and failures and to clearly justify the decisions, practices, and techniques used in the creation of each orthosis.	<ul style="list-style-type: none"> The lecture method The discussion method The method of cooperative learning 	<ul style="list-style-type: none"> Written tests(mid And final terms and quizzes), The guidance and leadership of the educational process Notes & observation 	
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a2	Describe the role of the orthotist, prosthetist, physical therapist, and other professionals in the rehabilitation of persons with movement dysfunction.	<ul style="list-style-type: none"> ▪ The lecture method ▪ The discussion method ▪ The method of cooperative learning 	<ul style="list-style-type: none"> ▪ Written tests(mid ▪ And final terms and quizzes), ▪ The guidance and leadership of the educational process <p>Notes & observation</p>
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(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 motion in biological tissues, given the loading conditions and material properties	<ul style="list-style-type: none"> ▪ lectures ▪ discussion ▪ cooperative learning ▪ Assignments 	<ul style="list-style-type: none"> ▪ Written tests(mid ▪ And final terms and quizzes), ▪ The guidance and leadership ▪ Notes & observation
b2	Appropriately use augmented feedback in therapeutic situations with individuals using orthoses ,prostheses or artificial organs	<ul style="list-style-type: none"> ▪ lectures ▪ Interactive class discussions ▪ Assignments 	<ul style="list-style-type: none"> ▪ Written tests(mid ▪ And final terms and quizzes), ▪ The guidance and leadership of the educational process ▪ Notes & observation ▪ REV.Home work

(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	use concepts of kinematics to analyze human motion	<ul style="list-style-type: none"> ▪ Interactive class ▪ Discussions ▪ Directed self-study ▪ Demonstration 	<ul style="list-style-type: none"> ▪ Written tests(mid ▪ And final terms and quizzes), ▪ Notes & observation ▪ REV.Home work

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c2	Apply knowledge of mathematics, science, information technology and design to solve engineering problems.	<ul style="list-style-type: none"> Interactive class Discussions Directed self-study Presentation 	<ul style="list-style-type: none"> Written tests (final terms and quizzes), Notes & observation REV.Home work
(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:			
	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1	Determine key attributes and attitudes that health professionals should possess to be successful members of interdisciplinary rehabilitation teams.	<ul style="list-style-type: none"> discussions, Presentation Presentation 	<ul style="list-style-type: none"> Presentation
d2	review available measurement and fabrication methods, illustrating the current technical application of these scientific principles.	<ul style="list-style-type: none"> discussions, Presentation 	<ul style="list-style-type: none"> Presentation

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	Introduction	<ul style="list-style-type: none"> overview of the prosthetics objectives purpose 	1st	2	-
2	Analyzing of improper human walkers	<ul style="list-style-type: none"> Introduction Walking requirements source of movement patterns of loss 	2nd	2	a1, a2

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Dr. Mohammed Al-shamahi

Dr. Abdulrahman Obaid

		<ul style="list-style-type: none"> • deformity in the grip of the knee joint 			
3	Orthotic devices	<ul style="list-style-type: none"> • Walking characteristics for those with motor unit insufficiencies • Walking methods for those with motor unit deficiencies • Loss of motor unit and the surrounding sensory nervous system • Injury to the sacral region and the fifth lumbar vertebra • Injury to the third and fourth lumbar vertebrae • Injury to the first lumbar vertebra And the second • an abnormality in the central control, injury to one of the two hemispheres of the brain • cerebral palsy • insufficient energy 	3ed	2	a1, a2, b1
4	Orthotic devices (Theory lecture and discussion)	<ul style="list-style-type: none"> • Definition of orthotic device • The main parts of the orthotic device • The main principles of orthotic device manufacture • Orthotic device manufacturing methods • Materials used to manufacture orthodontic devices • Metals used in orthotic devices 	4th	2	a1, b1
5	Foot orthotic devices (Theory lecture and group)	<ul style="list-style-type: none"> • Introduction • Symptoms • Using orthotic devices for 	5th	2	a1, a2, b2,
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	work)	<p>the foot</p> <ul style="list-style-type: none"> • Deformities of the foot • forefoot • Arch of the foot • tendencies of the sole of the foot • Flat foot 			
6	Knee orthotics (Theory Lecture and Group Work)	<ul style="list-style-type: none"> • Introduction • Biomechanics of the knee <p>Pathological conditions and matrix orthotics</p>	6th	2	a2, b1, b2
7	Orthotics for the knee, ankle and foot (Theory Lecture and Group Work)	<ul style="list-style-type: none"> • Introduction • Medical applications of the orthosis 	7th	2	b1, b2
8	Mid-Term Theoretical Exam	<ul style="list-style-type: none"> • Mid-Term 	8th	2	a1, a2, b1, b2
9	Artificial Organs Artificial Heart Valves (Theory lecture and group work)	<ul style="list-style-type: none"> • Introduction • Cardiac Anatomy and Pathophysiology • Prosthetic Heart Valves • Evaluation of Prosthetic Valves 	9th	2	a2, b1, b2, c1
10	Artificial Heart and Cardiac Assist Devices (Theory lecture and discussion)	<ul style="list-style-type: none"> • Cardiac Anatomy and Pathophysiology • Engineering Design • Heart Assist Technology • Evaluation of Blood Pumps 	10th	2	b1, b2, c1, c2
11	Cardiac Pacemakers (Theory lecture and discussion)	<ul style="list-style-type: none"> • Cardiac Electrophysiology • The Electrocardiogram • Cardiac Pacemaker • Pacemaker Implantation 	11th	2	c1, c2, d1

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		<ul style="list-style-type: none"> • Cardioverter 			
12	Artificial Kidney (Theory lecture and group work)	<ul style="list-style-type: none"> • The Nephron and Mass Transfer • Dialysis Procedure and the Dialysis System • History of Dialysis • Dialyzer Cartridge Reuse 	12th	2	b2, c1, c2, d2
13	Spinal orthoses (Theory lecture and group work)	<ul style="list-style-type: none"> • Biomechanics of the spine • Stability of the spinal column • Stability of the functional spinal unit • Biomechanics of stabilization 	13th	2	b1, c2, d1, d2
14	Artificial Pancreas (Theory lecture and group work)	<ul style="list-style-type: none"> • Structure and Function of the Pancreas • Endocrine Pancreas and Insulin Secretion • Diabetes • Insulin 	14 th	2	a2, b1, c1, c2, d1
15	Artificial Pancreas (Theory lecture and group work)	<ul style="list-style-type: none"> • Insulin Therapy • Insulin Administration Systems • Insulin Production Systems 	15 ^h	2	a2, c2, d2
16	Final Theoretical Exam	All topics	16th	2	a1, a2, b1, b2, c1
Number of Weeks /and Units Per Semester			16	32	

V. Teaching Strategies of the Course:

- The lecture method (using modern teaching strategies to achieve the goals of this course)
- The discussion method
- The method of cooperative learning
- Presentation,

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- Directed self-study,

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Class discussions,
- Presentations.
- Solve problem
- Review home work

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
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	Aligned Course Learning Outcomes
1	Assignments	3-13	5	5%	d1, d2
2	Quiz 1	6	5	5%	a1, a2, b1
3	Midterm Theoretical Exam	8	20	20%	a1, a2, b1, b2
4	Quiz 1	12	5	5%	a1, a2, b1, b2, c1
5	Presentation	3-13	5	5%	d1, d2
6	Final Theoretical Exam	16	60	60%	a1, a2, b1, b2, c1
Total			100	100%	

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IX. Learning Resources:

1. John D. Hsu MD, John Michael, John Fisk MD-AAOS Atlas of Orthoses and Assistive Devices, 4th Edition Mosby(2008).
2. Ed. Joseph D. Bronzino. The Biomedical Engineering Handbook: Second Edition. Boca Raton: CRC Press LLC, 2000
3. Gerald E. Miller - Artificial Organs - A Publication in the Morgan & Claypool Publishers' series
4. Synthesis lectures on biomedical engineering

1- Required Textbook(s) (maximum two): مثال example

1. N Ozkaya and M Nordin, Fundamentals of Biomechanics, Third Edition, Springer, New York, 1999.
2. Duane Knudson, **Fundamentals of Biomechanics**, Second Edition, Springer,
3. Engstrom B., Van de Ven C. Therapy for Amputees, Churchill Livingstone, London, 1999
4. Susan J. Hall, Ph.D. BASIC BIOMECHANICS, SIXTH EDITION Copyright © 2012 by The mcgraw-Hill Companies

2- Essential References:

1. N Ozkaya and M Nordin, Fundamentals of Biomechanics, Third Edition, Springer, New York, 1999.
2. Duane Knudson, Fundamentals of Biomechanics, Second Edition, Springer,
3. Engstrom B., Van de Ven C. Therapy for Amputees, Churchill Livingstone, London, 1999
4. Susan J. Hall, Ph.D. BASIC BIOMECHANICS, SIXTH EDITION Copyright © 2012 by The McGraw-Hill Companies

3- Electronic Materials and Web Sites etc.:

Websites:

<http://www.ausport.gov.au/info/physiology> علم وظائف الأعضاء :

<http://www.per.ualberta.ca/biomechanics/> الميكانيكا الحيوية

www.morganclaypool.com

www.icrc.org

www.mhhe.com

• Journals:

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• Other Web Sources:

•

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X. Course Policies: (Based on the Uniform Students' By law (2007) تتحرك كما هي)

1	Class Attendance: Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	Tardiness: A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
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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Second Part of Course Specification

Faculty of Medical Technology

Department of Biomedical Engineering Technology

Artificial Organs and Extremities

Course No. (07.02.733)

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

I. Course Identification and General Information:

	Course Title:	Artificial Organs and Extremities			
2	Course Code & Number:	07.12.723			
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 / 2 Semester			
5	Pre -Requisite (if any):	None			
6	Co -Requisite (if any):	None			
7	Program (s) in which the Course is Offered:	Biomedical Engineering Technology			
8	Language of Teaching the Course:	English - Arabic			
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 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. At the end of this course students will be have a clear idea of the function and application of the Orthotics and Prosthetics in Rehabilitation.

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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 | Describe the role of the orthotist, prosthetist, physical therapist, and other professionals in the rehabilitation of persons with movement dysfunction. |
| a2 | Identify user and healthcare needs to provide prosthesis and orthotic technology maintenance based solutions to real-world problem. |

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

- | | |
|----|---|
| b1 | Analyze the motion in biological tissues, given the loading conditions and material properties |
| b2 | Appropriately use augmented feedback in therapeutic situations with individuals using orthoses, prostheses or artificial organs |

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

- | | |
|----|--|
| c1 | Relate the knowledge of mathematics, science, information technology and design to solve engineering problems. |
| c2 | Develop the concepts of kinematics to analyze human motion |

D. Transferable Skills: Upon successful completion of the course, students will be able to:

- | | |
|----|---|
| d1 | Communicate effectively in writing and orally in a variety of professional contexts. |
| d2 | Ensure clear and precise communication, international standards for terminology should be used to describe orthoses, prostheses, properties of materials, units of measure (whether imperial or metric) as well as the engineering principles for describing the various effects of loading on these materials. |

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"> overview of the prosthetics objectives purpose 	1st	2

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2	Analyzing of improper human walkers	<ul style="list-style-type: none"> • Introduction • Walking requirements • source of movement • patterns of loss • deformity in the grip of the knee joint 	2nd	2	
3	Orthotic devices	<ul style="list-style-type: none"> • Walking characteristics for those with motor unit insufficiencies • Walking methods for those with motor unit deficiencies • Loss of motor unit and the surrounding sensory nervous system • Injury to the sacral region and the fifth lumbar vertebra • Injury to the third and fourth lumbar vertebrae • Injury to the first lumbar vertebra And the second • an abnormality in the central control, injury to one of the two hemispheres of the brain • cerebral palsy • insufficient energy 	3ed	2	
4	Orthotic devices (Theory lecture and discussion)	<ul style="list-style-type: none"> • Definition of orthotic device • The main parts of the orthotic device • The main principles of orthotic device manufacture • Orthotic device manufacturing methods • Materials used to manufacture orthodontic devices • Metals used in orthotic devices 	4th	2	
5	Foot orthotic devices (Theory lecture and group work)	<ul style="list-style-type: none"> • Introduction • Symptoms • Using orthotic devices for the foot • Deformities of the foot • forefoot 	5th	2	
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		<ul style="list-style-type: none"> Arch of the foot tendencies of the sole of the foot Flat foot 		
6	Knee orthotics (Theory Lecture and Group Work)	<ul style="list-style-type: none"> Introduction Biomechanics of the knee Pathological conditions and matrix orthotics 	6th	2
7	Orthotics for the knee, ankle and foot (Theory Lecture and Group Work)	<ul style="list-style-type: none"> Introduction Medical applications of the orthosis 	7th	2
8	Mid-Term Theoretical Exam	<ul style="list-style-type: none"> Mid-Term 	8th	2
9	Artificial Organs Artificial Heart Valves (Theory lecture and group work)	<ul style="list-style-type: none"> Introduction Cardiac Anatomy and Pathophysiology Prosthetic Heart Valves Evaluation of Prosthetic Valves 	9th	2
10	Artificial Heart and Cardiac Assist Devices (Theory lecture and discussion)	<ul style="list-style-type: none"> Cardiac Anatomy and Pathophysiology Engineering Design Heart Assist Technology Evaluation of Blood Pumps 	10th	2
11	Cardiac Pacemakers (Theory lecture and discussion)	<ul style="list-style-type: none"> Cardiac Electrophysiology The Electrocardiogram Cardiac Pacemaker Pacemaker Implantation Cardioverter 	11th	2
12	Artificial Kidney (Theory lecture and group)	<ul style="list-style-type: none"> The Nephron and Mass Transfer Dialysis Procedure and the Dialysis System 	12th	2

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	work)	<ul style="list-style-type: none"> History of Dialysis Dialyzer Cartridge Reuse 		
13	Spinal orthoses (Theory lecture and group work)	<ul style="list-style-type: none"> Biomechanics of the spine Stability of the spinal column Stability of the functional spinal unit Biomechanics of stabilization	13th	2
14	Artificial Pancreas (Theory lecture and group work)	<ul style="list-style-type: none"> Structure and Function of the Pancreas Endocrine Pancreas and Insulin Secretion Diabetes Insulin	14 th	2
15	Artificial Pancreas (Theory lecture and group work)	<ul style="list-style-type: none"> Insulin Therapy Insulin Administration Systems Insulin Production Systems	15 ^h	2
16	Final Theoretical Exam	All topics	16th	2
Number of Weeks /and Units Per Semester			16	32

V. Teaching Strategies of the Course:

- lecture
- Discussion
- Cooperative learning
- Presentation,
- Self-study,

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Class discussions,
- Presentations.

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- Solve problem
- Home work

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%

IX. Learning Resources:

1. John D. Hsu MD, John Michael, John Fisk MD-AAOS Atlas of Orthoses and Assistive Devices, 4th Edition Mosby(2008).
2. Ed. Joseph D. Bronzino. The Biomedical Engineering Handbook: Second Edition. Boca Raton: CRC Press LLC, 2000
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3. Engstrom B., Van de Ven C. Therapy for Amputees, Churchill Livingstone, London, 1999
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2- Essential References:

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2. Duane Knudson, Fundamentals of Biomechanics, Second Edition, Springer,
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4. Susan J. Hall, Ph.D. BASIC BIOMECHANICS, SIXTH EDITION Copyright © 2012 by The McGraw-Hill Companies

3- Electronic Materials and Web Sites etc.:

Websites:

<http://www.ausport.gov.au/info/physiology> علم وظائف الأعضاء :

<http://www.per.ualberta.ca/biomechanics/> الميكانيكا الحيوية

www.morganclaypool.com

www.icrc.org

www.mhhe.com

• Journals:

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• Other Web Sources:

•

X. Course Policies: (Based on the Uniform Students' By law (2007) تتحرك كما هي)

Class Attendance:	
1	Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
Tardiness:	
2	A student will be considered late if he/she is not in class after 10 minutes of the start time of class.

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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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