German Jordanian University
School of Applied Medical Sciences
Department of Biomedical Engineering

BM333: Biomaterials Lab

Course Catalog
1 Credit hour (3 hrs laboratory) The aim is to Understanding the fundamental concepts of the multidisciplinary science of biomaterials in addition to Learning the main mechanical properties of different type of materials(metals, polymers, ceramics, xeno-bone, skin…etc) that affect material design. Moreover, Study mechanical properties for materials which should be replace in our body, in order to mimic the part that will be replaced, so that studying the mechanical properties for Biological materials such a (bovine bones) take in consideration in this lab.

Lab Engineer	
Lab Engineer	Eng. Huda AlShami
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Evaluation		
Assessment Tool	**Weight**	**Expected Due Date**
Lab Reports	30 %	Each report is due at the beginning of the next lab session
Midterm Exam	30%	Assigned at the beginning of each semester
Final Exam	40%	Assigned at the beginning of each semester
Total	100%	After completing final exam

	Topics Covered	
Week	**Experiment No.**	**Topic**
1	----------	Introduction to Biomaterials Lab
2	Experiment 1	Tensile and Compression Test
3	Experiment 2	Bending Test
4	Experiment 3	Hardness Test
5	Experiment 4	Fatigue Test
6	Exam	**Midterm Exam**
7	Experiment 5	Creep Test
8	Experiment 6	Impact Test
9	Experiment 7	Buckling Test
10	Experiment 8	Microscopic Examination
11	Experiment 9	Corrosion and Degradation
12	Experiment 10	Material Treatment (Hardening by Carburizing) + Material Treatment using different media of Quenching
13	Exam	**Final Exam**

Objectives and Outcomes	
Objectives	**Outcomes**
1. Understand the concept of Tensile and Compression	1.1 Provide practical exercises for using general tensile testing machine to determine the tensile behavior of different type of material (Iron , Brass , steel , Bone) . 1.2 Understand the stress-strain curves and use it in determining various mechanical properties: 1.3 In this experiment, we will study the mechanical properties of a steel specimen by applying Tensile test and the mechanical Properties for Bovine bone by applying a compression test. 1.4 For the biological application,the mechanical properties of bovine- bone under both compression and tensile testing.
2. Performing practical bending tests.	2.1 Understanding the free-body diagrams FBD for bending and drawing the reactions; moment diagram and shear diagram for simply supported beam. 2.2 Calculation of bending stress and deflection caused by the load and calculation of the moment of inertia of different cross-sections. 2.3 Obtaining the Modulus of Elasticity from deflection formula.

	2.4 Understanding the concept of Neutral Axis N.A and Neutral Plane and distinguishing between layers in compression and layers in tension in bending.
3. understand the meaning of hardness	3.1 to be able to distinguish between the hardness values, given for different materials. 3.2 To become familiar with the basic methods and machines used to measure the hardness of materials. 3.3 To be able to relate the hardness to some properties of materials.
4. to get familiar with the principle of fatigue testing.	4.1 Students are required to construct an S-N curve (stress level - number of cycles to failure) of the test samples provided. 4.2 Students can define the fatigue endurance limit or fatigue life and fatigue strength of the materials.
5. Study the principal of creep testing and practice the testing	5.1 Get familiar with the causes of creep in metals and indicate the factors influencing creep behavior. 5.2 Analyze the data and draw the creep curve. 5.3 Applying Creep test on chicken skin to study the viscoelastic properties of soft tissues.
6. familiarize the students with Impact test.	6.1 Determining the influence of the notch shape on notched bar impact work 6.2 Determining the influence of the specimen material on notched bar impact work 6.3 Determining the Ductile Brittle Transition Temperature (DBTT) 6.4 Visual evaluation of the fracture surface
7. determine critical buckling loads for columns with support	7.1 To examine the Euler theory of buckling. 7.2 To investigate the influence of different material parameters. 7.3 To compare experimentally observed values of critical stress with the theoretical values 7.4 To study behavior of different types of columns and find Euler's buckling load for each case
8.To understand surface characterization of materials and the contribution of microscopes in this regard.	8.1 To understand different principles of operation behind various microscopic techniques. 8.2 Getting familiar with metallic sample preparation for micro-examination using the metallurgical

	microscope. 8.3 Examining the grains in the prepared metallic sample using the microscope and calculating the grain size.
9. learning the different quenching media in heat treatment.	9.1 performing the carburizing process. 9.2 Measuring the hardness of steel after quenching by different media. 9.3 Studying the changes in hardness of steel due to changes of quenching media.
10. Identify metal corrosion	10.1 Define factors affecting corrosion and corrosion rate. 10.2 Calculate corrosion rate

Lab Report Requirements	
Report section	**Description**
Introduction	This section should provide the context and motivation for the experiment, briefly explain relevant theory in sufficient detail, introduce any relevant laws, equations or theorems, and clearly state the aim or research question that the experiment is designed to address. You should try to write it in your own words, rather than paraphrasing the lab manual (but if you have to, be sure to include the appropriate references). It's always a good idea to read the entire experiment in the manual before you begin your introduction.
Procedure	This section must include a description of the procedure followed. It should not simply be a re-statement of the procedure section of this manual. You should interpret the procedure section and develop your own step-by step method.
Results	In this section, you present the main data collected during your experiment. Each key measurement needs to be reported appropriately. Data are often presented in graphs, figures or tables. These need to be labelled appropriately to clearly indicate what is shown. Tables should be labelled numerically above the table as Table 1, Table 2, etc. Everything else (graphs, images, diagrams etc.) is labelled numerically below the figure as Figure 1, Figure 2, etc.
Discussion	This section should demonstrate how will you understand what happened in the experiment. You should identify and comment on any trends you have observed, compare the experimental results with any predictions, identify how any sources of error might impact on the interpretation of your results, suggest explanations for unexpected results, and where appropriate, suggest how the experiment could have been improved.
Conclusion	This section should provide a message summing up what has been

	learned from the experiment such as: briefly restate the purpose of the experiment (the question it was seeking to answer), identify the main findings (answer to the research question), note the main limitations that are relevant to the interpretation of the results, summarize what the experiment has contributed to your understanding of the problem.
References	List all sources that you have referred to in the body of your report. These can include references to accepted literature values or equations you use in your calculations. You should use proper referencing techniques.
Appendix	It contains material that is too detailed to include in the main report, such as tables of raw data, software code or detailed calculations.
Formatting	Font type: Times New Roman. Font size: 12 for the main paragraphs and 14 bold for the titles. Justify the paragraphs. Numbering. Figures should be inserted in the center of the page and they should be labeled below the figure with font size 10. Tables should be inserted in the center of the page and they should be labeled above the table with font size 10.

Policy	
Attendance	Attendance will be checked at the beginning of each lab session. University regulations will be strictly followed for students exceeding the maximum number of absences (20%).
Reports	Each student must hand his\her own separate report. Laboratory reports are due to ***one week after*** the experiment was carried out and it will be collected at the beginning of each laboratory. If any report is not submitted to the TA by the deadline, it will be judged as "**LATE**".
Examinations	The midterm and the final exams are closed book tests. Students who are not able to attend an examination (medical or another emergency) must notify the instructor. Make up tests require a Valid University excuse.
Student Conduct	It is the responsibility of each student to adhere to the principles of academic integrity. Academic integrity means that a student is honest with him/herself, fellow students, instructors, and the University in matters concerning his or her educational endeavors. Cheating will not be tolerated in at all. University regulations will be pursued and enforced on any cheating process.