



**The University of Jordan**  
**Accreditation & Quality Assurance Center**

**COURSE**

<b>1</b>	Course title	Conservation and Restoration of Archaeological Metals
<b>2</b>	Course number	2632441
<b>3</b>	Credit hours (theory, practical)	5 (2. 3)
	Contact hours (theory, practical)	3
<b>4</b>	Prerequisites/corequisites	-
<b>5</b>	Program title	B.A degree in Cultural Resources Management and Conservation
<b>6</b>	Program code	20
<b>7</b>	Awarding institution	
<b>8</b>	Faculty	Faculty of Archaeology and Tourism
<b>9</b>	Department	Cultural Resources Management and Conservation
<b>10</b>	Level of course	4
<b>11</b>	Year of study and semester (s)	2016 / 1 <sup>st</sup>
<b>12</b>	Final Qualification	B. A
<b>13</b>	Other department (s) involved in teaching the course	
<b>14</b>	Language of Instruction	Arabic / English
<b>15</b>	Date of production/revision	4/ 09/ 2016

**16. Course Coordinator:**

Office numbers, office hours, phone numbers, and email addresses should be listed.

Mustafa Al-Naddaf  
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 0790554398

**17. Other instructors:**

*Office numbers, office hours, phone numbers, and email addresses should be listed.*

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**18. Course Description:**

*As stated in the approved study plan.*

The course clarifies internal and external factors of the corrosion of copper, bronze, iron, and silver. In addition, the course includes the optimum methods of cleaning, stabilization, consolidation, covering, restoration, and the best methods to display in museums or store different metal objects.

## 1. 19. Course aims and outcomes:

2.

**A- Aims:**

1. An understanding of copper and iron and their alloys.
2. An understanding of ancient smelting process to extract copper and iron from their ores.
3. The ability to evaluate and identify the corrosion of copper and iron based objects
4. The ability to assess the condition of objects made of copper and iron based objects
5. The ability to apply the suitable conservation measure and treatments for the corroded copper and iron based objects according to their condition.
6. The ability to evaluate environmental condition and adjust them to suite copper and iron based objects before and after conservation treatment.

**B- Intended Learning Outcomes (ILOs):**

Upon completion of the course, the student must demonstrate the knowledge and the ability to:

1. Recognize the aspects of production and function of objects made of copper and its alloys and iron and its alloys.
2. Assess the condition of archaeological copper based objects, and identify their corrosion processes and products.
3. Apply the suitable conservation treatment according to the state of preservation of the object and document her/his work.
4. Explore the conservation literature and make a classroom presentation on a topic relevant to the topic of the course.

**20. Topic Outline and Schedule:**

3.

Topic	Week	Instructor	Achieved ILOs	Evaluation Methods	Reference
-Introduction - Deterioration of metals and alloys: Corrosion Corrosion and patina	1	M. Al-Naddaf	- Introducing the students to the importance of metal and in the field of archaeology and	-	A handbook compiled from different resources on metal conservation

			conservation. - enabling the students to understand technical terms used in metal conservation.		
Effect of environment on metal corrosion Dry corrosion Aqueous corrosion	2	M. Al-Naddaf	Enabling the students to understand the factors causing the deterioration of metal	Lab discussion. Presenting hand specimen.	A handbook compiled from different resources on metal conservation
Electrochemical corrosion Passive and active corrosion Anaerobic microbial corrosion Electrochemical series of metals	3	M. Al-Naddaf	Enabling the students to understand the factors causing the deterioration of metal	Lab discussion.	A handbook compiled from different resources on metal conservation
Corrosion forms Uniform corrosion Galvanic corrosion Pitting corrosion Crevice corrosion Intergranular corrosion Selective leaching (dealloying) Stress corrosion cracking	4	M. Al-Naddaf	Enabling the students to understand the factors causing the deterioration of metal and their deterioration forms.	Lab discussion.	A handbook compiled from different resources on metal conservation
General description of copper Copper ores	5	M. Al-Naddaf	Enabling the students to understand	Lab discussion.	A handbook compiled from different

Copper alloys Copper corrosion			the properties of copper and copper alloys objects.		resources on metal conservation
Corrosion of copper from land sites Corrosion of copper from marine sites The corrosion of copper alloys	6	M. Al-Naddaf	Enabling the students to understand the factors causing the deterioration of copper and copper alloys objects.	Lab discussion.	A handbook compiled from different resources on metal conservation
Conservation treatment of copper based objects Galvanic reduction cleaning Electrolytic reduction cleaning	7	M. Al-Naddaf	Enabling the students to understand how copper based object should be treated.	-	A handbook compiled from different resources on metal conservation
Chemical treatment Sodium Sesquicarbonate ( $\text{Na}_2\text{CO}_3 \cdot \text{NaHCO}_3$ ) Sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) Benzotriazole (BTA) ( $\text{C}_6\text{H}_5\text{N}_3$ ) Final treatment and sealant	8	M. Al-Naddaf	Enabling the students to understand how copper based object should be treated.	Lab discussion.	A handbook compiled from different resources on metal conservation
General description of iron Iron ores Iron alloys	9	M. Al-Naddaf	Enabling the students to understand the properties of iron and iron alloys objects.	Lab discussion.	A handbook compiled from different resources on metal conservation

Iron corrosion			And its corrosion		
Iron conservation Initial documentation Storage prior to treatment Storage prior to treatment – solutions:	1 0	M. Al-Naddaf	Enabling the students to understand how iron based object should be treated.	Lab discussion.	A handbook compiled from different resources on metal conservation
Mechanical cleaning Preliminary artifact evaluation	1 1	M. Al-Naddaf	Enabling the students to understand how iron based object should be treated	Lab discussion.	A handbook compiled from different resources on metal conservation
Treatment Electrochemical cleaning Chemical cleaning Annealing Drying Sealant and consolidation Storage and periodic inspection	1 2	M. Al-Naddaf	Enabling the students to understand how iron based object should be treated.	Lab discussion.	A handbook compiled from different resources on metal conservation
General characteristics of silver, Silver ores, Silver alloys, Silver corrosion	1 3	M. Al-Naddaf	Enabling the students to understand the properties of silver and silver alloys objects.	Lab discussion.	A handbook compiled from different resources on metal conservation
Embrittlement of archaeological silver,	1 4	M. Al-Naddaf	Enabling the students to understand the corrosion of	Lab discussion.	A handbook compiled from different resources on

Conservation of silver and its alloys, Ancient metallurgy of silver			silver and its alloys and should they be treated		metal conservation
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### 21. Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods: All the lectures will be presented using powerpoint presentation. Some practical sessions will be held at the lab.

### 22. Evaluation Methods and Course Requirements:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements: The evaluation system based on 3 exams and some assignments.

### 23. Course Policies:

- A- Attendance policies:  
Attendance of all lectures is obligatory; in any case absence should not exceed 15% of the contact hours.
- B- Absences from exams and handing in assignments on time:  
Make up exam can be held only in emergency cases and the approval of the dean is a must.
- C- Health and safety procedures:
- D- Honesty policy regarding cheating, plagiarism, misbehavior:  
The regulations of the University will be applied
- E- Grading policy:  
First exam: 20%  
Second exam: 20%  
Assignments: 10 %  
Final exam: 50%
- F- Available university services that support achievement in the course:

**24. Required equipment:**

A fully equipped conservation lab.

**25. References:**

A- Required book (s), assigned reading and audio-visuals:

A handbook compiled from the following resources on metal conservation:

1. Selwyn, L. 2004, *Metals and Corrosion: A Handbook for the Conservation Professional*, Ottawa: The Canadian Institute for Conservation.
2. Cronyn, J. 1990, *The Elements of Archaeological Conservation*, New York: Routledge.
3. Stambolov, T. 1985, *The Corrosion and Conservation of Metallic Antiquities and Works of Arts*, Amsterdam: Central Research Laboratory for Objects of Art and Science.
4. Hamilton, D.L. 1976, *Conservation of Metal Objects from Underwater Sites: A Study in Methods*, Austin: Texas Antiquities Committee.
5. Goffer, Z. 2007, *Archaeological Chemistry*, New Jersey: Wiley-Interscience.
6. Scott, D. 2002, *Copper and Bronze in Art: Corrosion, Colorants, Conservation*, Los Angeles: Getty Publications.
7. Scott, D. and Eggert, G. 2009, *Iron and Steel in Art: Corrosion, Colorants, Conservation*, London: Archetype Publications.

B- Recommended books, materials, and media:

See above

**26. Additional information:**

A facebook group will be established in order to facilitate communication among the students and the instructor. References and media will be supplied via this group.



Name of Course Coordinator: **M. Al-Naddaf** Signature: ----- Date:

4.09.2016

Head of curriculum committee/Department: ----- Signature:

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Head of Department: ----- Signature: -----

Head of curriculum committee/Faculty: ----- Signature:

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Dean: ----- -Signature: -----

Assurance

Copy to:  
Head of Department  
Assistant Dean for Quality

Course File