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|----------------------------------|--|--------------------------------|
| <b>Form:<br/>Course Syllabus</b> | <b>Form Number</b>                                     | EXC-01-02-02A                  |
|                                  | <b>Issue Number and Date</b>                           | 2/3/24/2022/2963<br>05/12/2022 |
|                                  | <b>Number and Date of Revision or Modification</b>     |                                |
|                                  | <b>Deans Council Approval Decision Number</b>          | 2/3/24/2023                    |
|                                  | <b>The Date of the Deans Council Approval Decision</b> | 23/01/2023                     |
|                                  | <b>Number of Pages</b>                                 | 06                             |

|     |  |  |
|-----|--|--|
| 1.  | <b>Course Title</b>  | Materials Science  |
| 2.  | <b>Course Number</b>                                       | 0333743  |
| 3.  | <b>Credit Hours (Theory, Practical)</b>                    | (3,0)  |
|     | <b>Contact Hours (Theory, Practical)</b>                   | (3,0)  |
| 4.  | <b>Prerequisites/ Corequisites</b>                         | none   |
| 5.  | <b>Program Title</b>                                       | Chemistry  |
| 6.  | <b>Program Code</b>  | 03   |
| 7.  | <b>School/ Center</b>                                      | Science  |
| 8.  | <b>Department</b>  | Chemistry  |
| 9.  | <b>Course Level</b>  | Master   |
| 10. | <b>Year of Study and Semester (s)</b>                      | 2024-2025  |
| 11. | <b>Other Department(s) Involved in Teaching the Course</b> | none   |
| 12. | <b>Main Learning Language</b>                              | English  |
| 13. | <b>Learning Types</b>                                      | <input type="checkbox"/> Face to face learning <input checked="" type="checkbox"/> Blended <input type="checkbox"/> Fully online |
| 14. | <b>Online Platforms(s)</b>                                 | <input type="checkbox"/> Moodle <input checked="" type="checkbox"/> Microsoft Teams  |
| 15. | <b>Issuing Date</b>  | 20/11/2024   |
| 16. | <b>Revision Date</b>                                       | 20/11/2024   |

**17. Course Coordinator:**

|                             |                             |
|-----------------------------|-----------------------------|
| Name: Imad Hamadneh         | Contact hours: 4-5 Mon, Wed |
| Office number: 22164        | Phone number: 0775500003    |
| Email: i.hamadneh@ju.edu.jo |                             |



### 18. Other Instructors:

Name:

Office number:

Phone number:

Email:

Contact hours:

### 19. Course Description:

As stated in the approved study plan.

### 20. Program Student Outcomes (SO's): (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program).

SO1. Develop chemistry expertise, focus on theory and practice, and contribute to advancing knowledge in a specific research field.

SO2. Conduct original, high-quality research that advances knowledge in chemistry by developing complex projects using innovative methodologies.

SO3. Mentor junior researchers and students and demonstrate leadership in the scientific community through collaboration, peer review, and knowledge exchange.

SO4. Recognize the ethical implications and responsibly use chemistry solutions to tackle global challenges.

SO5. Participate in ongoing professional development to stay up to date with the latest research and innovations.

### 21. Course Intended Learning Outcomes (CLO's): (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. To correlate the principles of chemistry in Materials Science and Chemistry.

2. **Problem solving:** to be able to apply mathematical and scientific knowledge to calculate the crystalline volume, dimensions, densities, and directions. The calculations related to materials synthesis, using proper software for the calculations (ASO-1 -5).

3. **Design:** the postgraduates will be able to use their understanding of materials synthesis and chemistry concepts to formulate and design nanoceramics with different techniques to meet the application's desires. (ASO-1,2,3 and ASO-5).



| Course CLOs | The learning levels to be achieved |               |          |           |            |          |
|-------------|------------------------------------|---------------|----------|-----------|------------|----------|
|             | Remembering                        | Understanding | Applying | Analysing | evaluating | Creating |
| CLO-1       | ✓                                  |               |          | ✓         |            |          |
| CLO-2       | ✓                                  | ✓             | ✓        | ✓         | ✓          |          |
| CLO-3       | ✓                                  | ✓             | ✓        |           | ✓          |          |

## 22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

| Program SO's | SO (1) | SO (2) | SO (3) | SO (4) | SO (5) |
|--------------|--------|--------|--------|--------|--------|
| Course CLO's |        |        |        |        |        |
| CLO-1        | ✓      |        |        | ✓      |        |
| CLO-2        | ✓      | ✓      | ✓      | ✓      | ✓      |
| CLO-3        | ✓      | ✓      | ✓      |        | ✓      |

## 23. Topic Outline and Schedule:

| Week | Lecture | Topic  | CLO/s Linked to the Topic | Learning Types<br>Face to Face (FF)<br>Blended (BL)<br>Fully Online (FO) | Platform Used | Synchronous (S) | Evaluation Methods | Learning Resources |
|------|---------|--|---------------------------|--|---------------|-----------------|--------------------|--------------------|
| 1    | 1.1     | Properties of solids - Bonding,                        | 1&2                       | BL   |               |                 |                    |                    |
|      | 1.2     | Crystal structure, crystal energy, Madelung constant,  | 1&2                       | BL   |               |                 |                    |                    |
|      | 1.3     | The Born-Lande Equation                                | 1&2                       | BL   |               |                 |                    |                    |
| 2    | 2.1     | The Kapustinskii's Equation.                           | 1&2                       | BL   |               |                 | Assignment         |                    |
|      | 2.2     | Packing Factor<br>14 Bravais Lattices                  | 1&2                       | BL   |               |                 |                    |                    |
|      | 2.3     | Clusters of atoms and molecules                        | 1,2 &3                    | BL   |               |                 |                    |                    |
| 3    | 3.1     | Directions Planes                                      | 1,2 &3                    | BL   |               |                 |                    |                    |
|      | 3.2     | Linear Density   | 1,2 &3                    | BL   |               |                 |                    |                    |
|      | 3.3     | Planar Density   | 1&2                       | BL   |               |                 |                    |                    |
| 4    | 4.1     | Theoretical Density                                    | 1&2                       | BL   |               |                 |                    |                    |
|      | 4.2     | Actual Density and Porosity                            | 1&2                       | BL   |               |                 | Assignment         |                    |
|      | 4.3     | Electronic structure of solids - Free electron theory, | 1,2 &3                    | BL   |               |                 | Mid Exam           |                    |
| 5    | 5.1     | Band theory, Fermi energy levels.                      | 1,2 &3                    | BL   |               |                 |                    |                    |



|    |      |  |        |           |  |  |               |  |
|----|------|--|--------|-----------|--|--|---------------|--|
|    | 5.2  | Imperfections on Solids  | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 5.3  | Electrons and holes, atomic imperfection                                   | 1,2 &3 | <b>BL</b> |  |  |               |  |
| 6  | 6.1  | Non-stoichiometry  | 1,2 &3 | <b>BL</b> |  |  | Assignment    |  |
|    | 6.2  | Line defects   | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 6.3  | Plane defects  | 1,2 &3 | <b>BL</b> |  |  |               |  |
| 7  | 7.1  | Phonons, excitons  | 1&2    | <b>BL</b> |  |  | Assignment    |  |
|    | 7.2  | Polarity, eximers  | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 7.3  | Characteristics of semiconductors - Electric, dielectric,                  | 1,2 &3 | <b>BL</b> |  |  |               |  |
| 8  | 8.1  | Absorption of light, photoconductivity,                                    | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 8.2  | Diffraction of light, photoconductivity,                                   | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 8.3  | Magnetic, thermal and mechanical properties                                | 1,2 &3 | <b>BL</b> |  |  |               |  |
| 9  | 9.1  | Imperfection equilibrium - Chemical potential.                             | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 9.2  | Ionization, imperfection of native atoms.                                  | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 9.3  | Equilibria that control disorder, external impurities                      | 1,2 &3 | <b>BL</b> |  |  |               |  |
| 10 | 10.1 | Diffusion - Theory   | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 10.2 | Kirkendal Effect,  | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 10.3 | Ionic conductivity   | 1,2 &3 | <b>BL</b> |  |  | Presentations |  |
| 11 | 11.1 | Structural transformation Classification,                                  | 1,2 &3 | <b>BL</b> |  |  |               |  |
|    | 11.2 | kinetics, reaction order,  | 2 &3   | <b>BL</b> |  |  |               |  |
|    | 11.3 | recrystallization, movement of grain boundaries                            | 2 &3   | <b>BL</b> |  |  | Assignment    |  |
| 12 | 12.1 | precipitation, sintering   | 2 &3   | <b>BL</b> |  |  |               |  |
|    | 12.2 | Chemical reactions   | 1&2    | <b>BL</b> |  |  |               |  |
|    | 12.3 | Non-crystallinity, dissociation  | 1&2    | <b>BL</b> |  |  |               |  |
| 13 | 13.1 | nucleation law, reactivity   | 1&2    | <b>BL</b> |  |  | Assignment    |  |
|    | 13.2 | photographic process   | 1&2    | <b>BL</b> |  |  |               |  |
|    | 13.3 | oxidation theory.  | 1&2    | <b>BL</b> |  |  |               |  |
| 14 | 14.1 | Aspects of Solid-State Synthesis. - Self-assembly,                         | 1&2    | <b>BL</b> |  |  |               |  |
|    | 14.2 | Property of Materials, Processing, & Performance                           | 1&2    | <b>BL</b> |  |  |               |  |
|    | 14.3 | constructing and studying the properties of ordered molecules on surfaces. | 1&2    | <b>BL</b> |  |  | Assignment    |  |
| 15 | 15.1 | adsorption and sorption.   | 1&2    | <b>BL</b> |  |  | Presentations |  |
|    | 15.2 | Surface alloys, Lever rule   | 1&2    | <b>BL</b> |  |  | Presentations |  |



|    |      |   |     |    |  |  |               |  |
|----|------|---|-----|----|--|--|---------------|--|
|    | 15.3 | catalysts and their application in surface chemistry, | 1&2 | BL |  |  | Presentations |  |
| 16 |      |   |     |    |  |  | Final Exam    |  |

#### 24. Evaluation Methods:

Opportunities to demonstrate achievement of the CLOs are provided through the following assessment methods and requirements:

| Evaluation Activity | Mark | Topic(s)  | CLO/s Linked to the Evaluation activity | Period (Week) | Platform |
|---------------------|------|---|---|---------------|----------|
| Midterm Exam        | 25   | Properties of solids<br>Crystal structure<br>Electronic structure of solids |   | Week 7        |          |
| Assignments         | 10   | All topic   |   | Weeks (2-13)  |          |
| Final Presentation  | 15   | Property of Materials, Processing, & Performance                            |   | Week 14       |          |
| Final Exam          | 40   | All topic   |   | Week 16       |          |
|                     |      |   |   |               |          |

#### 25. Course Requirements:

(e.g.: students should have a computer, internet connection, webcam, account on a specific software/platform...etc.):



## 26. Course Policies:

- A- Attendance policies:
- B- Absences from exams and submitting assignments on time:
- C- Health and safety procedures:
- D- Honesty policy regarding cheating, plagiarism, misbehavior:
- E- Grading policy:
- F- Available university services that support achievement in the course:

## 27. References:

- A- Required book(s), assigned reading and audio-visuals:
  - 1- Fundamentals of Materials Science and Engineering (10thEd) William D. Callister, Jr.
- B- Recommended books, materials, and media:
  - 1. Solid State Chemistry, CRC, (4<sup>th</sup> ED) Lesley E. Smart., Elaine A. Moore,
  - 2. The Science and Engineering of Materials (6th Ed), Donald Askeland

## 28. Additional information:

|  |                     |                |
|--|---------------------|----------------|
| Name of the Instructor or the Course Coordinator:<br><b>Prof. Imad Hamadneh.</b>                                 | Signature:<br>..... | Date:<br>..... |
| The Head of Graduate Studies Committee/<br>Department Chemistry<br><b>Dr. Murad AlDamen, Prof.</b>               | Signature:<br>..... | Date:<br>..... |
| The Head of Department of Chemistry<br><b>Dr. Murad AlDamen, Prof.</b>   | Signature:<br>..... | Date:<br>..... |
| Vice Dean for Graduate Studies and Scientific<br>Research / School of Science<br><b>Dr. Kamal Sweidan, Prof.</b> | Signature:<br>..... | Date:<br>..... |
| The Dean of School of Science<br><b>Dr. Mahmoud I. Jaghoub, Prof.</b>  | Signature:<br>..... | Date:<br>..... |



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