Course Specification

Program(s) on which is given : Physics (Minor) & Physics and Laser Sciences (Major)

Department Offering the Program : Physics

Year / Level : 4

Date of course specification : (2012)

A - Basic Information

Title : Crystal Physics Course Code : P4115

Credit hours : Lecture (2 h./ week) Tutorial : ---

Total : (2 Credit hours / week)

B - Professional Information

1- Overall Aims of the Course :

The teaching aim of this course is to give an overall view about Crystal Physics with a separate discussion of most individual physical properties of crystals.

By the end of this course , the student should be able to:

- **understand the general definitions and concepts of most physical properties of crystals.**
- **draw the unit cell of some crystal structures.**
- **use tensor and matrix representations for studying the effect of symmetry operations on crystal classes.**
- **understand the physics of most properties of crystals, e.g.,**

  Pyroelectricity, Piezoelectricity, Piezomagnetism, Thermoelectricity and Elasticity as well as their applications.

2- Intended Learning Outcomes of the Course (ILOS)

a- Knowledge and Understanding

The student should be able to:

a.1 Define the general concepts and definitions of most physical properties / or effects of anisotropic media.

a.2 Express the physical property or the effect in terms of tensor and matrix representation.

a.3 Investigate the symmetry operations and point groups of crystal classes.

b- <u>Intellectual Skills</u>

The student should be able to :

b.1 Write tensor equations representing different physical properties.

b.2 Expand the tensor equations and study the effect of symmetry operations on the values of the tensor components representing the physical property of interest.

b.3 Apply the transformation law of orthogonal axes to express the new components of the tensor property in terms of those of the original one and vice versa.

c- <u>Professional and Practical Skills</u>

The student should be able to:

c.1 Calculate the transformation matrix (generating matrix) of any crystal class.

c.2 Determine the produced flux density due to any applied force field to any crystal system.

c.3 Determine the magnitude of any physical property in any specified crystallographic direction in which the force field is applied.

d- <u>General and Transferable Skills</u>

The student will also be :

d.1 Enhanced in using PC and Internet to search for topics related to course materials.

d.2 Enhanced his writing ability of assigned reports about subjects of course materials.

d.3 Enhanced his oral communication during presenting his own written report.

3- <u>Content:</u>

Topic	Number of hours	Number of Lectures
1st Week : Registration		
2nd Week : Addition & Withdrawal		
Definitions of solid state physics and Crystal physics. Classification of solids according to their physical properties.	**2**	**1**
Anisotropic behavior of crystals - Physical properties as tensors and intrinsic symmetry	**2**	**1**
Thermodynamic investigation of intrinsic symmetry - Matrix representation of symmetry operations and classes	**2**	**1**

Crystal symmetry - Numann`s principle and law of transformation of vectors and tensors	**2**	**1**
Value of a physical property in a given direction – Special cases for Tetragonal, Hexagonal and Trigonal classes. Higher order effects.	**2**	**1**
Mid-term Exam	**2**	**1**
Physical properties in matrix notation & curie`s principle – The Euler`s theorem.	**2**	**1**
Electro-caloric and pyro-electric effects - Applications	**2**	**1**
Piezoelectricity: Piezoelectric effects- Mathematical representation of the phenomenon – Applications.	**2**	**1**
Electrostriction - Magnetostriction & piezomagnetism	**2**	**1**
Nernst effect and Thermoelectricity- Seebeck, Peltier, and Thomson effects.	**2**	**1**
Thermal expansion & Ferroelectricity (Definitions and phase transitions in ferroelectrics)- Applications.	**2**	**1**
Elasticity Hooke`s law in crystals -The Young`s modulus	**2**	**1**
Final term Exams	**2**	

4- Teaching and Learning Methods

4.1 Course Notes (in the form of a Notebook)

4.2 Oral presentations

5- A- Student Assessment:

5.1 Reports: To assess skill of collecting data and ability of team work. (1 report / 3 weeks).

5.2 Oral : To assess skill of discussing and analyzing the report (every three weeks).

5.3 Mid- term exam : To assess understanding and memorizing Skills (the 8th Week).

5.4 Final-term exam : To assess overall performance (the 16th & 17th Weeks).

5-B - Weighting Assessment:

Mid-term examination :	**20 %**
Final-term examination :	**60 %**
Oral examination :	**10 %**
Other types of assessment :	**10 %**
Total :	**100 %**

6- List of Textbooks & References:

6.1 Lecture Notes: prepared in the form of a book , authorized by the department

6.2 Essential Books:

- **An Introduction to Crystal Physics by Ervin Hartmann (2001) International Union of Crystallography.**
- **Crystallography for Solid State Physics by A R Verma and O N Srivastava (1982).**
- **Problems in Crystal Physics with Solutions by N V**

Perelomova and M M Tagieva Mir Publisher , Moscow.

7- <u>Facilities required for teaching and learning:</u>

7.1 Writing board.

7.2 General Library in the building of the faculty.

7.3 Internet Room.

Course Coordinator: Prof. Abd El-Mageed Hamid Khafagy

Head of Department: Prof.Dr. Sana Maize

Date: / /