Course Specifications

Program: **M.S. Inorganic Chemistry (major)**
M. S. Physical Chemistry (major)
Level: Graduate

A. Basic Information

Title: **Advanced Inorganic Chemistry**
Code: **CH6211**
Credit hours: **2 h** **Lecture:** **2h/week**
Tutorial: **0** **Practices:** **0**
Academic year : 2012

B. Professional Information:

1. Overall Amis of the course:

* By the end of the course the student will be able to

- Outline the structure of the hydrogenic atom
- Clarify the structure of many – electron atoms
- Discuss aspects of Molecular Orbital Theory
- Identify Crystal field theory
- Relate ligand – Field and Electronic – Spectroscopy

1. Intended Learning outcomes of the course (ILOs), after completing this course the student will be able to:

i. know and understand:

- Identify spherically symmetric potential, general solution
- Discuss transformation to spherical polar coordinates
- Present the angular equation
- Show the radial equation
- Tabulate the quantum numbers: n, l, m, and s
- Interpret the Pauli exclusion principle and Slater determinant.
- Illustrate penetration, shielding, and building up principle
- Show term – structure for polyelectron of free ion
- Recognize bonding and antibonding molecular orbitals
- Draw molecular - orbitals correlation diagram for: diatomic molecules
- Differentiate between the second row homo – and hetero – diatomic, term symbol for linear molecules
- Show molecular – orbital Energy Levels: triatomic, π – system, centric molecule: benzene, tetramethylenecyclobutane, BF_3.
- Compare butadiene versus cyclobutadiene

ii. gain intellectual skills such:

- Analyze the final solution for the full wave function in acceptable real forms.
- Illustrate spin – orbital coupling
- Deduce octahedral crystal field potential, V_{oct}, D_{4h}, T_d
- Explain the effect of V_{oct} on the d wave functions

iii. obtain professional and practical skills such:

- Design three dimensions plot of s orbital, p orbital, d orbital, and the z – component of orbital angular momentum.
- calculate the most probable radius, mean radius of an orbital
- present delocalization energy, electron density, formal charge at atoms, and bond order

iv. have general and transferable skills as:

- Show splitting of levels and terms in chemical environment
- interpet transition from weak to strong field, construction of the energy level diagrams
- clarify Orgel diagrams
- Present Tanobe – Sagano diagrams

2- Content

Topic	No. of hours	Lecture	Practical
The structure of the hydrogenic atom Spherically symmetric potential Angular, Radial equations, final solution in real forms. Quantum numbers: n, l, m, and s Pauli Exclusion Principle and Slater determinant. Three dimensions plot of s orbital, p orbital, d orbital Orbital angular momentum Calculating the most probable r	10	5	0
The structure of many – electron atoms Penetration, shielding, and building up principle Spin – orbit coupling	2	1	0
Molecular Orbital Theory Molecular - Orbitals Correlation Diagram for: H_2, He_2, He_2^+ The second row homo – and hetero – diatomic Term Symbol for linear Molecules Triatomic, π – system of Allyl radical: electron density at atoms, formal charge, and bond order Molecular – Orbitals for centric molecule Butadiene versus cyclobutadiene Benzene: delocalization energy Tetramethylenecyclobutane: bond order BF_3.	8	4	0
Crystal field theory Octahedral Crystal Field Potential, Voct, D4h, Td The effect of Voct on the d wave functions	4	2	0
Ligand – Field Splitting of levels and terms in chemical environment Transition from weak to strong field, construction of the energy level diagrams Orgel diagrams Tanobe – Sagano diagrams	4	2	0

Teaching and Learning Methods:

Lectures, discussion and active lecture

2. **Student Assessment Methods:**

written exam, quizzes and open book exam

Assessment Schedule

Assessment 1:	**on the fifth week**
Assessment 2:	**on the sixth week**
Assessment 3:	**on the tenth week**
Assessment 4:	**on the twelfth week**
Assessment 5:	**on the fourteenth week**

Weighting of Assessments

Mid – Term Examination and oral exam:	**20%**
Semester work:	**20%**
Final – Term:	**60%**
Total:	**100%**

3. **List of References**

a- text books

A. B. P. Lever: *Inorganic Electronic spectroscopy*

B.N. Figgis: *Introduction to Ligand Field*

F. A. Cotton: *Chemical Applications of Group Theory*

4. **Facilities Required for Teaching and Learning:**

overhead projector, audio video projector and data show

Course Coordinator: Joseph J. Stephanos, Assoc. Prof.
Head of Department: Prof. Ahmad Abd El Migid:

Date: 2012