NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF SCIENCES
CHEMISTRY PROGRAM

CQ332A – INORGANIC CHEMISTRY IV

I. GENERAL INFORMATION

CODE	:	CQ332A – Inorganic Chemistry IV
SEMESTER	:	6
CREDITS	:	06
HOURS PER WEEK	:	08 (Theory – Practices – Laboratory)
PREREQUISITES	:	Inorganic Chemistry III
CONDITION	:	Mandatory

II. COURSE DESCRIPTION

The course of Inorganic Chemistry IV corresponds to the sixth semester of the Chemistry program. The course is of a theoretical and experimental nature and provides students with an integral view of inorganic chemistry and its possible trends in the immediate future of science.
In this course a review of specialized topics of inorganic chemistry will be carried out, where main interest will be given to the fundamental concepts of the chemistry of organometallic compounds, considering also their application in the catalysis. A review will also be made about polymeric inorganic compounds, paying special attention to the clusters, cages, rings and coordination polymers, considering their applications. This course includes a review of Bioinorganic Chemistry, with special interest in the Fe, Cu and Co metallic centers present in biomolecules and in the studies of model systems.

III. COURSE OUTCOMES

By the end this course the student will:

- Explain the existence of compounds between metallic elements and ligands, differentiating them from coordination compounds in order to know how these types of compounds react.
- Describe the properties of organometallic compounds from their link to understand the different applications in the industry.
- Explain the formation of metal-metal bonds to know the behavior of inorganic polymeric compounds (clusters).
- Know some topics of inorganic chemistry in bioinorganic and supramolecular chemistry in order to analyze advances in chemistry.

IV. LEARNING UNITS

1. INTRODUCTION TO ORGANOMETALLIC CHEMISTRY / 18 HOURS

General properties of organometallic compounds / 18–electron rule / Limitations of the 18–electron rule / Electron count / Oxidation states, ambiguous oxidation states / Coordination number and geometry / Alkyl, aryl, hydrides and other ligands with σ bond to metal / Complexes

of carbonyls, phosphines, H2, NO2, N2 and isoelectronics / Complexes of π – giving ligands / Ligands with π–systems: Alkenes. Extended π–Systems / Cyclic π–Systems. Metallocenes. Fullerenes as ligands / Alkyne complexes (M – C), carbenes (M = C) and carbines (M ≡ C).

2. REACTION MECHANISMS IN ORGANOMETALLIC COMPOUNDS / 20 HOURS

Redox reactions: Oxidative addition, reductive elimination / Insertion and elimination reactions / Electrophilic and nucleophilic addition and abstraction reactions / Electron transfer mechanism. Application of organometallic compounds in catalysis / Homogeneous catalysis: Ziegler-Natta Process, Monsanto Process and Wacker Process.

3. INORGANIC POLYMERIC COMPOUNDS / 8 HOURS

Inorganic polymeric compounds, definition and classification: chains, rings and cages / Boranes. Formation of M-M bond and metal clusters / Formation of molecular orbital. M-M bond types (σ, π and δ) / Metal clusters: NAE structures and Wade rules.

4. INTRODUCTION TO BIOINORGANIC CHEMISTRY / 6 HOURS

Introduction to Bioinorganic chemistry / Functions of metal ions in living systems / Biomolecules: amino acids, proteins, enzymes, protoporphyrins. Metalloenzymes / Iron bioinorganic chemistry as an oxygen transporter: myoglobin and hemoglobin. Complex models.

V. LABORATORIES AND PRACTICAL EXPERIENCES

1. Synthesis of cobalt macrocycles part I
2. Synthesis of cobalt macrocycles part II
3. Paper exhibition
4. Presentation of the advance of practical work
5. Visit to research laboratories
6. Structure of clusters
7. Chromium acetate synthesis
8. Practical work I
9. Practical work II
10. Delivery of practical work I

VI. METHODOLOGY

Theoretical classes, seminars, qualified practices and laboratory practices will be taught.
Theory: The course will be developed by the responsible teacher with the help of chalk and blackboard, students prepare expositions and debate among them. Reading of scientific articles and their discussion in classes.
Laboratory practices: They will be developed in the laboratories. The concepts learned in the theory classes will be illustrated in an experimental way.
The students, in some topics, will apply "collaborative learning" which culminates with an exposition of said topic.

VII. EVALUATION FORMULA

Evaluation for each didactic unit: All the didactic units will be evaluated in three components with a score from 0 to 20, obtaining three (03) grades:

- Product grade: NPn
- Performance grade: NDn
- Knowledge grade: NCn.

DIDACTIC UNIT	PRODUCT (25%)	PERFORMANCE (25%)	KNOWLEDGE (50%)
I	EP1	ED1	EC1
II	EP2	ED2	EC2
III	EP3	ED3	EC3
IV	EP4	ED4	EC4

Where: EPn + EDn + ECn = 1

- 0<EPn<1
- 0<EDn<1
- 0<ECn<1
- EP1 + EP2 + EP3 + EP4 = 2.50
- ED1 + ED2 + ED3 + ED4 = 1.50
- EC1 + EC2 + EC3 +EC4 = 1.00

Grade for each didactic unit:

$$NUDn = (EPn) * NPn + (EDn) * NDn + (ECn) * NCn$$

Calculation of the final grade (FG):

$$FG = \frac{NUD1 + NUD2 + NU3 + NUD3}{4}$$

VIII. BIBLIOGRAPHY

- Didier Astruc; “Química Organometálica”; Editorial Reverté S.A., Barcelona; 2003.
- Catherine E. Housecroft & Alan Sharpe; “Química Inorgánica” segunda Edición; Editorial Pearson Prentice Hall; 2006.
- Gary L, Miessler; “Inorganic Chemistry” Segunda Edición. Editorial Prentice Hall; New Yersey 1999.