****

****

**Course book-second course**

**Department of …Chemistry…………………….**

**College of ………Education……………………….**

**University of ……Salahuddin-Erbil…………………….**

**Subject: Molecular Bonding**

**Course Book – (1stYear) second course**

**Lecturer's name: Beriwan Muhammad Hammad Amin**

**Academic Year: 2022/2023**

|  |  |  |  |
| --- | --- | --- | --- |
| **1. Course name** | **The concept Inorganic Chemistry** | | |
| **2. Lecturer in charge** | **Beriwan Muhammad** | | |
| **3. Department/ College** | **Chemistry / Education** | | |
| **4. Contact** | **e-mail : birewan.hamadamin**[**@su.edu.krd**](mailto:Hikmat.mohamad@su.edu.krd)  [**Tel:+964**](Tel:+964) **07504965410)** | | |
| **5. Time (in hours) per week** | **Theory: 2 + 2 = 4**  **Practical: 0** | | |
| **6. Office hours** | **2** | | |
| **7. Course code** |  | | |
| **8. Teacher's academic profile** | **Education:**  **M.Sc. in Inorganic Chemistry**, University of Salahaddin-Erbil, 02/2011- 07/ 2013  *Thesis:* **Synthesis and Characterization of Co(II),Ni(II),Cu(II),and Pd(II) Complexes with Thio-1,3,4-Oxadiazole Derivatives**  ***Supervisor****:* Dr. **Dr.Hikmat Ali Mohamad**.  **Assist. Chemistry**, 27/11/2007- 21/2/2011  **B.Sc. in Chemistry**, from University of Salahaddin, college of education, chemistry department 2006-2007.  **No. of Publications:** (5).  **Teaching Experience:**  **Inorganic chemistry Lab., 2014 – Present**  **Laboratory instructor for undergraduate chemistry Dept.**  **1-practical Inorganic chemistry for 2nd stage of chemistry.**  **2-practical Industrial chemistry 3 th stage of**  **chemistry.**  **3-Theoretical Inorganic chemistry for 1st stage of chemistry** | | |
| **9. Keywords** | **1 st year , Inorganic chemistry, education** | | |
| **10. Course overview:**  If organic chemistry is considered to be the ‘chemistry of carbon’, then inorganic chemistry is the chemistry of all elements except carbon. In its broadest sense, this is true, but of course there are overlaps between branches of chemistry Inorganic chemistry is not simply the study of elements and compounds; it is also the study of physical principles. For example, in order to understand why some compounds are soluble in a given solvent and others are not, we apply laws of thermodynamics. If our aim is to propose details of a reaction mechanism, then a knowledge of reaction kinetics is needed. Overlap between physical and inorganic chemistry is also significant in the study of molecular structure. In the solid state, X-ray diffraction methods are routinely used to obtain pictures of the spatial arrangements of atoms in a molecule or molecular ion. To interpret the behaviour of molecules in solution, we use physical techniques such as nuclear magnetic resonance (NMR) spectroscopy; the equivalence or not of particular nuclei on a spectroscopic timescale may indicate whether a molecule is static or undergoing a dynamic process in this text, we describe the results of such experiments but we will not  The aim of study of Inorganic Chemistry is:   1. The study of Atom concept, historical out lines and discoveries 2. The study an electronic behaviour in their atomic and molecular orbital 3. Adopt idea that describes of chemical bonding 4. The study of physical properties and Ionic structures   The molecular symmetry and Milliken symbol | | | |
| **11. Course objective:**  At the end of the course students will be able to :   * Explain certain key introductory concepts in, atomic structure, orbital energy, shielding, covalent and ionic bonds, ionic structures, hybridization, valence shell electron pair repulsion, molecular symmetry and molecular symbols. * Use the skills development in the explanation of physical and chemical behaviours of some molecules such as H2O, NH3, and CH3 etc. * To provide experience in periodic table, periodicity, metal, non metal, metalloids properties. * To obtain necessary information about bond theories ; molecular orbital theory , valence bond theory . * Focus on the type of crystals, in order to knowing some properties of them which related to the nature of the crystal. | | | |
| **12. Student's obligation**  **\* The students must be attending lecture 2 hours weekly.**  **\*** All students must get monthly and daily examination. They also  may be participate in discussion and conclusion.  \***Final exam will be determined the exam board**  . | | | |
| **13. Forms of teaching**  Different form of teaching will be used to reach the objectives of the course, discussion and conclusion, and video films of VSEPR, ionic structure, hybridization, handout, Data show…. Etc. | | | |
| **14. Assessment scheme**  The students are required to do closed book exam at the mid of the semester  ‌ | | | |
| **15. Student learning outcome:**  **The students learning during this course :**   1. **Electronic configuration** 2. **Solving problems of shielding** 3. **Understanding knowledge about periodic table.** 4. **Explanation of bond forming.** 5. **Determining of group point** 6. **Learning of types of crystal units** 7. **Solving some examples of term symbol.** | | | |
| **16. Course Reading List and References‌:**  Required book**:**  1- Chemistry Structure & bonding  Roger L. Deco & Harry B. Gray  2-General Chemistry sixth edition  Kenneth W. Whitten | | | |
| 17. The Topics:  The introduction to the covalent  molecular stricture  Resonance  – Lewis structure  Week10:  Molecular geometry  Week11:  VSEPR method and molecular geometry molecular symmetry molecular orbital theory  Week12:  The molecular and chemical covalent bond  Molecular orbital formation (δ&π ) orbital (S,P) mixing orbital's  - The second period  Week13 :  Term symbol of linear molecular  differing diatomic molecules … triatomic molecules  Week14:  Molecular orbital of H2O – Valence bond theory (VBT  Week15 :  Hydrogen molecules hybridization – BCl3 , CH4 molecular  -Valence bond treatment of NH3,H2O ,HF molecules  Week16:  C2H6 ,C2H4, HCHO , C6H6 , Phosphors compound  Sulpher compound  chlorine compound  Hybridization rules  Simple molecular  structure designation method  Week17 :  Lattice Energy, Lattice enthalpy and the Born-Haber cycle, the born-Mayer equation  Week18 :  Covalent bond  Week19:  Lewis structure, Photonuclear Covalent bond distance , covalent radius and van der Waals radius , The valence bond (VB) model of bonding in H2 , The valence bond (VB) model applied to F2,O2 and N2  Week 20:  Molecular orbital theory , Molecular orbital theory applied to the bonding in H2 , The bonding of He2, Li2, and Be2 , The bonding in F2and O2 , What happens if the s-p separation is small , The octet rule : first row p-block elements.  Week 21:  SP Hybridization: a scheme for linear species, sp2 Hybridization: a scheme for regional species, sp3 Hybridization : a scheme for tetrahedral and related species  Week 22 :  VSEPR,  Week 23:  Molecular symmetry  Week 24 :  Milliken Symbols | | **Lecturer's Name :Beriwan Muhamad Hamad Ameen** |
|  | |  |
| **18. Practical Topics (If there is any)** | |  |
| No practical topics | |  |
| **19. Examinations:**  **19. Examination**  **Q1) Write True False of the following:**  **1-** Uncertainty principle "states that is impossible to know simultaneously  both the momentum and the position of a particle with certainty " .  2- If ml = +1 , 0 , -1; l = 2 .  **3-** The identity operation En leaves the whole molecular unchanged.  **4-** A1g: is symmetry corresponding to Cn .  **Q2)**  **Fill in the blanks:**  **1-Lanthanides: ------- elements +lanthanum.**  2- There are two theories to explain the covalent bond -----------------  and ------------------------ .  **3- The electronic configuration of [ 78Pt ] is----------------------**  **4-** The hybrid orbital may be form σ-bond, while non precipitate orbital can form --------------- .  **Q3)**  **Using MO diagram , calculate B.O of the following molecules:**  **1- N2  , 2-**  **Q4) Using VSEPR predict the geometrical shape and hybridization type of: 1- (SO4) 2- , 2- I3 - , 3- XeF2  , 4- O3**  **Q5) Write True False of the following:**  1- Dalton theory as follows: • Elements are made of tiny particles called **atoms**  **2-** Thomson proposed that cathode rays must consist of tiny negatively charged particles, which we now call **electrons**.  **3-** The hydrogen atoms, called, tritium, have mass number 1.  4- For the Lyman series, n1 = 1, for the Balmer series, n1 = 2, and for the Paschen, series, n1 = 4  **Q6) : Define the following items :**  **1-Zeeman effect .**  **2- The Uncertainty Principle** .  Q7) **Fill in the blanks :**   1. **The distance between any two adjacent crests is called** ----------------. 2. **2-The FM radio published their programs with frequency ( 91.5 X 106 HZ ) and wavelength ------------ meter .**   **3-The un charged particle with a mass slightly greater than proton is------------**  **4- The radiation which can be seen with a naked eye is --------------- ray .**  **--------------------------------------------------------------------------------------------------**  **Q8) A: The isotope  is used medically for diagnosis of pancreatic disorders. How many protons, neutrons, and electrons does an atom of  have?**  **B: Define the following items :**   1. **Uncertainty Principle .** 2. **Afbau principle**   **--------------------------------------------------------------------------------------------**  **Q9)**  **A: : Calculate Zeff. for valence electron in Zn ( Z = 30 ) .**  **B: Using electronic configuration ; predict number of period and group of : 1- 29Cu , 2- 15P .**  **Q10) Choose the correct answer for each of the following :**  **1-The F- bock in periodic table is also called:**  **a- inner transition elements, b- representative elements, c- radioactive elements**  **d- inert elements , e- no one of them .**  **2-CH4 do not has real (i) but it has :a- Cn , b- Sn , c- C2 , d- σh , e- no one of them .**  **3- The FCO angle in F2CO is 126o , while ClCO angle in Cl2CO is ---------- :**  **a- 128 , b- 130 , c- 132 , d- 124 , e- no one of them .**  **4- Every molecule has at least the ------------- : a- σv ,  b- i , c- σd , d- E , e- no one of them .**  **5- The Mulliken symbol of dxy orbital is : a- A1g , b- B1g , c- B2g , d- Eg , e- no one of them .**  **( 20 M )**  **Q11) Fill in the blanks :**   1. **The un charged particle with a mass slightly greater than proton is--------------------------** 2. **The FM radio published their programs with frequency ( 91 X 106 HZ ) and wavelength**   **----------------------- meter.**  **3- An example of isoelectronic is He and ----------------------**  **4- In a certain lattice crystal Erep. = -----------------**  **5- The greatest polarizing power element in halogen group is -----------------------------**  **( 20 M )**  **-----------------------------------------------------------------------------------------------------------------------------------**  **Q12) A : Write True or False of the following :**   1. **The stable term is that which has a higher multiplicity.** 2. **According to MOT diagram the B.O of O2 is ( 4 ) .** 3. **BF3 is triangular in shape while B2 F2 is square planar .** 4. **The B.O of NO is ( 2 ) .** 5. **The group point ofCH4 isTh .**   **B : Define the following items :**  **i) Pauli exclusion principle.**  **ii) Eighen function .**  **( 20 M )**  **Q13)**  **A : Calculate lattice energy of NaCl crystal from the following data by use of Born- Haber cycle :**  **Sublimation energy = 108.7 kj/mol**  **Dissociation energy for Cl2 = 225.9 kj / mol**  **Ionization energy for Na(g) = 485.9 kj/mol**  **Electron affinity for Cl(g) = - 351.4 kj /mol**  **Heat of formation of NaCl = - 414.2 kj / mol .**  **B : Determine the atomic number of the element which has the quantum number**  **n = 4 , *l =* 1 *,ml =* 1 , *ms* = + 1/2 .**  **( 20 M )**  **Q14 ) A : arrange the following orbitals according to increasing in energy level :**  **6S , 5P , 4d ,6P .**  **B : Write the following equations : 1- Schrödinger equation depending on Cartesian**  **coordinates. 2- de Broglie. ( 20 M )**  . | | |
| **20. Extra notes :**  **\* We suggest that each examination may be after the end of course (30 hours )** | | |
| **21. Peer review:** | | |