**CHEM 102 SYLLABUS**

**Text book: Raymond Chang, Chemistry,10th edition, 2010**

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| Topics | Text book pages | Number of Lectures |

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| **Chapter 7: Quantum Theory and the Electronic Structure of Atoms** | | | |
| **7.1 From Classical Physics to Quantum Theory:** Speed, length, frequency, number of the waves of light, Electromagnetic radiation, Plank's equation (The quantization of light energy)  **7.2 The photoelectric Effect** (The matter nature of light)  ***Exercises*** | 276- 282 | 2 | **3** |
| **7.3 Bohr’s theory for hydrogen atom:** Emission spectra**, emission** spectrum of hydrogen atom Assumptions  ***Exercises*** | 282-287 | 1 |

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| 7.4 The dual nature of electrons: De Broglie hypothesis | | | | |
| 7.5 Quantum mechanics: Heisenberg principle, Quantum mechanics of the hydrogen atom  *Exercises* | 288-294 | 1 | | **5** |
| 7.6 Quantum numbers: The principle quantum number, the angular momentum quantum number, the magnetic quantum number, the electron spin quantum number,  *Exercises* | 294-296 | 1 | |
| 7.7 Atomic orbitals: s*, p, d,* orbitals, energy of ng up, or n + *l* principle)  *Exercises* | 297-300 | 1 | |
| 7.8 Electron configurations: The Pauli exclusion, principle diamagnetism and para magnetism. the shielding effect of many-electron atoms, Hund’s rule, general rules for assigning electron to atomic orbitals  *Exercises* | 300 - 307 | 1 | |
| 7.9 The building-up principal: The Aufbau principle, building irregularities of configurations in transition elements  *Exercises* | 307-309 | 1 | |
| Chapter 8: Periodic Relationship Among the Elements | | | | |
| 8.2 Periodic classification of elements: Representing free elements in chemical equation, electron configuration of cations and anions  *Exercises* | 326-330 | 3 | **4** | |
| 8.3 Periodic variation in physical properties of elements: Effective nuclear charge, atomic radius, ionic radius  8.4 Ionization energy  8.5 Electron affinity  *Exercises* | 331- 343 | 1 |

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| Chapter 9: Chemical Bonding I | | | |
| 9.1 Lewis dot symbols  9.2 The ionic bond  9.3 Lattice energy of ionic compounds: The Born-Haber cycle for determining lattice energy, lattice energy and the formula of ionic compounds,  9.4 The covalent bond  *Exercises* | 366  367-369  369-374  374-377 | 2 | **6** |
| 9.5 Electronegativity: Electronegativity and oxidation numbers  *Exercises* | 377-380 | 1 |
| 9.6 Writing Lewis Structures  9.7 Formal charge and Lewis structure  *Exercises* | 380 – 386 | 1 |
| 9.8 The concept of resonance  *Exercises* | 386 – 398 | 2 |
| 9.9 Exceptions to the Octet Rule: The incomplete octet, odd-electron molecules, the expanded octet  *Exercises* |
| 9.10 Bond energy (enthalpy)  *Exercises* |
| FIRST MIDTERM EXAM | | | |
| Chapter (10): Chemical Bonding II. Molecular geometry and hybridization of atomic orbitals | | | | |
| 10.1 Molecular geometry: Molecules in which the central atom has no lone pairs, geometry of molecules with more than one central atom, guidelines for applying the VSEPR model  10.2 Dipole Moment  *Exercises* | | 410 - 424 | 1 | **5** |
| * 1. Valence bond theory   2. Hybridization of atomic: sp 3, sp2, and sp hybridization, procedure for hybridizing atomic orbitals, hybridization of *s, p* and *d* orbitals   *Exercises* | | 424 – 436 | 2 |
| * 1. Hybridization in molecules   2. Molecular orbital theory: Bonding and antibonding molecular orbitals   *Exercises* | | 437 - 443 | 1 |
| * 1. Molecular orbital configurations: Rules governing molecular electron configuration and stability, hydrogen and helium molecules, homonuclear diatomic molecules of second-period elements, the lithium molecule, the carbon molecule, the oxygen molecule   2. Delocalized molecular orbitals: Benzene molecule, the carbon ion   *Exercises* | | 443– 452 | 1 |
| Chapter (5): Gases | | | | |
| 5.7 The kinetic molecular theory of gases:(chapter 5)  5.8 Deviation from the ideal gas | | 203-204  211-213 | 1 | **3** |
| Chapter (11): Intermolecular forces and liquids and solids  11.1 The kinetic molecular theory of liquids and solids  11.2 Intermolecular forces: Dipole-dipole forces, ion-dipole forces, dispersion forces, hydrogen bond  11.3 Properties of liquids: Surface tension, viscosity, the structure and properties of water  *Exercises* | | 462-472 | 2 |

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| Chapter (13) Chemical Kinetics | | | |
| 13.1The rate of a reaction: Reaction of molecular bromine and formic acid, decomposition of hydrogen peroxide, reaction rate and stoichiometry  13.2 The rate low  13.3The relation between reactant concentration and time: First order reaction (only)  13.4 Activation energy and temperature dependence of rate constant: The collision theory of chemical kinetics, the Arrhenius equation  13.5 Reaction mechanisms: rate laws and elementary steps. experimental support for reaction mechanisms  13.6 catalysis: Heterogeneous catalysis (only)  *Exercises* | 558-5576  582-549    594-596 | 3 | **5** |
| SECOND MIDTERM EXAM (10 GRADS) | | | |
| Chapter (14)Chemical equilibrium | | | |
| 14.1 The concept of equilibrium and the equilibrium constant: The equilibrium constant  14.2 Writing equilibrium constant expressions: Homogenous equilibrium , equilibrium constant and units, Heterogenous equilibrium, multiple equilibrium, the form of K and the equilibrium equation, summary of guidelines for writing equilibrium constant expressions  *Exercises* | 616 – 630 | 2 | **5** |
| 14.3 The relationship between chemical kinetics and chemical equilibrium  14.4 What does the equilibrium constant tell us?: Predicting the direction of a reaction, calculating equilibrium concentration  *Exercises* | 630 – 637 | 2 |
| 14.5 Factors that affect chemical equilibrium: Le chateliers principle, changes in concentration, changes in volume and pressure, changes in temperature, the effect of a catalyst, the summary of factors that may affect the equilibrium position  *Exercises* | 638 - 645 | 1 |

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| Topics | | Text book pages | Number of lectures | | |
| Chapter (4) Reactions in aqueous solutions | | | | | |
| 4.4 Oxidation -reduction Reaction: Oxidation numbers  *Exercises* | | 135-139 | 1 | | **1** |
| Chapter (19) Oxidation-reduction reactions (Redox reactions) | | | | | |
| 19.1 Redox Reaction: Balancing redox reactions  *Exercises* | 838-840 | | 1 | | **1** |
| Chapter (15) Acid and bases | | | | | |
| 15.1 Brønsted Acids and Bases  15.2 The Acid-Base properties of water: The ion product of water  15.3 pH—A Measure of Acidity  *Exercises* | | 660 - 666 | 1 | **6** | |
| 15.4 Strength of Acids and Bases  15.5 Weak acids and acid ionization constants: The quadratic equation, percent ionization  15.6 Weak bases and base ionization constants  15.7 The relationship between the ionization constants  of acids and their conjugate bases  *Exercises* | | 666 - 681 | 2 |
| 15.9 Molecular structure and the strength of acids: Hydrohalic acids, oxoacids, carboxylic acids  15.10 Acid-Base properties of salts: Salts that produce neutral solutions, salts that produce basic solutions, salts that produce Acidic solutions, salts in which both the cation and the anion hydrolyze  15.11 Acid-Base properties of oxides and hydroxides: Basic and amphoteric hydroxides  15.12 Lewis acids and bases  *Exercises* | | 685 - 701 | 3 |
| TOTAL HOURS | | **42** | **42** | | |

**Distribution of the 100 grades over semester:**

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|  | **Grades** | |
| **Practical** | | **30** |
| **1st midterm** | **15** | **30** |
| **2nd midterm** | **15** |
| **Final exam** | | **40** |
| **Total** | | **100** |

**FINAL EXAM WILL BE IN ALL TOPICS**

**الاختبار النهائي سيكون في جميع مواضيع المقرر**