Course Code	Course Title	ECTS Credits
MED-102	**General Chemistry**	6
School	**Semester**	**Prerequisites**
Medical School	Fall (Semester 1)	None
Type of Course	**Field**	**Language of Instruction**
Required	Medicine	English
Level of Course	**Year of Study**	**Lecturer(s)**
Undergraduate	1st	Dr Photos Hajigeorgiou Dr Stella Loizou (Lab)
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

General Objectives of the Course:

The main objectives of the course are:

- To give students an introduction to the basic principles of general chemistry, and its applications in the medical sciences.
- To assist in the development of strong problem-solving skills.
- To help cultivate critical thinking in the approach to learning.
- To help in the acquisition of sound hands-on practical skills in the chemistry lab.

General Learning Outcomes:

The following list provides the learning objectives that will be covered in the lectures, lab practicals and tutorials of each week:

Week 1

LOBs covered during lectures:

1. Describe atomic structure and determine electronic configurations for neutral atoms as well as ions.
2. Perform calculations related to isotopic species.
3. Recognize atomic orbitals of s, p, and d type visually.
4. Draw atomic orbitals in 3D perspective diagrams.
5. Identify the spatial aspects controlled by orbital quantum numbers.
6. Explain atomic periodic properties on the basis of electronic configurations.

LOBs covered during tutorials:

7. Solve exercises related to atomic structure, electronic configurations, and periodic properties.

Week 2

LOBs covered during lectures:

8. Distinguish between different types of mixtures.
9. Explain the formation of ionic bonds between metals and non-metals.
10. Use Coulomb's Law to explain the strength of ionic bonds.
11. Describe the nature of covalent bonds and predict which compounds involve covalent bonds.
12. Determine whether a molecule is polar on the basis of geometry and

electronegativity differences.

LOBs covered during lab practicals:

13. Work safely in making basic measurements in the chemistry lab.

Week 3

LOBs covered during lectures:

14. Draw Lewis structures of molecules and molecular ions.
15. Describe how resonance structures form and identify the structure of the resonance hybrid.
16. Determine the geometry (shape) of molecules and molecular ions.
17. Identify which types of hybrid orbitals are employed by central atoms, particularly for organic molecules.
18. Discuss valance bond and molecular orbital theories and calculate bond order.
19. Name chemical compounds from the chemical formula and vice versa.

LOBs covered during lab practicals:

20. Explain how precipitates form in aqueous solutions and predict which solution mixtures will lead to a precipitate.
21. Perform calculations to predict the yield of a chemical reaction.

Week 4

LOBs covered during lectures:

22. Balance chemical equations.
23. Perform calculations using balanced chemical equations.
24. Discuss the conditions that lead to ideal gas behaviour.
25. Perform calculations on the basis of the Ideal Gas Law and its variants.

LOBs covered during tutorials:

26. Explain how hybrid orbitals are involved in forming molecules with various shapes.

Week 5

LOBs covered during lectures:

27. Perform calculations on thermochemistry.
28. Predict reaction spontaneity using entropy and the Gibb's free energy change.

LOBs covered during tutorials:

29. Perform yield calculations using balanced chemical equations.

Week 6

LOBs covered during lectures:

30. Identify types of intermolecular forces present in atoms, molecules, and ions.
31. Identify the presence of hydrogen bonding in inorganic and biological molecules.
32. Explain differences in physical properties in terms of the intermolecular forces

involved.

LOBs covered during lab practicals:

33. Perform volumetric analysis (titrations) in order to determine an unknown solution concentration.

Week 7

MIDTERM EXAM

LOBs covered during lectures:

34. Explain the factors that affect the rate of a chemical reaction.
35. Derive the rate law given experimental data

LOBs covered during tutorials:

36. Solve numerical problems on various aspects of ideal gases and thermochemistry with emphasis on heat and spontaneity.

Week 8

LOBs covered during lectures:

37. Identify reaction order and predict how the concentration changes with time.
38. Predict how the rate of a reaction with temperature and activation energy.
39. Perform calculations on half-life for chemical reactions and for radioactive decay.

LOBs covered during tutorials:

40. Explain the importance of intermolecular forces in liquids and in predicting boiling points and solubility.

Week 9

LOBs covered during lectures:

41. Explain how temperature affects the reaction rate.
42. Describe the concept of dynamic equilibrium.
43. Write equilibrium expressions.
44. Perform calculations on chemical systems at equilibrium.

LOBs covered during lab practicals:

45. Derive a rate law from experimental data.

Week 10

LOBs covered during lectures:

46. Predict what will happen to a chemical reaction if it is disturbed at equilibrium.
47. Describe the three definitions of acids and bases.
48. Describe the pH scale and describe methods for determining the pH of a solution.
49. Perform calculations on weak acid equilibria.

LOBs covered during tutorials:

50. Perform numerical calculations related to the rate of chemical reactions.

Week 11

LOBs covered during lectures:

51. Describe the equilibrium theory and apply it in dealing with weak acids and bases.
52. Perform calculations on buffer solutions.
53. Calculate oxidation numbers in molecules and molecular ions.
54. Balance redox equations in acidic and alkaline solutions.
55. Identify colligative properties and perform qualitative and quantitative analysis on such properties.
56. Solve a variety of exercises on redox reactions.

LOBs covered during lab practicals:

57. Perform volumetric analysis to determine a molecular mass and an acid-dissociation constant of a weak acid.

LOBs covered during tutorials:

58. Explain the principles of chemical equilibria and use them to make predictions on various aspects of chemical reactions.

Week 12

LOBs covered during lectures:

59. Solve a variety of exercises on colligative properties.

LOBs covered during tutorials:

60. Carry out calculations of pH and equilibrium concentrations using the laws of chemical equilibria.

Course Contents:

Topics covered in lectures

- Structure of the atom - Isotopes - Average atomic mass - Orbitals, an introduction.
- Orbitals, spatial aspects - Quantum numbers - Aufbau Principle
- Electronic configurations - Periodic properties (atomic radius, ionization energy) - Groups of the Periodic Table (trends in properties)
- Elements, compounds, mixtures - Ionic bonding
- Covalent bonding
- Electronegativity - bond polarity - molecular polarity
- Lewis structures
- Bonding theories
- Chemical nomenclature
- Chemical equations – balancing – calculations based on balanced chemical equations
- Ideal gases

- Types of energy - interconversions of energy - thermal and chemical energy - state functions - heat and work.
- Energy and enthalpy - physical and chemical changes - calorimetry and heat capacity.
- Hess Law and enthalpy changes – entropy
- Attractive forces in liquids - bond polarity and molecular shape
- Intermolecular forces (4 kinds).
- Hydrogen bonding - hydrogen bonding in biological systems
- Rate of reaction - factors influencing rate - stoichiometry of rate - determining rate law.
- Determining rate laws from initial rate data
- Dependence of concentration on time - first-order, second-order reactions - half-life
- Reaction rate and temperature
- Collision model - Arrhenius equation – catalysis
- The equilibrium state - Equilibrium constants Kc and Kp - Heterogeneous equilibria
- Using the equilibrium expression
- Le Chatelier's Principle
- Definitions of Acids and Bases - Strong and weak acids/bases - dissociation of water
- The pH Scale - Calculating pH for strong acids and bases
- Weak acid equilibria and buffers
- Oxidation-reduction reactions
- Balancing redox equations
- Colligative properties
- Colligative properties – problems
- Redox reactions - problems

Topics covered in laboratory practicals

- Laboratory Safety Rules - Basic Laboratory Measurements
- Double Displacement Reactions and Precipitates
- Determination of Acetic Acid Concentration in Vinegar
- Determination of the Rate Law in Chemical Kinetics
- Determination of the Molecular Mass and Acid-Dissociation Constant of a Weak Acid

Topics covered in tutorials

- Atomic structure – electronic configurations – Periodic properties
- Lewis structures and molecular orbitals.
- Calculations on chemical reactions.
- Calculations on ideal gases and thermochemistry
- Identifying intermolecular forces and using them to predict physical properties
- Calculations on chemical kinetics
- Calculations on chemical equilibria
- Acid-base calculations

Learning Activities and Teaching Methods:

Lectures, Tutorials, Laboratory Practical Sessions.

Assessment Methods:

Laboratory report (10%), Midterm Exam (30%), and Final Exam (60%). Assessment is by Single Best Answers (SBAs) and Short Answer Questions (SAQs).

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
T.L. Brown, H.E. Lemay, B.E. Bursten, C.J. Murphy	Chemistry The Central Science	Prentice Hall	2015 13th Global Edition	978129205 7712

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
R.H. Petrucci, W.S. Harwood, and F.G. Herring	General Chemistry Principles and Modern Applications	Prentice Hall	2002 8th Edition	0-13-014329-4
J.E. McMurry and R.C. Fay	Chemistry	Prentice Hall	2012 6th Edition	978-0-321-76087-6