Course Title	**General Chemistry**				
Course Code	**MED-102**				
Course Type	Required				
Level	Undergraduate				
Year / Semester	Year 1/ Semester 1 (Fall)				
Teachers Names	**Course Lead:** Prof Photos Hajigeorgiou **Contributor:** Dr Stella Loizou Dr Marios Stylianou				
ECTS	6	Lectures / week	3	Laboratories / week	2
Course Purpose and Objectives	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.				
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 the arrangement of the Periodic Table 2. Describe the main properties of metals, non-metals, and metalloids 3. Identify the names, positions, and main properties of selected groups in the Periodic Table 4. Describe atomic structure 5. Identify subatomic particles and describe their properties 6. Perform calculations related to isotopic species 7. Recognize atomic orbitals of s, p, and d type visually 8. Identify the spatial aspects of atomic orbitals controlled by quantum numbers				

	Week 2 ***LOBs covered during lectures:*** 9. Discuss the rules that govern the values allowed for the various quantum numbers 10. Determine electronic configurations for neutral atoms as well as ions 11. Apply Hund's Rule in writing electronic configurations 12. Define the Pauli Exclusion Principle in determining a set of quantum numbers for an electron in an atom 13. Explain atomic periodic properties on the basis of electronic configurations 14. Work safely in making basic measurements in the chemistry lab 15. Describe the loss of electrons by metal atoms in forming positive ions 16. Describe the gain of electrons by non-metal atoms in forming negative ions. 17. Explain the formation of ionic bonds between metals and non-metals. 18. Explain Coulomb's Law as it pertains to chemical systems. 19. Use Coulomb's Law to explain the strength of ionic bonding. 20. Describe the nature of a covalent bond. 21. Discuss the concept of electronegativity in the formation of polar bonds. 22. Determine whether a molecule is polar or not. ***LOBs covered during tutorials:*** 23. Solve exercises related to atomic structure, electronic configurations, and periodic properties ***LOBs covered during lab practicals:*** 24. Explain how precipitates form in aqueous solutions and predict which solution mixtures will lead to a precipitate. 25. Perform calculations to predict the yield of a chemical reaction. **Week 3** ***LOBs covered during lectures:*** 26. Draw Lewis structures of molecules and molecular ions. 27. Describe how resonance structures form and identify the structure of the resonance hybrid. 28. "Calculate the formal charge. 29. Discuss how the formal charge can be used to determine the relative stabilities of resonance forms. 30. Determine the geometry (shape) of molecules and molecular ions 31. Discuss and apply valence bond theory. 32. Identify the types of hybrid orbitals employed by central atoms.

LOBs covered during lab practicals:

24. Explain how precipitates form in aqueous solutions and predict which solution mixtures will lead to a precipitate.

25. Perform calculations to predict the yield of a chemical reaction.

Week 4

LOBs covered during lectures:

33. Discuss the importance of trace elements in life and give examples of trace element deficiencies.
34. Define radioactive isotopes and give examples of their use in medicine.
35. Balance chemical equations.
36. Perform calculations using balanced chemical equations.
37. Perform calculations on aqueous solutions and dilutions.

LOBs covered during lab practicals:

24. Explain how precipitates form in aqueous solutions and predict which solution mixtures will lead to a precipitate.

25. Perform calculations to predict the yield of a chemical reaction.

LOBs covered during tutorials:

38. Draw Lewis structures and explain how hybrid orbitals are involved in forming molecules with various shape.

Week 5

LOBs covered during lectures:

39. List the principal gases in the Earth's atmosphere
40. Identify and discuss the various Gas Laws
41. Discuss the conditions that lead to ideal gas behaviour
42. Perform calculations based on the Ideal Gas Law
43. Perform calculations for a gas mixture based on Dalton's Law of partial pressures
44. Discuss ideal gas behaviour in terms of the kinetic theory
45. Explain semi-quantitatively how Graham's Law can be used to describe diffusion and effusion
46. Describe how kinetic and potential energies interconvert according to the First Law of Thermodynamics
47. Describe the different types of thermodynamic systems
48. Discuss internal energy and interpret energy diagrams

LOBs covered during tutorials:

50. Perform yield calculations using balanced chemical equations.

LOBs covered during lab practicals:

49. Perform calculations based on chemical equation and aqueous solutions.

Week 6

Summative midterm exam

LOBs covered during lectures:

51. List the thermodynamic standard conditions.
52. Perform calculations on internal energy changes.
53. Identify conditions for the thermodynamic standard state.
54. Discuss the changes in temperature as constant heat is delivered to a solid object.
55. Perform calculations on calorimetry.
56. Calculate the heat of a reaction using heats of formation.
57. Calculate the heat of a reaction using bond enthalpies.
58. Discuss the involvement of entropy in determining reaction spontaneity.
59. Predict reaction spontaneity using the Gibb's free energy change equation.
60. Discuss the key contaminants that have an effect in human health.

LOBs covered during lab practicals:

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

Week 7

LOBs covered during lectures:

61. Discuss the different types of intermolecular forces and how they arise.
62. Identify types of intermolecular forces present.
63. Explain differences in physical properties in terms of the intermolecular forces involved.

LOBs covered during practicals:

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

LOBs covered during tutorials:

64. Solve numerical problems on various aspects of ideal gases.

Week 8

LOBs covered during lectures:

65. List the factors that affect the rate of a chemical reaction.
66. Explain how various factors affect the rate of a chemical reaction.
67. Derive the Rate Law given experimental data.
68. Discuss how the concentration changes with time for different reaction orders.
69. Calculate the concentration at a given time for different reaction orders.
70. Interpret kinetic data plots in order to identify reaction order.
71. Determine the half-life from a plot of concentration versus time for a first-order reaction.
72. Explain how temperature affects the reaction rate.
73. Perform calculations related to temperature changes and the reaction rate.
74. Interpret Arrhenius plots to determine the activation energy.

LOBs covered during tutorials:

75. Solve a wide variety of numerical problems on various aspects of thermochemistry with emphasis on heat and spontaneity.

Week 9

LOBs covered during lectures:

76. Describe the concept of dynamic equilibrium.
77. Write equilibrium expressions.
78. Perform calculations of Kc from Kp and vice versa.
79. Predict in which direction a chemical system will shift to establish equilibrium.
80. Perform various types of calculations on chemical systems at equilibrium.
81. Predict what will happen to a chemical reaction if it is disturbed at equilibrium in various ways.
82. Discuss the interplay between chemical kinetics and chemical equilibrium.

LOBs covered during tutorials:

83. Solve various problems on intermolecular forces.

Week 10

LOBs covered during lectures:

84. Describe the two definitions of acids and bases.
85. Determine acid/conjugate base pairs.
86. Identify whether an acid is strong or weak.

	87. Discuss the relative strengths of acids and their conjugate bases. 88. Describe the dissociation of distilled water. 89. Predict the approximate pH of some common substances. 90. Discuss the various ways of making pH measurements and their accuracy. 91. Estimate the pH of a solution using acid-base indicators. 92. Calculate the pH of strong acid and strong base solutions. 93. Calculate the equilibrium concentrations of all species in weak acid dissociation. 94. Calculate the pH of a weak acid solution. 95. Calculate the Ka of a weak acid. 96. Calculate the equilibrium concentrations of all species in weak base dissociation. 97. Calculate the pH of a weak base solution. 98. Calculate the pH of a buffer solution. 99. Calculate the new pH of a buffer solution on addition of extra acid or bas. 100. Perform calculations using the Henderson-Hasselbach equation. 101. Define half-life of a drug. 102. Describe the action of drugs in human body using examples. ***LOBs covered during tutorials:*** 103. Solve problems related to the rate of chemical reactions. **Week 11** ***LOBs covered during lectures:*** 104. Describe the concepts of oxidation and reduction. 105. Calculate oxidation numbers in chemical formulas. 106. Identify the oxidizing and reducing agents in a redox reaction. 107. Predict reaction reactivity on the basis of the Activity Series. ***LOBs covered during tutorials:*** 108. Solve problems related to chemical equilibria. **Week 12** ***LOBs covered during tutorials:*** 108. Solve problems related to acids and bases		
Prerequisites	None	Required	None
Course Content	***Topics covered in lectures*** • Introduction to General Chemistry • The Structure of Matter		

(Elements – Periodic Table – Selected Groups – Categories of Matter)

- Atomic and Electronic Structure I
- (Atomic Theory of Matter – Structure of the Atom – Subatomic Particles – Atomic Symbols – Isotopes – Electronic Structure of Atoms – Quantum Mechanical Picture – Orbitals – Electronic Quantum Numbers)
- Atomic and Electronic Structure II

  (Electron Spin – Aufbau Principle – Electronic Configurations – Pauli Exclusion Principle – Trends in Atomic Radius – Trends in Ionization Energy)
- Atomic and Electronic Structure III

  (Electronic Configurations – Pauli Exclusion Principle – Trends in Atomic Radius – Trends in Ionization Energy)
- Laboratory Safety Rules - Basic Laboratory Measurements
- Ionic Bonding

  (Coulomb’s Law – Octet Rule – Ionic Bonding – Crystal Lattice – Lattice Energy)
- Covalent Bonding

  (Covalent Bond Formation – Diatomic and Polyatomic Molecules – Electronegativity – Percent Ionic Character – Polar Covalent Bonds – Dipole Moment – Basic Geometry)
- Lewis Structures and Molecular Geometry

  (Drawing Lewis Structures – Resonance Forms – Formal Charge – VSEPR Theory – Actual Geometry)
- Valence Bond Theory

  (Valence Bond Theory – Hybrid Atomic Orbitals – Sigma and Pi Bonds)
- Trace Elements and Radioactive Isotopes in Medicine
- Chemical Equations

  (Chemical Equations – Physical State Symbols – Balancing Chemical Equations – The Mole and Avogadro’s Number – Molar Mass – Aqueous Solutions – Stoichiometry – Yields – Limiting Reactants – Solution Dilutions)
- Ideal Gases

  (Atmosphere – Properties of Gases – Atmospheric Pressure – Enclosed Gases – Gas Laws – Ideal Gas Equation – Partial Pressure and Dalton’s Law – Kinetic-Molecular Theory – Graham’s Law – Diffusion and Effusion of Gases)
- Thermochemistry I

  (Energy – First Law of Thermodynamics – Thermometer – Chemical Energy – Thermodynamic Systems – Internal Energy – Energy Diagrams)

	• Thermochemistry III (Hess's Law – Standard Heat of Formation – Bond Dissociation Energy – Entropy – Gibb's Free Energy) • Environmental Contaminants and Human Health • Intermolecular Forces (Gas, Liquids and Solids – Bond Polarity and Molecular Polarity – London Dispersion Forces – London Dispersion Forces and Structure – Polarizability – Ion-Dipole Forces – Dipole-Dipole Forces –Hydrogen Bonding – Intermolecular Forces and Boiling Points) • Chemical Kinetics I (Reaction Rate – Factors Affecting Reaction Rate – Measuring Reaction Rate – Initial Rate – Rate Law – Reaction Order) • Chemical Kinetics II (Concentration and Time – Half-Life – Radioactive Decay Rate – Zero, First, and Second-Order Reactions – Reaction Order Plots) • Chemical Equilibrium I (Dynamic Equilibrium – Equilibrium Constants – Heterogeneous Equilibria – Applications of Equilibrium Expressions) • Chemical Equilibrium II (Equilibrium Concentrations – Le Châtelier's Principle – Kinetics versus Equilibrium – Spontaneity and Equilibria) • Acids and Bases I (Arrhenius Definitions – Bronsted-Lowry Theory – Lewis Acids and Bases – Strong and Weak Acids – Acid/Conjugate Base Strengths) • Acids and Bases II (Dissociation of Water – The pH Scale – Measuring pH – Calculating pH for Strong Acids and Bases) • Acids and Bases III (Weak Acid Equilibria – Weak Acid Dissociation – Equilibrium Concentrations for Weak Acids and pH – Weak Base Equilibria – Calculation of pH for Weak Base Solutions – Acid-Base Properties of Salts – Common Ion Effect – Buffer Solutions – Buffer Capacity – Henderson-Hasselbach Equation) • Pharmacokinetics - The kinetics of Drugs in the Human Body • Oxidation-Reduction Reactions (Redox Equations – Oxidation Numbers – Activity Series) • Oxidation-Reduction Reaction Problems ***Topics covered in laboratory practicals*** • Double Displacement Reactions and Precipitates • Determination of Acetic Acid Concentration in Vinegar

	Topics covered in tutorials • Atomic structure – electronic configurations – Periodic properties • Lewis structures and molecular orbitals. • Calculations on chemical reactions. • Calculations on ideal gases • Thermochemistry • Intermolecular Forces • Chemical kinetics • Chemical equilibria • Acids and base
Teaching Methodology	Lectures, Tutorials, Laboratory Practical Sessions.
Bibliography	**Required Textbooks/Reading:**

Authors	Title	Edition	Publisher	Year	ISBN
T.L. Brown, H.E. Lemay, B.E. Bursten, C.J. Murphy	Chemistry: The Central Science	15th Global Edition	Pearson	2022	9781292407616

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
R.H. Petrucci, Jeffry D. Madura, F.G. Herring, C. Bissonnette	General Chemistry Principles and Modern Applications	12th Edition	Pearson	2023	9781292726137
R. Chang, K. Goldsby	Chemistry	12th Edition	Pearson	2015	9780076727704

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