<table>
<tr><td>Course Title</td><td colspan="5">General Chemistry</td></tr>
<tr><td>Course Code</td><td colspan="5">MED-102</td></tr>
<tr><td>Course Type</td><td colspan="5">Required</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Year 1/ Semester 1 (Fall)</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Course Lead:
Prof Photos Hajigeorgiou

Contributor:
Dr Stella Loizou</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3</td><td>Laboratories / week</td><td>2</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">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.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">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:
Describe the arrangement of the Periodic Table
Identify the names, positions, and main properties of selected groups in the Periodic Table
Describe the main properties of metals, non-metals, and metalloids
Identify different forms of matter
Describe atomic structure.
Identify subatomic particles and describe their properties.
Perform calculations related to isotopic species.
Week 2
LOBs covered during lectures:<ol start="8">
Recognize atomic orbitals of s, p, and d type visually.</td></tr>
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9. Identify the spatial aspects of atomic orbitals controlled by 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. Describe the loss of electrons by metal atoms in forming positive ions
15. Describe the gain of electrons by non-metal atoms in forming negative ions
16. Explain the formation of ionic bonds between metals and non-metals
17. Explain Coulomb's Law as it pertains to chemical systems
18. Use Coulomb's Law to explain the strength of ionic bonding

LOBs covered during lab practicals:

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

LOBs covered during tutorials:

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

Week 3

LOBs covered during lectures:

21. Discuss the importance of trace elements in life and give examples of trace element deficiencies.
22. Define radioactive isotopes and give examples of their use in medicine.
23. Describe the nature of a covalent bond
24. Discuss the concept of electronegativity in the formation of polar bonds
25. Determine whether a molecule is polar or not
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

LOBs covered during lab practicals:

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

Week 4

LOBs covered during lectures:

33. Identify the types of hybrid orbitals employed by central atoms
34. Discuss and apply valence bond theory
35. Discuss molecular orbital theory
36. Determine molecular electronic configurations for neutral diatomic molecules and related ions
37. Calculate the bond order
38. Determine the magnetic properties of diatomic molecules and ions
39. Give systematic names for inorganic compounds given the chemical formula
40. Give chemical formulas for inorganic compounds given the name

LOBs covered during lab practicals:

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

LOBs covered during tutorials:

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

Week 5

LOBs covered during lectures:

43. Balance chemical equations
44. Perform calculations using balanced chemical equations
45. Perform calculations on aqueous solutions and dilutions
46. List the principal gases in the Earth's atmosphere
47. Discuss the conditions that lead to ideal gas behaviour
48. Perform calculations based on the Ideal Gas Law
49. Perform calculations for a gas mixture based on Dalton's Law of partial pressures
50. Discuss ideal gas behaviour in terms of the kinetic theory

51. Explain semi-quantitatively how Graham's Law can be used to describe diffusion and effusion
52. Explain how the van der Waals equation simulates real gas behaviour
53. Explain the trends in the van der Waals constants in terms of physical quantities

LOBs covered during tutorials:

54. Perform yield calculations using balanced chemical equations.

Week 6

LOBs covered during lectures:

55. Describe how kinetic and potential energies interconvert according to the First Law of Thermodynamics
56. Explain how a thermometer works
57. Describe the different types of thermodynamic systems
58. Give examples of state functions and path functions
59. List the thermodynamic standard conditions
60. Discuss the changes in temperature as constant heat is delivered to a solid object
61. Perform calculations on calorimetry
62. Calculate the heat of a reaction using Hess's Law
63. Calculate the heat of a reaction using heats of formation
64. Calculate the heat of a reaction using bond enthalpies
65. Discuss the involvement of entropy in determining reaction spontaneity
66. Predict reaction spontaneity using the Gibb's free energy change equation

Week 7

MIDTERM EXAM

LOBs covered during lectures:

67. Identify types of intermolecular forces present
68. Explain differences in physical properties in terms of the intermolecular forces involved
69. Identify types of intermolecular forces present
70. Identify the presence of hydrogen bonding in inorganic and biological molecules
71. Explain differences in physical properties in terms of the intermolecular forces involved

72. Discuss the involvement of hydrogen bonding in sustaining life
73. Discuss the key contaminants that have an effect in human health.

LOBs covered during tutorials:

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

Week 8

LOBs covered during lectures:

75. List the factors that affect the rate of a chemical reaction
76. Explain how various factors affect the rate of a chemical reaction
77. Derive the Rate Law given experimental data
78. Discuss how the concentration changes with time and with temperature for different reaction orders
79. Calculate the concentration at a given time for different reaction orders
80. Interpret kinetic data plots in order to identify the reaction order
81. Determine the half-life from a plot of concentration versus time for a first-order reaction
82. Predict how the concentration changes with time and with temperature
83. Explain how temperature affects the reaction rate

LOBs covered during lab practicals:

84. Derive a rate law from experimental data.

LOBs covered during tutorials:

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

Week 9

LOBs covered during lectures:

86. Describe the concept of dynamic equilibrium
87. Write equilibrium expressions
88. Perform calculations of Kc from Kp and vice versa
89. Predict in which direction a chemical system will shift to establish equilibrium
90. Perform various types of calculations on chemical systems at equilibrium

91. Predict what will happen to a chemical reaction if it is disturbed at equilibrium in various ways
92. Discuss the interplay between chemical kinetics and chemical equilibrium
93. Calculate the Gibb's free energy change given an equilibrium constant
94. Describe the three definitions of acids and bases and make comparisons between the three
95. Determine acid/conjugate base pairs
96. Identify whether an acid is strong or weak
97. Discuss the relative strengths of acids and their conjugate bases

LOBs covered during lab practicals:

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

LOBs covered during tutorials:

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

Week 10

LOBs covered during lectures:

100. Describe the dissociation of distilled water
101. Predict the approximate pH of some common substances
102. Discuss the various ways of making pH measurements and their accuracy
103. Estimate the pH of a solution using acid-base indicators
104. Calculate the pH of strong acid and strong base solutions
105. Calculate the equilibrium concentrations of all species in weak acid dissociation
106. Calculate the pH of a weak acid solution
107. Calculate the Ka of a weak acid
108. Calculate the Percent Dissociation of a weak acid
109. Calculate the equilibrium concentrations of all species in weak base dissociation
110. Calculate the pH of a weak base solution
111. Calculate the pH of a buffer solution
112. Calculate the new pH of a buffer solution on addition of extra acid or base
113. Perform calculations using the Henderson - Hasselbach equation

	114. Define half-life of a drug. 115. Describe the action of drugs in human body using examples. ***LOBs covered during tutorials:*** 116. Perform numerical calculations related to the rate of chemical reactions. **Week 11** ***LOBs covered during lectures:*** 117. Describe the concepts of oxidation and reduction 118. Calculate oxidation numbers in chemical formulas 119. Identify the oxidizing and reducing agents in a redox reaction 120. Predict reaction reactivity on the basis of the Activity Series 121. Calculate molarity, molality and mole fraction for a solution 122. Explain vapour pressure lowering and perform calculations on this phenomenon 123. Explain boiling point elevation and freezing point depression and perform calculations using these phenomena 124. Explain osmotic pressure and perform calculations of this quantity 125. Discuss real-life applications of colligative properties ***LOBs covered during tutorials:*** 126. Explain the principles of chemical equilibria and use them to make predictions on various aspects of chemical reactions. **Week 12** ***LOBs covered during tutorials:*** 127. Carry out calculations of pH and equilibrium concentrations using the laws of chemical equilibria.		
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) • Atomic and Electronic Structure II (Quantum Mechanical Picture – Orbitals – Electronic Quantum Numbers – Electron Spin – Aufbau Principle) • Atomic and Electronic Structure III (Electronic Configurations – Pauli Exclusion Principle – Trends in Atomic Radius – Trends in Ionization Energy) • Ionic Bonding (Coulomb's Law – Octet Rule – Ionic Bonding – Crystal Lattice – Lattice Energy) • Trace Elements and Radioactive Isotopes in Medicine • 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) • Bonding Theories – Valence Bond Theory (Valence Bond Theory – Hybrid Atomic Orbitals – Sigma and Pi Bonds) • Bonding Theories – Molecular Orbital Theory (Molecular Orbitals – Diatomic Molecule MOs – Bond Order – MO Configurations – Magnetic Properties) • Nomenclature (Naming Ionic Compounds – Naming Covalent Molecules – Naming Acids) • 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 I (Atmosphere – Properties of Gases – Atmospheric Pressure – Enclosed Gases – Gas Laws – Ideal Gas Equation) • Ideal Gases II (Partial Pressure and Dalton's Law – Kinetic-Molecular Theory – Graham's Law – Diffusion of Gases – Real Gases and Van der Waal's Equation) • Thermochemistry I

	(Energy – First Law of Thermodynamics – Thermometer – Chemical Energy – Thermodynamic Systems – Internal Energy – State Functions and Path Functions) • Thermochemistry II (Expansion Work – Enthalpy – Thermodynamic Standard State – Physical Changes – Calorimetry – Heat Capacity) • Thermochemistry III (Hess's Law – Standard Heat of Formation – Bond Dissociation Energy – Entropy – Gibb's Free Energy) • Intermolecular Forces I (Gas, Liquids and Solids – Bond Polarity and Molecular Polarity – Ion-Dipole Forces – Dipole-Dipole Forces – London Dispersion Forces) • Intermolecular Forces II (London Dispersion Forces and Structure – Polarizability – Hydrogen Bonding – Intermolecular Forces and Boiling Points – Hydrogen Bonding and Life on Earth) • Environmental Contaminants and Human Health • 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 Kinetics III (Temperature and Reaction Rate – Collision Theory – Energy Diagrams – Activation Energy – Arrhenius Equation - Catalysis) • 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 – Percent Dissociation)

	• Acids and Bases IV (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) • Colligative Properties (Mole Fraction and Molality – Vapour-Pressure Lowering – Boiling Point Elevation – Freezing Point Depression – Osmotic Pressure – Applications of Colligative Properties) • Oxidation-Reduction Reaction Problems • Colligative Properties 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 • Thermochemistry • Identifying intermolecular forces and using them to predict physical p • Calculations on chemical kinetics • Calculations on chemical equilibria • Acid-base calculations
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	13th Global Edition	Pearson	2015	9781292057712

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
R.H. Petrucci, W.S. Harwood, and F.G. Herring	General Chemistry Principles and Modern Applications	10th Edition	Pearson	2011	9780132064521
J.E. McMurry and R.C. Fay	Chemistry	6th Edition	Pearson	2013	9781292025025

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