Government Science College, Vankal

Department of Microbiology

Short Term Course

Course Code: STCMB02 **Course Name:** Mathematics for Biologists **Duration:** 30 h

INTRODUCTION

Knowledge of basic mathematical calculations is required even for biologists. Knowledge of scientific notations, units and interconversions are frequently practiced in biology. Clarity of mole concept and ability to perform calculations based on mole concept, molarity and normality are helpful while working in microbiology labs and preparing buffers and media. Similarly calculations based on pH are very useful for preparing buffer solutions. OD based calculation of cell growth, DNA and proteins are very useful in calculating concentrations in lab samples. Finally skills for presenting data in graphical forms with errors are essential for students.

COURSE OBJECTIVES

- Understand and apply mathematical concepts essential for biological sciences.
- Perform calculations related to scientific notation, mole concepts, and solution concentrations.
- Apply mathematical techniques to biological data and laboratory results.

MODULES

Module 1: Scientific Notations and Units (5 hours)

- Introduction to scientific notation
- Converting between scientific notation and standard form
- Units of measurement (SI units, derived units)
- Practice problems

Module 2: Mole Concept and Stoichiometry (5 hours)

- Definition of a mole and Avogadro's number

- Molar mass and molecular weight calculations
- Stoichiometric calculations
- Practice problems

Module 3: Concentration Units (5 hours)

- Definitions and calculations for molarity (M), normality (N), and molality (m)
- ppm, ppb and percentage solutions
- Dilution calculations
- Practice problems

Module 4: pH and Buffer Calculations (5 hours)

- Definition and importance of pH in biological systems
- Calculating pH from hydrogen ion concentration
- Buffer solutions and Henderson-Hasselbalch equation
- Practice problems

Module5: Optical Density (OD) based calculations (5 hours)

- OD calculations in measuring cell density and growth
- OD based calculations of DNA and Protein concentration

Module6: Data Analysis and Interpretation (5 hours)

- Mean, median, standard deviation, and error analysis
- Graphical representation of data (charts, graphs)
- Practice problems

ASSESSMENT:

- **Weekly Quizzes:** Short quizzes at the end of each week to assess understanding.
- **Final Project:** A practical project involving the application of course concepts to a biological problem or dataset.

REFERENCES:

- **Textbook:** "Mathematics for the Life Sciences" by Erin N. Bodine, Suzanne Lenhart, and Louis J. Gross
- **Software:** Access to a spreadsheet program (e.g., Microsoft Excel) for data analysis

PREREQUISITES:

- Basic understanding of high school level biology and chemistry

ISSUE OF MARKSHEET AND CERTIFICATE

The college shall publish the result after evaluation and with the recommendations of course coordinator at the end of programme.

1. After successful completion of the course, no marks will be given to students only grades will be given as per follows

Percentage Range of Marks (Theory + Practical)	**Remarks**
90-100	O
80-90	A
60-80	B
40-60	C

COURSE COORDINATOR:

Dr. Anil Kumar Singh,
Assistant Professor, Microbiology Department,
GSC Vankal.

Government Science College, Vankal

Department of Chemistry

Short Term Course

Course Code: STCCHEM02 **Course Name:** Periodic Table and Periodic Properties **Duration:** 30 h

Periodic Table and Periodic Properties

Introduction

The periodic table is a fundamental tool in chemistry that organizes elements based on their properties and atomic structure. Understanding periodic properties is crucial for predicting element behavior and interactions. This course will explore the organization of the periodic table, periodic trends, and the implications of these properties in various chemical contexts.

Objectives

- Know Comprehend the organization and structure of the periodic table.
- Analyse periodic trends and their implications for element properties.
- Apply knowledge of periodic properties to predict chemical behaviour.
- Understand the historical development and future directions in periodic table research.

Course Modules

Module 1: Introduction to the Periodic Table

- Historical Background
- Development of the Periodic Table
- Modern Structure and Layout

Module 2: Atomic Structure and Electron Configuration

- Atomic Theory
- Electron Shells and Orbitals
- Relationship Between Electron Configuration and Periodic Properties

Module 3: Periodic Trends: Atomic Radius

- Definition and Measurement

- Trends Across Periods and Groups
- Factors Affecting Atomic Radius

Module 4: Periodic Trends: Ionization Energy
- Definition and Significance
- Trends in the Periodic Table
- Factors Influencing Ionization Energy

Module 5: Periodic Trends: Electron Affinity
- Concept and Measurement
- Trends Across Periods and Groups
- Applications in Chemical Bonding

Module 6: Periodic Trends: Electronegativity
- Definition and Scale
- Trends and Patterns
- Role in Chemical Bonding

Module 7: Group Trends and Properties
- Alkali Metals
- Alkaline Earth Metals
- Transition Metals and Inner Transition Metals

Module 8: Periodic Properties of Nonmetals and Metalloids
- Nonmetals: Characteristics and Trends
- Metalloids: Unique Properties
- Applications in Industry and Technology

Module 9: Periodic Trends in Chemical Reactivity
- Reactivity of Metals and Nonmetals
- Trends in Oxidation States
- Examples from Different Groups

Module 10: The Lanthanide and Actinide Series
- Characteristics and Trends

- Applications and Uses
- Challenges in Handling and Studying These Elements

Module 11: Modern Advances in Periodic Table Research
- Discoveries of New Elements
- Theoretical Models and Predictions
- Future Directions in Element Discovery

Module 12: The Periodic Table and Chemical Bonding
- Relationship Between Periodic Properties and Bonding Types
- Predicting Bond Types and Strengths
- Examples and Case Studies

Module 13: Practical Applications of Periodic Trends
- Periodic Trends in Material Science
- Industrial Applications
- Environmental and Health Implications

Module 14: Review and Application of Periodic Properties
- Summary of Key Concepts
- Application in Real-World Scenarios
- Case Studies and Problem-Solving Exercises

LEARNING OUTCOMES

Upon completion of the course, students will be able to:

- Understanding the Structure of the Periodic Table: Recognize the layout of the periodic table, including periods, groups, and the arrangement of elements based on atomic number and electron configuration
- Periodic Trends: Comprehend trends such as atomic radius, ionization energy, electron affinity, and electronegativity across periods and down groups.
- Element Classification: Identify and categorize elements as metals, nonmetals, and metalloids, and understand their typical properties and uses

- Group-Specific Properties: Understand the distinctive properties and reactivity of different groups such as alkali metals, alkaline earth metals, halogens, and noble gases
- Chemical Bonding and Reactivity: Explain how periodic properties affect the type and strength of chemical bonds, including ionic and covalent bonding

REFERENCES

1. The Periodic Table: A Very Short Introduction by Peter Atkins.
2. Inorganic Chemistry: Principles of Structure and Reactivity by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr.
3. Chemistry: The Central Science by Theodore L. Brown, H. Eugene LeMay, Bruce E. Bursten, and Catherine Murphy.
4. Descriptive Inorganic Chemistry by Geoff Rayner-Canham and Tina Overton.
5. Introduction to General, Organic and Biochemistry by Frederick A. Bettelheim, Joseph M. Landesberg, and William H. Brown.

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90-100	O
80-90	A
60-80	B
40-60	C
<40	F

COURSE COORDINATOR:

Dr. Dharmesh Mahajan,
HoD, Chemistry Department,
GSC Vankal.