

*This syllabus is provided as a general informational guide. Some of the information may vary depending on the specific course section and instructor. Different sections of the same course may require different textbooks. Verify the section specific textbook information in the CUNY's Academic Course Schedule Web Page. Modifications of the grading system presented here will be communicated by the instructors of the sections when they meet the class.*

**BOROUGH OF MANHATTAN COMMUNITY COLLEGE**

The City University of New York

Department of Science

**Title of Course** SCIENTIFIC INSTRUMENTATION **Class Hours** 2

**Course Code** SCI430 - 134 **Laboratory Hours per Week** 4

**Semester** \_\_\_\_\_

**Instructor Information:** Prof. Abel E. Navarro, Ph.D.

Office N699H, Phone 2122208000 x 7421, Email: [anavarro@bmcc.cuny.edu](mailto:anavarro@bmcc.cuny.edu)

Office Hours: Tuesday 12-1pm, 4-6pm and Thursday 5-6pm

**Credits** 4

**Course Description:** This course covers the theory and practice and quantitative method with special attention to instrumentation currently employed such as optical, electro-chemical and chromatographic techniques. The physicochemical theory and operating characteristics of the instrumentation are stressed. The laboratory emphasizes measurements of biological and environmental significance.

**Basic Skills** ACR 095; ENG 088 OR ESL 095; and MAT 056

**Prerequisites** BIO 220 or PHY 220 or PHY 225 or CHE 202

**Corequisites** NONE

<b>Course Student Learning Outcomes (Students will be able to...)</b>	<b>Measurements (means of assessment for student learning outcomes listed in first column)</b>
<b>1.</b> Students will solve and discuss analytical problem systematically, creatively, and reflexively, ready to assemble knowledge and formulate strategy.	<b>1.</b> Exam and Laboratory experiments. Oral presentations.
<b>2.</b> Students will select an appropriate method or methods to solve a chemical problem.	<b>2.</b> In-class worksheets, Exam and Laboratory experiments. In-class case studies.
<b>3.</b> Demonstrate the understanding of modern chemical instrumentation theory.	<b>3.</b> Exam and Laboratory experiments.
<b>4.</b> Students will graph and interpret experimental data to extract the maximum information from it.	<b>4.</b> Exam and Laboratory Experiments, Lab reports.

**Below are the college's general education learning outcomes, the outcomes that are checked in the left-hand column indicate goals that will be covered and assessed in this course. (Check at least one.)**

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	<b>General Education Learning Outcomes</b>	<b>Measurements (means of assessment for general education goals listed in first column)</b>
X	<b>Communication Skills-</b> Students will be able to write, read, listen and speak critically and effectively.	Students will analyze scientific papers on environmental pollution, short-answer questions in exam, oral presentations in topics related to the course.
X	<b>Quantitative Reasoning-</b> Students will be able to use quantitative skills and the concepts and methods of mathematics to solve problems.	Students will quantitatively compare the impact of environmental pollution in living organisms, energy consumption, and maximum allowable pollutant concentrations; by using graph analysis and calculations. Exams, homework, and quizzes.
X	<b>Scientific Reasoning-</b> Students will be able to apply the concepts and methods of the natural sciences.	Exam questions, homework assignment and case study on new approaches towards solving environmental contamination in our planet. Potential solutions and alternative technologies will be discussed in class. Exams, quizzes and homework.
<input type="checkbox"/>	<b>Social and Behavioral Sciences-</b> Students will be able to apply the concepts and methods of the social sciences.	
<input type="checkbox"/>	<b>Arts &amp; Humanities-</b> Students will be able to develop knowledge and understanding of the arts and literature through critiques of works of art, music, theatre or literature.	
<input type="checkbox"/>	<b>Information &amp; Technology Literacy-</b> Students will be able to collect, evaluate and interpret information and effectively use information technologies.	
<input type="checkbox"/>	<b>Values-</b> Students will be able to make informed choices based on an understanding of personal values, human diversity, multicultural awareness and social responsibility.	

**Required Text:** *Analytical Chemistry* by Gary Christian, Purnendu Dasgupta, Kevin Schug, John Wiley & Sons, Inc., 2014, 7<sup>th</sup> Edition. ISBN-978-0-470-88757-8. E-text: ISBN-978-1-118-80516-9

**Other Resources:** *Analytical Chemistry: A Guided Inquiry approach quantitative analysis collection* by Juliette Lants and Renee Cole, The POGIL Project, John Wiley & Sons, Inc., 2014. ISBN 978-1-118-89131-5

The students are encouraged to read the lecture slides before every class and analyze the case studies found at the end of the chapter until the main content of the chapter is mastered. The

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instructor will periodically post on Blackboard links and visual resources for a better understanding of the materials covered in class.

## Evaluation and Requirements of Students

The laboratory will be evaluated in preparation, laboratory technique and lab reports (laboratory notebook/journal). A student who is absent from more than two laboratory session seriously jeopardizes his/her grade for the course. Research Project Report will take place at the end of the semester. Blackboard site for the course has Practice Exams.

## Grading Policy

3 Exams	35%
Final Exam	25%
Research Project	10%
Lab Notebook	20%
Oral Presentation	10%

## OUTLINE OF CONTENTS

Date	Chapter	Lecture Topics
Jan 29		<b>Introduction and Review of Basic Chemical Calculations.</b> Limiting reagent, equilibrium constant, thermodynamics, graphing and plotting of experimental results. Instructions for laboratory notebook.
Feb 5	<b>13</b>	<b>Potentiometric Titrations. 13.7 – 13.17</b> Voltaic cells, reference electrodes, glass pH electrode, standardization buffers, using pH meter, applications.
Feb 19	<b>16</b>	<b>Spectrochemical Methods Part I. 16.1, 16.6, 16.7, 16.9.</b> Electromagnetic radiation, Solvent in spectrometry, Quantitative calculations, Beer's law, Types of instruments.
Feb 26	<b>16</b>	<b>Spectrochemical Methods Part II. 16.13, 16.14, 16.15, 16.16.</b> Spectrometric errors, Deviations from Beer's law, Fluorometry, Chemiluminescence.
<b>Mar 5</b>		<b>EXAM I (CHAPTERS Introduction, 13, 16). Deadline HW 1.</b>
Mar 12	<b>PowerPoint slides</b>	<b>Infrared Spectroscopy</b> IR radiation, Vibrational spectroscopy, Identification of organic compounds, Structure determination.
Mar 19	<b>PowerPoint slides</b>	<b>Nuclear Magnetic Resonance</b> Nuclear spin, NMR instrumentation, Solid state NMR,

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		Identification of hydrogen atoms in organic compounds. Structure determination.
Mar 26	<b>17</b>	<i>Atomic Spectrometric Methods. 17.1, 17.2, 17.3, 17.4, 17.6, 17.7.</i> Principles, Atomic Absorption, Atomic Emission and Atomic Fluorescence Spectrometry.
<b>Apr 2</b>		<b>EXAM II (CHAPTERS 16 and 17). Deadline HW 2.</b>
Apr 9	<b>19</b>	<i>Chromatography: Principles and Theory. 19.1 - 19.4.</i> Principles, Chromatographic techniques, column efficiency. Stationary and Mobile phases.
Apr 16	<b>20</b>	<i>Gas and Liquid Chromatography. 20.1-20.5, 20.10. 21.2, 21.2, 21.4, 21.8, 21.9.</i> GC Separations, columns, detectors, quantitative determinations, separation of chiral compounds.
Apr 30	<b>21</b>	<i>HPLC analysis, Thin layer chromatography, electrophoresis.</i>
May 7	<b>26</b>	<i>Environmental Sampling and Analysis</i> Air, water, soil and sediment sampling and analysis. Contaminated Land sites and EPA methods and analyses.
<b>May 14</b>		<b>EXAM III (CHAPTERS 19, 20 and 21). Deadline HW 3. Deadline for Research Project final report.</b>
<b>May 21</b>		<b>FINAL EXAM (All chapters)</b>

### Lab Schedule – SCI430-134

DATE	EXPERIMENTS FOR SCIENTIFIC INSTRUMENTATION
Jan 31	Safety Video. Introduction to plotting and use of software.
Feb 7	Determination of the pH of Hair Shampoos (EXP 14)
Feb 14	Spectrophotometric determination of iron. (EXP 23).
Feb 21	Spectrophotometric determination of inorganic phosphorus in serum. (EXP 27).
Feb 28	Ultraviolet Spectrophotometric Determination of Aspirin, Phenacetin, and Caffeine in APC Tablets Using Solvent Extraction. (EXP 30).
Mar 7	Spectrophotometric determination of lead on leaves using solvent extraction. (EXP 26).
Mar 14	Visit to Newtown Creek Wastewater Treatment Plant

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Mar 21	Elucidation of organic compounds by FTIR and NMR (HANDOUT)
Mar 28	Student Oral Presentations
Apr 4	Thin Layer Chromatography separation of amino acids. (EXP 36).
Apr 11	Research Project – Water quality analysis in BMCC and local buildings
Apr 18	Earth Day – Poster presentation in RHT (may be moved to Wednesday 17 <sup>th</sup> )
May 2	Research Project – Water Quality Analysis in Central Park (Manhattan)
May 9	Research Project – Water Quality Analysis in Prospect Park (Brooklyn)

### **Class Participation**

Participation in the academic activity of each course is a significant component of the learning process and plays a major role in determining overall student academic achievement. Academic activities may include, but are not limited to, attending class, submitting assignments, engaging in in-class or online activities, taking exams, and/or participating in group work. Each instructor has the right to establish their own class participation policy, and it is each student's responsibility to be familiar with and follow the participation policies for each course.

BMCC is committed to the health and well-being of all students. It is common for everyone to seek assistance at some point in their life, and there are free and confidential services on campus that can help.

**Single Stop** [www.bmcc.cuny.edu/singlestop](http://www.bmcc.cuny.edu/singlestop), room S230, 212-220-8195. If you are having problems with food or housing insecurity, finances, health insurance or anything else that might get in the way of your studies at BMCC, come by the Single Stop Office for advice and assistance. Assistance is also available through the Office of Student Affairs, S350, 212-220- 8130.

**Counseling Center** [www.bmcc.cuny.edu/counseling](http://www.bmcc.cuny.edu/counseling), room S343, 212-220-8140. Counselors assist students in addressing psychological and adjustment issues (i.e., depression, anxiety, and relationships) and can help with stress, time management and more. Counselors are available for walk-in visits.

**Office of Compliance and Diversity** [www.bmcc.cuny.edu/aac](http://www.bmcc.cuny.edu/aac), room S701, 212-220-1236. BMCC is committed to promoting a diverse and inclusive learning environment free of unlawful discrimination/harassment, including sexual harassment, where all students are treated fairly. For information about BMCC's policies and resources, or to request additional assistance in this area, please visit or call the office, or email [olevy@bmcc.cuny.edu](mailto:olevy@bmcc.cuny.edu), or [twade@bmcc.cuny.edu](mailto:twade@bmcc.cuny.edu). If you need immediate assistance, please contact BMCC Public safety at 212-220-8080.

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**Office of Accessibility** [www.bmcc.cuny.edu/accessibility](http://www.bmcc.cuny.edu/accessibility), room N360 (accessible entrance: 77 Harrison Street), 212-220-8180. This office collaborates with students who have documented disabilities, to coordinate support services, reasonable accommodations, and programs that enable equal access to education and college life. To request an accommodation due to a documented disability, please visit or call the office.

### **BMCC Policy on Plagiarism and Academic Integrity Statement**

Plagiarism is the presentation of someone else's ideas, words or artistic, scientific, or technical work as one's own creation. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations, require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism. Students who are unsure how and when to provide documentation are advised to consult with their instructors. The library has guides designed to help students to appropriately identify a cited work. The full policy can be found on BMCC's Web site, [www.bmcc.cuny.edu](http://www.bmcc.cuny.edu). For further information on integrity and behavior, please consult the college bulletin (also available online).