CHEM 281 – ANALYTICAL CHEMISTRY | 5 CREDITS (3+5P)

SYLLABUS

CATALOG DESCRIPTION

Fundamentals of instrumental chemical analysis. Topics include: statistical methods, digital control and data acquisition, gas/liquid chromatography, emission/absorption spectroscopy, capillary electrophoresis, volumetric, gravimetric, and electrochemical analysis. For chemistry and some pre-professional majors.

Prerequisites: CHEM 112

Semester Offered: Spring

Common Student Learning Outcomes

Upon successful completion of San Juan College programs and degrees, the student will demonstrate competency in…

BROAD AND SPECIALIZED LEARNING

Students will actively and independently acquire, apply, and adapt skills and knowledge with an awareness of global contexts.

CRITICAL THINKING

Students will think analytically and creatively to explore ideas, make connections, draw conclusions and solve problems.

CULTURAL AND CIVIC ENGAGEMENT

Students will act purposefully, reflectively, and ethically in diverse and complex environments.

EFFECTIVE COMMUNICATION

Students will exchange ideas and information with clarity in multiple contexts.

INFORMATION LITERACY

Students will be able to recognize when information is needed and have the ability to locate, evaluate, and use it effectively.

INTEGRATING TECHNOLOGIES

Students will demonstrate fluency in the application and use of technologies in multiple contexts.

Student work from this class may be randomly selected and used anonymously for assessment of course, program, and/or institutional learning outcomes. For more information, please refer to the Dean of the appropriate School.

Course Learning Outcomes

Upon successful completion of the course, the student will be able to…

1. Prepare solutions of desired molarity.
2. Interconvert between molarity, weight percent, parts per million, and parts per billion.
3. Perform equilibrium constant calculations, manipulations, and apply towards Le Chatelier's principle.
4. Use the buoyancy equation and correct for buoyancy.
5. Correctly use volumetric glassware such as burets, flasks, and pipets.
6. Calibrate volumetric glassware.
7. Describe and perform filtration, and drying procedures.
8. Describe and perform dissolution, fusion, digestion, and extraction sample prep procedures.

9. Use correct significant figures in calculations.
10. Describe and distinguish systematic and random errors.
11. Compute absolute and relative uncertainty.
12. Propagate errors in calculations.
13. Properly set up, annotate, and use spreadsheets.
14. Use spreadsheets for graphing.
15. Calculate mean, standard deviation, and relative standard deviation.
16. Compute and use the F test to determine if two sets of measurements are statistically different.
17. Use student's t to compute the confidence interval of replicate measurements.
18. Compare means with student's t test to determine if they are statistically different.
19. Set up a spread sheet for the t test.
20. Use Grubbs test for determining outliers.
21. Construct a calibration curve including error bars using a spread sheet.
22. Set up a spreadsheet to compute slope and intercept with errors using least squares analysis.
23. Outline quality assurance procedures and methods.
24. Perform analysis by standard addition.
25. Set up and use a spreadsheet for standard addition.
26. Perform analysis using internal standards.
27. Perform a back titration.
28. Perform a blank titration.
29. Perform a direct titration.
30. Perform a standardization.
31. Perform Volhard and Fajans argentometric titrations.
32. Perform gravimetric analysis.
33. Calculate pH and concentrations involved in acid base equilibria.
34. Prepare buffer solutions.
35. Use pH electrode and spreadsheet to find the endpoint numerically in an acid base titration.
36. Perform a Kjeldahl nitrogen analysis.
37. Compute ionic strength of solutions.
38. Compute activity coefficients.
39. Compute activities of species in solution.
40. Perform an EDTA titration.
41. Analyze and diagram an electrochemical cell.
42. Compute electrode and cell potentials.
43. Describe and use reference electrodes.
44. Describe how a AgCl electrode works.
45. Describe how a calomel electrode works.
46. Interconvert potentials between different reference electrodes.
47. Describe and use a silver indicator electrode.
48. Describe and use ion selective electrodes.
49. Describe and use pH electrodes.
50. Describe and use amperometry and voltammetry techniques.
51. Perform cyclic voltammetry in chemical analysis.
52. Describe and calculate properties and quantities involving light.
53. Use Beer's law.
54. Describe single and double beam spectrophotometers.
55. Describe photo-detection schemes including diode array and photo-multiplier-tubes.
56. Describe fluorescence and phosphorescence physical processes.
57. Describe absorbance and luminescence instrumentation.
58. Describe processes and components of an atomic absorption spectrophotometer.
59. Describe processes and components of an inductively coupled plasma spectrophotometer.
60. Perform analysis using an inductively coupled plasma spectrophotometer.

61. Describe gas/liquid chromatographic theory, equipment, and techniques.
62. Describe capillary electrophoresis theory, equipment, and techniques.
63. Calculate theoretical plates and resolution of columns.
64. Describe band dynamics.
65. Perform quantitative analysis using Gas Chromatography Mass Spectroscopy.