KAT 141/3 - Analytical Chemistry I

Course Objective: To provide students with the basic knowledge of concentration expression, basic statistics in analytical, chemical equilibrium, acid-base equilibrium and titration, complexometry equilibrium and titration, gravimetric analysis and precipitation titration, redox equilibrium and titration.

Topic	**Content**	**Number of lecture hours**	**Expected outcome – upon completion of this course, the student should be able to:**
1. Introduction	• What is analytical chemistry? • Classification of analytical methods • Steps in a quantitative analysis	1	• Know that analytical chemistry involves qualitative and quantitative analyses. • Know the steps in a quantitative analysis.
2. Concentration Expression	• % w/w, % w/v, ppt, ppm, ppb • Molarity, normality • 'Factor label method' for calculations	2	• Understand the concept of concentration. • Write the various expressions of concentration. • Convert from one unit of concentration to another.
3. Statistics	• Accuracy and precision • Systematic (determinate) and random errors • Significant figures • Rounding off error • Propagation of errors • Confidence interval, Confidence limits • *t* test, F test, Q test • Method of least squares	2	• Differentiate between accuracy and precision. • Understand what systematic and random errors are. • Apply statistical tests correctly to evaluate data - t, F, Q tests.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
4. Chemical Equlibria	• Chemical equilibria • Equilibrium constants • Le Chatelier's principle • Prediction of direction of reaction • Types of equilibria • Types of equilibrium constants	2	• Understand the concept of dynamic equilibria. • Understand that the equilibrium constant describes the relative concentrations of reactants and products. • Calculate the equilibrium constant.
5. Acid-Base Equilibria and Titrations	• Acid-base theories • Self-ionization constant, Kw • pH calculations of various solutions: strong acids and bases, weak acids and bases, salts of weak acids and bases, buffer solutions, polyprotic acids and their salts, polyfunctional bases and their salts, buffers of polyfunctional acids and bases • Titrations: strong acid and strong base, weak acid and strong base, weak base and strong acid, polyprotic acids and strong bases, polyfunctional bases and strong acids • Mixtures of acids • Indicators	9	• Know and understand the Bronsted-Lowry and Lewis theories for acids and bases. • Calculate the pH of various solutions. • Sketch titration curves for various kinds of acid-base titrations. • Understand how indicators for acid-base titrations work.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
6. Complexome-tric Titration	• Formation of complexes between ions and ligands • Complex formation constant • Acid ligand, ethylenediaminetetraacetic acid, EDTA • Effect of pH on EDTA equilibrium • Conditional formation constant • Fraction of species in polyligand complex, β values • Complexometric titration curves • Indicators	3	• Understand basic reactions involving complexometric titration. • Write expressions for complex formation constant between metals and ligands. • Sketch complexometric titration curve involving EDTA. • Understand how indicators for complexometric titration works.
7. Gravimetric Analysis	• Steps in gravimetric analysis • Calculations in gravimetric analysis.	3	• Understand steps in gravimetric analysis. • Do calculations involving gravimetric analysis using gravimetric factor.
8. Precipitation Titration	• Solubility product, Ksp • Molar solubility • Effect of co-ions on S • Effect of pH on S • Effect of complexing agents on S • Examples of precipitation titrations • Precipitation titration curve	3	• Understand basic reactions involving precipitation titration. • Write expressions for solubility products. • Construct precipitation titration curves. • Understand how indicators for precipitation titration work.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
9. Redox Equilibrium and Titration	• Electrochemical cell: galvanic cell and electrolytic cell • Cell notation • Half reactions • Standard electrode reduction potential • Nernst equation • Equilibrium constant for redox reactions • Redox titration • Redox titration curves • Indicators	5	• Distinguish between galvanic and electrolytic cells. • Write cell convention for electrochemical cells. • Understand the flow of ions and electrons in electrochemical cells. • Understand the standard reduction potentials. • Understand how redox titration curves are constructed. • Understand how indicators for redox titrations work.
	TOTAL	**30**	