KAT 341/3 - Pollution and Environmental Chemistry

Course Objective : To know the concepts of pollutions in air and water and various classes of pollutants.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of these experiments, the student should be able to:
1. The Key Concepts of Water Pollution	• Definition of water pollution and factors of water pollution • Concept of sustainable development • Classification and evaluation of factors of pollutants	1.5	• Understand the meaning and concept of pollution. • Understand the concept of sustainable development. • Understand all possible sources of water pollution as well as the characteristics of water pollutants.
2. Environmental Quality Act and Water Quality Standards	• Water Quality Criteria • Environmental Quality Act 1974 • Water Quality Standards • Water Quality Management	2	• Understand how water quality standards are developed and generated. • Know the Environmental Quality Act of Malaysia. • Compare the water quality criteria of Malaysia and other major nations.
3. Nutrients and Eutrophication	• Nutrients classification/definition • Phosphorus and Nitrogen cycles • Aquatic chemistry of phosphorous • Nutrients transport in aquatic environment • Eutrophication: its chemistry and impact on aquatic environment • Management of eutrophication problems • Analyses of P and N •	4	• Understand the meaning of nutrients and their effects on plants and animals. • Understand the nutrient cycles in water environment especially for P and N. • Write chemical formulas and properties of various types of phosphates. • Understand the transport process of phosphates into water environment. • Understand the aquatic chemistry of phosphates. • Know how eutrophication of aquatic environment occurs and how to control and manage this phenomenon.

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4. Heavy Metals	• Definition of heavy metals and metalloids/sources • Heavy metal toxicity • pE-pH diagram of heavy metals • Effect of ligand complexation of heavy metals • Biotic transformation • Management of heavy metal pollution • Analysis of heavy metals	6.5	• Comprehend the meaning of heavy metals and metalloids and their sources. • Understand why heavy metals are toxic and considered as serious water pollutants. • Draw pE-pH diagrams of metal ions. • Understand and interpret a given pE-pH diagram of metal ions system. • Understand the aquatic chemistry of heavy metals that includes the effect of pH, complexation and biological transformation.
5. Oxygen Demanding Substances	• Types of oxygen demanding substances and micro-organisms and utilization of oxygen • Carbonaceous oxygen demand and its effect on aquatic environment • Dissolved oxygen (DO), its balance in aquatic environment.and oxygen sag curve • Biochemical oxygen demand. (BOD) analysis and its application • Chemical oxygen demand (COD) analysis • Management of oxygen demanding substances	6.5	• Write the categories of pollutants that cause depletion of oxygen. • Understand how micro-organisms play a role in removing organic pollutants and consuming oxygen in the process. • Comprehend how organic pollutants are degraded by aerobic bacteria. • Comprehend the limit of solubility of oxygen by Henry's law. • Derive the Streeter-Phelps equation and apply it in modeling DO in water. • Understand the principles behind BOD and COD analyses. • Calculate the rate constant k from the BOD data. • List the various remediation and protective measures to be implemented to maintain DO level (at introductory level).

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6. Chemistry Of Air Pollution	• The basics of photochemistry in air pollution. • Chemistry of stratospheric ozone and the ozone layer depletion. • The chemistry of smog • The chemistry of acid rain	1 2.5 1 1	• Write photochemical reactions which show the generation of various types of reactive radicals by some specific air pollutants. • Understand the details of stratospheric ozone chemistry and the chemistry of ozone depletion. • Write the nomenclature of CFCs. • Know the definition of smog and the various factors that would initiate formation of smog. • Write the reactions involved in the formation of smog that also includes the role of NOx, hydrocarbon and peroxylacetylnitrate (PAN). • Comprehend the formation of acid rain via conversion of SO_2 and NO_x into its respective sulphuric and nitric acid. • The adverse impact of acid rain.
7. Meteorology Of Air Pollution	• Basics of meteorology • Vertical air movement ,adiabatic lapse rate, atmospheric stability and maximum mixing height • Types of plume	1 2.5 0.5	• Understand the meaning of air mass, air fronts, coriolis force, boundary layer, friction within boundary layer, wind profile and wind rose • Comprehend the concepts of air vertical movement and adiabatic lapse rate, the definition of air stability, and the relation between temperature profiles, lapse rate and atmospheric stability. • Know the effect of mixing height and inversion on air pollution. • Understand how looping, coning, fanning lofting, fumigation and trapping plumes are generated.

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8. Dispersion Of Air Pollutants	• Derivation of Gaussian dispersion equation	1	• Understand how Gaussian dispersion equation is derived. • Derive various specific equations from the general equation.
	• Pasquill-Gifford plots	0.5	• Use Pasquill-Gifford plots for the estimation of the vertical and horizontal dispersion coefficients for use in Gaussian dispersion equation.
	• Applications of dispersion models	1	• Use the Gaussian dispersion equation to model and predict the concentration of pollutant at various distances from its source in either x, y and z directions.
	• Line source	0.5	• Derive the line-source equation from the Gaussian dispersion equation and to apply it for modeling air pollutants generated by line sources such as automobiles on the highway.
	TOTAL	**33**	