



United Nations
Educational, Scientific and
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la science et la culture



AWSE
African Women
in Science and Engineering

CHEMISTRY & HIV and AIDS

Integrated Course
Module (Ghana)





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CHEMISTRY & HIV and AIDS

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Preamble

The pandemic of HIV and AIDS is a public health emergency of un-paralld magnitude and particularly so in resource strained countries, (especially those in sub Saharan Africa). Despite efforts to curb the spread of the pandemic, there are reports of increased prevalence rates and deaths due to HIV in the last 2 decades. It is estimated that the real impacts of the scourge will not be felt until 2050.

Universities have not been spared by the scourge. The disease has the potential to impair institutional functioning. The long lead time between initial HIV infection and development of AIDS has major implications for universities. The mandate of service to society demands the engagement of every university with HIV and AIDS.

Universities have a special responsibility for the development of human resources and are crucial agents of change and providers of leadership directions in society. Thus, they should be at the forefront in developing a deeper understanding of HIV and AIDS.

In an effort to prepare students to address HIV and AIDS at personal and professional levels, universities must be involved in a proactive and sustainable manner in mitigation of the pandemic through integration of HIV and AIDS in the teaching curriculum of every university faculty. This will ensure development of AIDS educated and AIDS competent graduates who will be adequately qualified to carry AIDS concerns into their subsequent lives, to address AIDS issues in their professions as managers, policy makers, leaders, politicians, community workers etc and to bring AIDS into the open within their societies.

This sample module has been developed from the existing modules in selected areas of chemistry. The content of the current teaching units remains the same but there is HIV and AIDS education and HIV related examples. Each teaching unit should be covered in 35 hours as before. The focus of the unit remains the same. It is anticipated that in the course of 35 contact hours the student will not only learn the basic tenets of chemistry as prescribed but will also be impacted with some HIV and AIDS knowledge that could influence, the perception, behavioral change, demystification and contribute in the fight against HIV and AIDS in the universities and communities at large.

This teaching module is an output of the In-Country Training Workshop on “Higher Education Science and Curricular Reforms: African Universities responding to HIV and AIDS at Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. The module contains input from participants from the 5 public universities in Ghana and is based on their curricula in the teaching of chemistry.

Acknowledgment

This integrated course module has benefited from the input of the participants from the following Institutions of Higher Education: Kwame Nkrumah University of Science and Technology, University of Ghana, University of Cape Coast, Kumasi Polytechnic, Garden City University College, University of Education in Winneba and the Christian Service University College.

The training workshop was facilitated by **Dr. Zipporah W. Ng'ang'a** from Kenyatta University, Kenya. Technical inputs were also received from Profs. Mabel Imbuga and Caroline Lang'at Thoruwa of African Women in Science and Engineering (AWSE).

Profound gratitude and further acknowledgement is expressed to UNAIDS who made the work possible through the UBW funds.

CH 103: INTRODUCTION TO CLASSICAL ANALYSIS AND SEPARATION TECHNIQUES

Course Description

Introduction to nature and scope of Analytical chemistry, Collection and treatment of analytical data, Types of errors and error analyses, Mean, Standard deviation, Variance, Student t-test, Confidence limits, Gravimetric and Titrimetric analysis.

Separation Techniques including non chromatographic techniques such as Liquid-liquid extractions, Distillation, Crystallization, Chromatographic Techniques such as planar and column chromatography which comprise of paper chromatography, Thin layer chromatography, ion exchange, Liquid-liquid and Gas-liquid chromatography. Gel electrophoresis.

Practical: Methodology of analytical chemistry with particular reference to Industrial and Environmental problems. Include practical in Gravimetric analyses, titrimetric analysis, non chromatographic and chromatographic analyses.

Details of topics in the module where HIV and AIDS education can be integrated.

Topic 1. Collection and treatment of analytical data

By the end of this topic, learners should be able to

- Understand the dynamics of HIV such as prevalence trends, incidence, mortality rates, protection and management

Collection of HIV AND AIDS related data:

Detailed disease description which include the following information; Clinical symptoms, host range including various age groups with emphasis of most vulnerable groups, etiology and etiological factors including routes and modes of transmission, incubation periods with emphasis of long latency stages of infection, Diagnostic methods- with emphasis of rapid diagnostic procedures, Treatments and prognoses with emphasis on role of

ARVS and nutrition in management of HIV and AIDS.

HIV and AIDS epidemiology with emphasis of different kind of data related to HIV and AIDS for example mortality data, prevalence data, incidence data, morbidity data, infection rates, Percentage responses to ARV treatments, Viral loads and CD4 profiles.

These are some of the sample data that can be used to teach the following analytical parameters: Types of errors, and error analyses, Mean, Standard deviation, Variance, Student t-test and Confidence limit.

Topic 2: Separation Techniques

By the end of this topic, learners should be able to:

- Understand the immune responses following HIV infection

Introduction to column chromatography

An example of separation of different immunoglobulin isotypes with reference to antibodies against HIV.

Topic 3: Gel Electrophoresis

By the end of this topic, learners should be able to:

- Understand HIV testing using gel electrophoresis in separation of viral proteins as used in HIV confirmatory tests
- Understand the importance of HIV testing in mitigation of the transmission of HIV

Protein separation in polyacrylamide gel, Emphasis of HIV proteins, Use of acrylamide gel in separation of HIV proteins according to molecular size in SDS PAGE. Different types of SDS PAGE. Use of separated HIV protein either for HIV diagnoses as in Western blotting or as potential candidates of vaccine. Emphasis should be on current rapid HIV diagnostic tests which are based on separated proteins in blotting paper.

An example of fractionation of HIV into different components based on the molecular sizes for the purposed diagnoses or identification of different components of the virus using Polyacrylamide gel electrophoresis should be emphasized.

CH 201: ATOMIC STRUCTURE AND CHEMICAL BONDING

Course Description:

Particles and waves, waves and the wave equation. Energy levels, electron configuration and the periodic table. Ionic, covalent, hydrogen and metallic bonds.

Selected topics for HIV integration in this unit:

Topic 1: Ionic, covalent, Hydrogen and metallic bonds-

By the end of this topic, learners should be able to:

- Understand the immune responses following HIV infection

Example of various forces bonds involved in antigen antibody interaction with respect to HIV derived antigen and antibodies. Emphasis should be made on various diagnostic techniques involving antigen and antibody reaction which are governed by various forces and bonds as taught in chemistry.

Topic 2: Valence bond theory

Antigen and antibody interactions. The valency of different antibodies. Binding properties of antibodies in relation to their valency.

Example of antibodies in course of HIV and AIDS with respect to their valence and

Titer.

CH 202: THEORY OF SPECTROSCOPIC METHODS

Course Description:

Electromagnetic spectrum. Relationship between energy, frequency and wavelength. Absorption and emission of electromagnetic radiation: electric

dipole and magnetic dipole transition moments. Fluorescence and phosphorescence.

Selected topics for HIV integration:

Topic 1: Relation ship between energy frequency and wavelength

By the end of this topic, learners should be:

- Understand the importance of HIV testing using Enzyme Linked Immunosorbent Assay (ELISA).

Use of different wavelength for determination of absorbance as measure of antibodies with reference to HIV antibodies. Introduction to HIV infection and host response by antibody formation as host protective mechanism. Application of ELISA using different wavelengths to measure antibody responses for the purposes of HIV testing.

Topic 2: Fluorescence and phosphorescence-

By the end of this topic. learners should be able to:

- Understand the importance of immune status monitoring in HIV infection
- Understand HIV pathogenesis

Emphasis should be made on role of fluorescence technique in CD4 counts as measure of HIV and AIDS progression. Introduction of HIV infection with emphasis of preference of HIV to CD4 cell.

Detection of HIV particle in various tissues using fluorescent microscopy for purposes of determination of HIV pathogenesis- Emphasis of the virus movement following introduction using the various routes- cut skin, mucosal, blood vessel etc....

Seminar: Positive living with HIV. The role of immune status monitoring.

- * Take Away Assignment.

CH 301: CHEMICAL KINETICS

Course Description

Reaction kinetics. Methods of determining rates and orders of chemical reactions. Reaction mechanisms. Dependence of reaction rates on temperature. Parallel, consecutive and reversible reactions. Mechanisms of enzyme catalyzed reactions. Theories of reaction rates.

Selected topics for HIV integration:

Topic 1: Chemical reactions and dependence on temperature

By the end of this topic, learners should be able to:

- Understand HIV disease progression by detection of antibodies against HIV using chemical reactions.

HIV and AIDS related antigen and antibody reactions should make a good example in this area. Emphasis of antibody based diagnostic procedure for HIV should be taught, optimization of the various diagnostic techniques by varying the temperature. Example of radio immunodiffusion, complement fixation tests in HIV diagnosis and the role of temperature in denaturation of complement proteins should be used.

The process of HIV infection with concomitant antibody formation can be taught at this level.

Topic 2: Enzyme substrate reactions

By the end of this topic, learners should be able to:

- Understand HIV testing

Enzyme linked immunosorbent assay (ELISA) should be demonstrated as applicable for preliminary antibody detection in HIV testing. Competitive and non competitive ELISA as used in HIV testing. The principle of enzyme substrate reactions in the Complement Fixation Test as used in confirmatory HIV testing. HIV testing and possible test results the benefits of testing, barriers that hinder testing should be emphasized.

- * Take-Away Assignments
- * Seminars and Workshops

CH 401: INSTRUMENTAL METHODS

Course Description

Spectrometric methods: ultra violet, visible- absorption and emission processes, infrared, nuclear, magnetic resonance, flame photometry and electrothermal atomic absorption. Fluorimetry. Immunoassay techniques and radioisotopes in analytical chemistry. Thermal analytical techniques. Chromatographic techniques.

Selected topics in the module for HIV integration:

Topic 1: Fluorimetry

By the end of this topic, learners should be able to:

- Understand immunosuppression
- Disease progression in HIV

Use of fluorimetry in determining CD4 counts in serum (FACS)

Role of CD4 cells in defence and consequences of T cell destruction can be emphasized here. Use of fluorochrome labelling techniques in monitoring HIV disease

Role Fluorescence conjugated antibody for monitoring CD4 counts. Response to chemotherapy by measuring CD4 counts by using FACS, use of Immunofluorescence assay (IFA) as confirmatory tests for HIV diagnosis.

Topic 2: Immunoassay techniques and radioisotopes in analytical chemistry

By the end of this topic, learners should be able to:

- Understand the immunology of HIV infection
- Management of HIV using Anti Retro Virals (ARV's)

Emphasis on etiology, pathogenesis, involvement of cellular and humoral arms of the immune system. Measurement of cellular responses due to HIV using radioisotopes, ie lymphocyte proliferation assays, chromium release assay. Measurement of humoral responses using immunoassay techniques like ELISA, radioimmunoassay (RIA). Use of radioisotopes in determining effects of ARV's.

- * Take Away Assignments
- * Seminars

Course Evaluation

- * A teaching unit is equivalent to 35 lecture hours.
- * All courses are examined at the end of the semester in which they are taken.
- * Examination consists of Continuous Assessment Tests which shall contribute 40 % and University examinations which shall contribute 60%.
- * The pass mark is 40%.
- * Only a student that is registered with the faculty / department shall be allowed to do examinations.
- * Failure to do a CAT shall lead to fail in the unit.
- * Each student must attend at least 2/3 of the lectures for a unit in a semester, to be allowed to sit for the examination.

List of Participants

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- 1 Prof. Sam Yeboah
- 2 Dr. Alfred Owusu
- 3 Mr. David K. Essumang
- 4 Dr. B.A. Mensah
- 5 Rev. Prof. D.K. Dodoo
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University of education Winneba

- 8 Mrs. Josephine Osei-Agyekum

University of Ghana

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- 10 Dr. June de Graft Hanson
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- 12 Mr. George A. Annor

Garden City University College

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Kumasi Polytechnic

- 14 Mrs. Beatrice Ennison

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- 16 Rev. E. Atami

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- 18 Mr. Eric K.T. Addison
- 19 Prof. Aba Bentil Andam
- 20 Mrs. Nana Yaa Koomson

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- 32 Mr. David K. Takyi
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