MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE & APPLIED SCIENCES

DEPARTMENT OF PHYSICAL & BIOLOGICAL SCIENCES

UNIVERSITY ORDINARY EXAMINATION

2018/2019 ACADEMIC YEAR

SECOND YEAR **FIRST** SEMESTER EXAMINATION FOR BSC IN ELECTRICAL AND ELECTRONICS ENGINEERING

ACH 104 – LABORATORY SAFETY METHODS

DURATION: 2 HOURS

DATE: APRIL 18 2019

TIME: 9.00 – 11.00 AM

Instructions to candidates:

1. Answer question One and Any Other Two questions
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

(a) Define the following terms:

(i) Laboratory safety

(ii) Laboratory security

(iii) Acute exposure (3marks)

(b) Identify a person or an entity that has responsibility for lab safety and state the responsibility. (2marks)

(c) Name one example of personal protection equipment (PPE) and one example of engineering control in lab safety. (1mark)

(d) Environmental Health & Safety EHS office is staffed with individuals who have a collective expertise in a variety of fields. State any two of such fields. (1mark)

(e) How different is an academic lab from an industrial lab in terms of resources and training? (2marks)

(f) List any three concerns of Good Laboratory Practice (GLP). (3marks)

(g) Why is a lab safety manual considered important for new teachers in an academic lab? (1mark)

(h) Explain why scaling down a reaction from gram scale to milligram scale to reduce the degree of pollution may not be wholly beneficial for an academic lab? (1mark)

(i) Scientists with disabilities SWDs welfare has been neglected in Kenya. Propose any strategy that can enhance the work and accessibility of SWDs in the lab. (1mark)

(j) State any two sources of information that helps determine EHS risks. (2mark)

(k) (i) State any factor that affects application of EHS management practices. (1mark)

(ii) When introducing new controls, resistance is expected. How can this be mitigated. (1mark)

(iii) Lab committees play a special role in EHs management in a lab. Explain. (1mark)

(iv) Your research supervisor has instructed you to use a new method in synthesizing a drug using phosgene a toxic and irritant, and radon a radioactive noble gas. State any two standard practices that will guide you through the expected management of change. (2marks)

(l) State a general safety rules that achieve the following goals of protecting lab users from external persons with evil motives. (1mark)

(m) If you must work alone in the lab some considerations must be made. State any two. (2marks)

(n) Using appropriate examples differentiate between acute and chronic health effects of chemical hazards. (2marks)

(o) Explain why there is a need for a 2 inch head space for bottles containing liquid waste. (1mark)

(p) Explain why water soluble wastes must be converted to insoluble solid wastes i.e. silicates before disposal into the landfills. (1mark)

(q) A camera may be used to collect data during a lab inspection. Why is it better than a typed report? (1mark)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

(a) There is need to encourage a culture of safety in a lab. Discuss any three strategies you can employ to achieve this. (3marks)

(b) Discuss two ways in which changes in legal and regulatory requirements have affected safety programs and operations in academic labs. (2marks)

(c) List any three questions one should ask and answer before preparing a purchase order of a chemical. (3marks)

(d) A chemical hygiene plan (CHP), sets forth four things that are capable of protecting lab employees and users from health hazards presented by chemicals at the workplace. List any three of these. (3marks)

(e) Differentiate between hazardous chemicals acute exposure and acute health effect. (2marks)

(f) After receiving a 5 litre 2% v/v hydrogen peroxide from Sigma Aldrich Ltd on March 2, 2018 a technician from Prof. Kelly Chibale's research group decided to transfer this chemical into smaller storage bottles of 500ml capacity, prepare a sample of the label the technician would put on the transfer containers noting that H_2O_2 is a strong oxidizer. (3marks)

(g) Cyanides are highly toxic and need special storage. Discuss any two safety considerations that must be met when dealing with the storage of potassium cyanide (2marks)

(h) Using appropriate examples explain how MSDS and PPEs can be used together to enhance lab safety. (2marks)

QUESTION THREE (20 MARKS)

(a) What is an inventory? (1mark)

(b) State any benefit of having an updated chemical inventory. (1mark)

(c) Prepare a chemical inventory for the following list of chemicals ensuring ease of trace and compatibility in storage areas given that only three storage areas are available i.e. a corrosion proof cabinet (CPC), a fireproof cupboard (FPC) and a wall shelf (WS).The inventory must have at least 6 data entry fields including the hazard classification where necessary. (6 marks)

(i) 5 liters of conc HNO_3 belonging to 1st year group, supplied by Sigma Aldrich bought on 11th Jan 2019.

(ii) Sodium carbonate belonging to Biochemistry research group, supplied by Imperial Chemicals Ltd, bought on June 1st 2018, weighing 500g.

(iii) A 200mm Mg ribbon belonging to Year2 chemistry group bought on 16/03/2017 from Excel Chemicals Ltd.

(iv) Ether in a 2.5 litre jerry-can bought for Dr Cruze on 30th May 2017 from Maxwel & Lint Ltd.

(d) Improper use of a fire blanket can be disastrous. Explain. (2marks)

(e) When a fire alarm is sounded in a lab one is expected to act for his safety and that of colleagues. State any three of such acts. (3marks)

(f) Briefly discuss the ***7 steps*** that a trained lab personnel should carry out to assess the risks of handling toxic chemicals. (7marks)

QUESTION FOUR (20 MARKS)

(a) Study the University of California Santa Barbara (UCSB) process SOP for Extractions, Distillations and Still quenching (see the appendices), then answer the following questions:

(i) What types of solvents are common to the processes covered in the SOP? (1mark)

(ii) Identify any PPE recommended for the process. (1mark)

(iii) Identify any safety engineering control for the process. (1mark)

(iv) State any two new technologies that have been incorporated into the distillation and still quenching. (2marks)

(v) Earlier accidents may be used in the SOP (see subsection on cooling water for refluxing distillation), quote the accident used/cited in this SOP and explain its importance. (2marks)

(vi) Under the quenching steps, identify a procedure that ensures safety of a person working next to you in the lab. (1mark)

(vii) Identify any online reference material cited in this SOP. (1mark)

(viii) List any non-online reference material cited in this SOP. (1mark)

(b) Handling of a chemical spill depends on volatility, toxity and flammability. Explain how handling of a spill of 5L NaOH differs from that of 5L ether. (3marks)

(c) Pictures/grahpics placed near lab entrances can be used as a permanent reminder for lab workers to observe basic lab rules to ensure personal safety. Explain this with three relevant pictures/sketches. (4marks)

(d) Using the chemical hazard chart used by National Fire Protection Association (***appendix***), list Four characteristics of the chemical with the label represented on the right hand side. (3marks)

QUESTION FIVE (20 MARKS)

(a) A lab inspection list should include the following aspects:

(i) Chemical storage
(ii) Chemical wastes
(iii) Housekeeping
(iv) PPEs
(v) Lab chemical hoods
(vi) Sign & labels
(vii) Gas cylinder storage
(viii) Facility issues

Prepare an inspection checklist for the MUT Lab covering any 6 of these aspects. (6marks)

(b) (i) Draw the fire triangle (1mark)

(ii) Differentiate between flashpoint and ignition temperature. (2marks)

(c) Draw the structure of the functional group responsible for flammability of acetyl compounds. (1mark)

(d) State any ergonomic hazard in the MUT Lab. (1mark)

(e) State any advantage of using an oil bath over a water bath. (2marks)

(f) A hydrogen gas cylinder is connected to a hydrogenator for high pressure hydrogenation experiments

(i) State any two precautions one should observe before using a hydro generator. (2marks)

(ii) If the tube connecting the hydrogenator to the reactor ruptures, state one safety measure (1mark)

(g) State two reasons why MS EXCEL is a preferred software for chemical inventory? (2marks)

(h) Explain how scanners and bar coding technologies can be used to track consumption and usage of a chemical in the lab. (2marks)