KISII UNIVERSITY
UNIVERSITY EXAMINATIONS

FIRST YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY IN ANALYTICAL CHEMISTRY
SECOND SEMESTER 2022/2023
[MAY, 2023]

DPAP 900: ADVANCED EXPERIMENTAL AND RESEARCH TECHNIQUES

STREAM: Y1 S2 **TIME: 3 HOURS**

DAY: TUESDAY, 9:00 – 12:00 P.M. **DATE: 02/05/2023**

INSTRUCTIONS
1. ***Do not write anything on this question paper.***
2. ***Answer Questions ONE (compulsory) and any TWO from section B.***

SECTION - A
Answer Questions 1 (compulsory) and any two from section B

QUESTION ONE

a. Give a brief notes on advances that have been made on;

i. Raman imaging, ***2marks***

ii. Gas chromatography, ***2 marks***

iii. Nuclear magnetic resonance ***2 marks***

iv. Paper based analytics ***2 marks***

b. Discuss the new LC-MS fragmentation methods that have been developed? ***6 marks***

c. Write explanatory note on advances in single cell assays. ***8 marks***

d. Separation technologies have seen substantial improvements in analytical realm. Focusing on Liquid chromatography, discuss in detail the major advances that have been made by various scientists. ***8 marks***

SECTION B
Answer any TWO Questions

QUESTION TWO

a. Write brief notes on magic-angle spinning approach as fronted by Christopher Jaroneic Professor of Chemistry and Biochemistry at Ohio State University.
5 marks

b. What are the structural constraints associated with the use of paramagnetic Tags? ***5 marks***

c. In the analysis of biological samples, as an analytical chemist, you are aware that a number of analytical techniques are destructive to the sample that may require lysing or staining. Basing your discussion on this limitation, give a detailed discussion on how vibrational spectroscopy techniques like Raman and Infrared spectroscopy are advanced and bet suited for the analysis of such samples. ***10 marks***

QUESTION THREE

a. Mass spectrometry has emerged to become one of the most versatile tools in the analytical chemistry toolbox. Briefly discuss its applications.
4 marks.
b. Discuss in details the three forms through which mass spectrometry can be used to determine attributes of protein drugs. ***4 marks***
c. Describe the operating principles of electron transfer dissociation (ETD)
4 marks
d. Highlight the applications of GC-MS ***3 marks***
e. Imaging at atmospheric pressure is an ongoing development in the mass spectrometry sphere. Describe what this technology can allow researchers to do. ***2 marks***
f. What popular mass spectrometry imaging methods employing microprobe based approaches are majorly reported in literature? ***2 marks***

QUESTION FOUR

a. Describe the operating principles of surface-induced dissociation (SID)
3 marks
b. What are the applications of surface-induced dissociation (SID)
4 marks
c. A recent analytic advance involves the fusion of inductively coupled plasma (ICP) mass spectrometry with the single- cell analysis (flow cytometry) to produce mass cytometry. Explain the differences.
3 marks
d. What are the advantages of miniaturization? ***3 marks***
e. Highlight examples of analytical instrumental miniaturization as practiced by researchers and technology firms. ***7 marks***