FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF PHYSICAL SCIENCES
DEPARTMENT OF GEOLOGY

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BTech GEOLOGY
2017/2018 SESSION

COURSE CODE: GEL 511 **UNIT:** 3

COURSE TITLE: ADVANCED IGNEOUS AND METAMORPHIC PETROLOGY

INSTRUCTIONS: ANSWER QUESTION 1 AND ANY OTHER QUESTION IN SECTION 'A' AND ANSWER ANY TWO QUESTIONS IN SECTION 'B'

TIME ALLOWED: 2 HOURS 30 MIN. **DATE:** 8th May, 2018

SECTION A – IGNEOUS PETROLOGY

1. Table 1contains the major oxides composition obtained from chemical analysis of three crystalline igneous rock samples.

a. Compute the sum of total alkalis for each rock sample.

b. Plot the values of SiO_2 against the sum of total alkalis on figures 1and 2 provided and use it to identify the rock samples (Detach the two figures and attach them to your answer booklet after plotting).

c. What do you think will be the value of partition coefficient of the rock identified in figure 2?
d. Briefly discuss the mineralogy and economic potential of this rock.

2. A peridotite collected from 35 meters below the surface of the earth was found to contain more than 60 wt. % SiO_2.
a. What do you think must have resulted in this value determined for the peridotite?
b. Explain in detail the answer given in 2 (a).
c. List and discuss two evidences in support of your answer in 2 (a).
d. What do you think should have been the actual value of SiO_2 for this rock?

3a. List the three basic compositional properties of an igneous rock.

b. Discuss in detail any one of the compositional properties listed in 3(a).

SECTION B – METAMORPHIC PETROLOGY

Q4. (a) Enumerate the six criteria commonly used for the classification of metamorphic rocks.

(b) In a tabular form, give three examples each of strongly foliated, weakly foliated and non-foliated metamorphic rocks.

(c) (i) Explain why eclogite has a higher density than its basaltic protolith.

(ii) List the three thermal regimes of and the terrains in which eclogites occur.

(iii) Write short notes on high-strain metamorphic rocks.

Q5. (a) (i) Give a mathematical form of the Gibb's phase rule and define all the terms.

(ii) State the Goldschmidt mineralogical rule.

(b) The data in Table 1 is the chemical composition of a typical metamorphic rock, along with the formula weight of each of the oxides.

(i) Compute the three components of an ACF diagram (**all steps must be shown)**

(ii) Using your answer from (bi) above, plot the data in a ternary diagram

Q6. (a) Outline four types of metamorphic reactions that result in more stable mineral assemblages.

(b) (i) Explain why pure calcite does not naturally decompose into lime and carbon dioxide under thermal metamorphic conditions.

(ii) Write an equation to illustrate thermal metamorphism of a sandy limestone, naming all the minerals involved.

(c) (i) Most devolatilizationmetamorphic reactions are endothermic. Explain.

(ii) Write one mineral paragenesis equation each, involving release of water and carbon dioxide.

Table 1: Concentration of major oxides of crystalline igneous rock samples.

Sample No.	1	2	3
Major Oxide (wt. %)			
SiO_2	58.70	62.31	73.95
TiO_2	0.88	0.71	0.28
Al_2O_3	17.24	17.27	13.48
Fe_2O_3	7.40	5.37	2.63
MnO	0.14	0.15	0.06
MgO	3.37	0.94	0.40
CaO	6.88	2.38	1.16
Na_2O	3.53	5.57	3.61
K_2O	1.64	5.07	4.37
P_2O_5	0.21	0.21	0.07
Total	**100**	**100**	**100**

Table 2: Composition of a metamorphic rock.

Element	Weight %	Formula Weight
SiO_2	54.06	60.08
Al_2O_3	13.64	102.0
Fe_2O_3	3.28	159.7
FeO	8.88	71.85
MgO	3.48	40.30
CaO	6.95	56.08
Na_2O	3.27	62.00
K_2O	1.69	94.20
TiO_2	2.24	79.87
P_2O_5	0.36	141.9
MnO	0.18	70.94

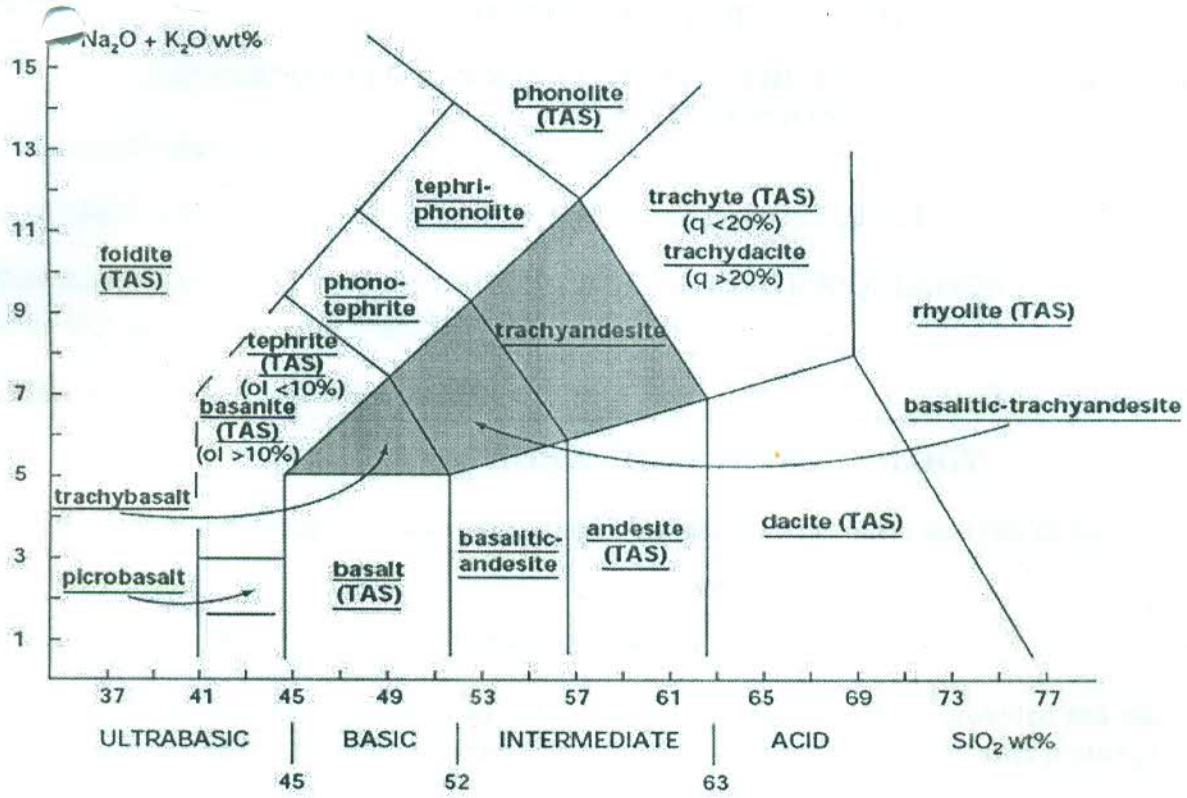

Figure 1. Chemical classification of crystalline igneous rocks using total alkali silica (TAS) diagrams (after Le Bas et al., 1986).

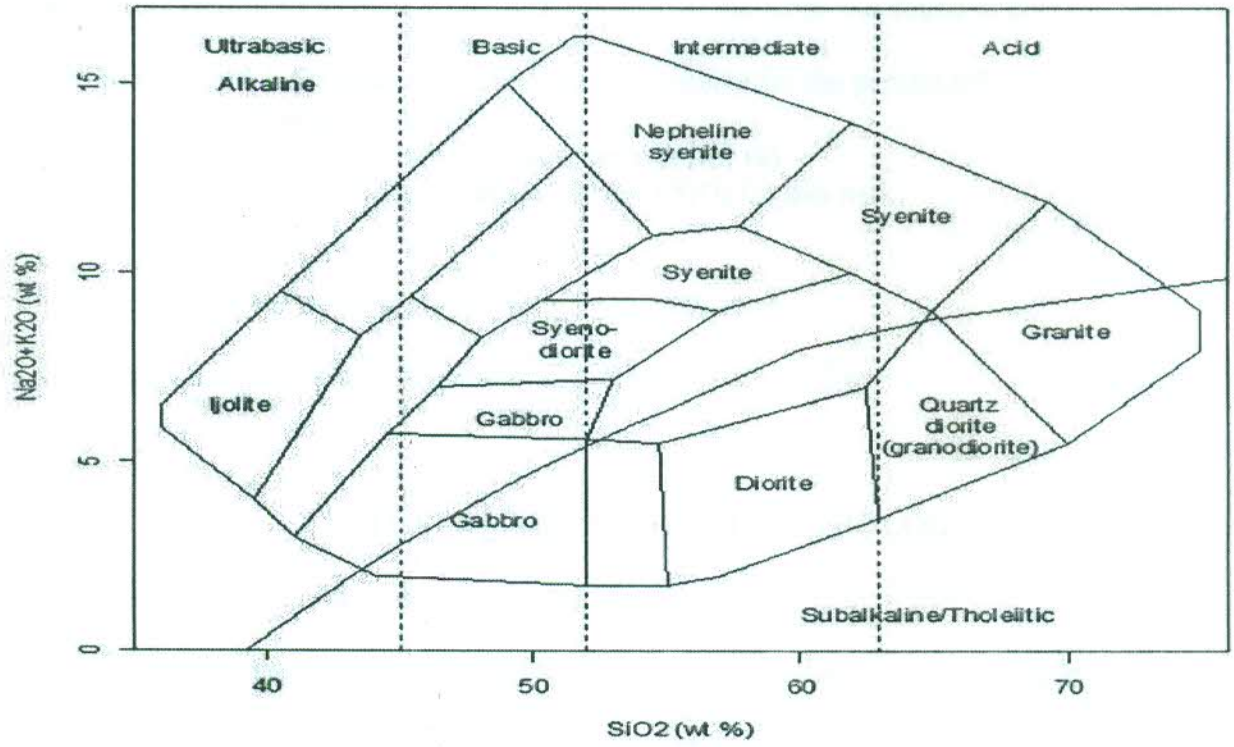

Figure 2. Classification diagram of crystalline igneous rock proposed by Cox et al. (1979).