Course Code: *CIT 413*
Credit Unit: *2*

Course Title: *Data Compression*
Time Allowed: *2hours.*

**Instruction: Answer only three (3) questions**

## Question 1

(a) You are employed as Data Analyst for a firm that handles space exploration projects. The firm receives large amount of image and sound data from its satellites and needs to store the data. Every detail is important in the data transmitted from the satellites for analysis by ground station scientists. Justify the use of either lossy or lossless data compression technique by the firm. (5 marks)

(b) Draw order 3 context table for PAPAAPPLE. (10 marks)

(c) Explain the advantages of dynamic dictionary-based compression. (2 marks)

(d) What are the parameters that must be controlled in order to compress silence in speech? (3 marks)

## Question 2

(a) Many experts and researchers proffered different meanings to information theory since its inception. Describe three (3) of these meanings. (6 marks)

(b) Explain entropy in data compression. (2 marks)

(c) Use the table below to decompress 0.59375 with arithmetic coding technique. (8 marks)

| Symbol | Probability | Symbol Interval |
|--------|-------------|-----------------|
| a | 2 | [0.0 , 0.5) |
| b | 1 | [0.5 , 0.75) |
| c | 1 | [0.75 , 1.0) |

(d) Write a simple algorithm to encode symbols using arithmetic coding technique. (2 marks)

(e) Suppose the probability of symbol in input stream is $\frac{1}{128}$. What is the minimum number of bits that can be used to represent the symbol? (2 marks)

## Question 3

(a) Describe Shannon's entropy. (3 marks)

(b) Show that the maximal value of $H_b(p)$ is 1 bit and is taken on for $p = \frac{1}{2}$. (3 marks)

(c) Use LZ77 technique to decompress/decode the tokens below:

(0,0,p) (0,0,a) (2,2,_) (5,2,u) (0,0,l) (5,2,l) (0,0,e) (12,1,a) (0,0,s) (3,1,_) (17,2,y) (16,1,e) (9,2,y) (0,0,.).  You are required to show status of LZ77 after decompressing each token. (7 marks)

(d) Discuss in detail, the difference(s) between LZ77 and LZ78 data compression techniques. (4 marks)

(e) Why is statistical method not good for graphic compression? (3 marks)

## Question 4

(a) Why is data compression essential in Nigeria as a developing country? (5 marks)

(b) List six (6) common data compression programs. (3 marks)

(c) Generate a table for speech compression using nonlinear companding technique to convert input codes   0-7 (3 bits) to 0-127 (7 bits) output code.  Note that the first bit will indicate whether the input code is positive or negative. (8 marks)

(d) Write short note on the following: (4 marks)

   (i) Lossy compression

   (ii) Data compression benchmark

## Question 5

(a) Explain modeling in data compression with relevant example? (3 marks)

(b) Differentiate between static and dynamic modeling. (4 marks)

(c) Draw adaptive Huffman binary tree for "constitutions". (8 marks)

(d) Mention three (3) disadvantages of context modeling. (3 marks)

(e) State four (4) uses of data compression. (2 marks)

*Best of luck*