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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**

**FACULTY OF SCIENCE**

**OCTOBER/NOVEMBER 2016 EXAMINATION**

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| **COURSE CODE:** | **CIT754** |
| **COURSE TITLE:** | **DIGITAL COMMUNICATIONS** |
| **CREDIT UNITS:** | **3** |
| **TIME ALLOTED:** | **2 HOURS, 30 MINUTES** |
| **INSTRUCTION:** | ***Answer any FIVE questions. Cordless nonprogrammable calculators may be used.*** |

1.

a.) Write down the expression for a bandpass digitally modulated signal in terms of the information sequence (I1, I2, I3, … In-2, In-1, In).

b.) Briefly define what a lowpass (baseband) signal is.

c.) Sketch the spectrum of a real-valued lowpass signal. (14 marks)

2.

a.) Distinguish between **bloc**k and **convolutional** codes.

b.) Briefly define the **rate** of a code.

c.) Derive an expression for the **transmission rate** R in terms of the code rate Rc, the constellation size (M) and the symbol duration *Ts*. (14 marks)

3.

a.) Briefly explain what a **finite field** is.

b.) Define what an **Abelian group** is listing its four main properties.

c.) Distinguish between **Rayleigh** and **Ricean** fading channels. (14 marks)

4.

a.) Derive an expression for the rate of a **Hamming** code.

b.) Generate the **parity check matrix** H for a (7,4) Hamming code.

c.) Briefly describe the concept of **diversity techniques** for multipath fading channels.

(14 marks)

5.

a.) Using a suitable diagram, describe the graphical technique for determining the **error-correction capability** of an (n,k) code.

b.) Distinguish between a **perfect code** and a **quasi-perfect code**.

c.) Briefly describe the concept of a **RAKE** demodulator. (14 marks)

6.

a.) With the aid of a suitable diagram, describe the structure of a **convolutional** encoder.

b.) Derive the code that will be generated by the convolutional encoder shown in ***Fig. Q6b*** if the input sequence is u = (100111).

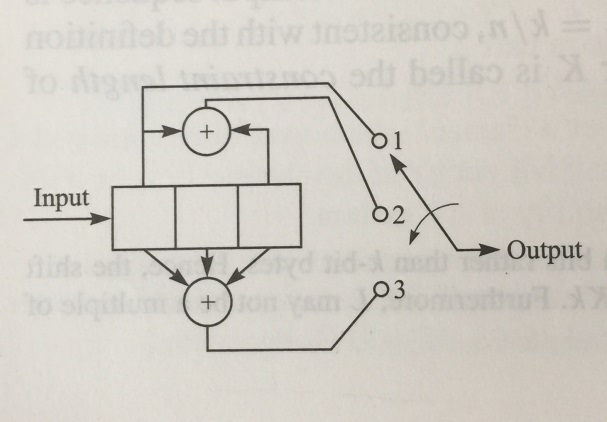
c.) Briefly explain what a **frequency-selective** channel is. (14 marks)

7.

a.) Briefly describe what a space-time block code (STBC) is.

b.) Write down the generated matrix for the **Alamouti code** and hence determine the value of the corresponding spatial code rate *R*.

c.) Briefly explain what a **slowly fading** channel is. (14 marks)



*Fig. Q6b: K=3, k = 1, n = 3*