UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY (BEngTech) : *ELECTRICAL*.
SUBJECT	:	**WAVE AND SIGNAL TECHNOLOGY 3A**
CODE	:	**WSTELA3**
DATE & TIME	:	**JULY, #TH (SUPPLEMENTARY-EXAM) - 2019**
DURATION	:	3 hours
WEIGHT	:	60: 100
TOTAL MARKS	:	72
FULL MARKS	:	**100%**

EXAMINER	:	Dr. KA Ogudo
MODERATOR	:	Dr. Patrice Umenne
NUMBER OF PAGES	:	3 PAGES

INSTRUCTIONS	:	ANSWER ALL QUESTIONS NEATLY. : ONE NON-PROGRAMMABLE CALCULATOR PER CANDIDATE.
REQUIREMENTS	:	AT MOST: TWO ANSWER SHEETS PER CANDIDATE.

QUESTION 1 **[12]**

Five telemetry signals, each of bandwidth 1 kHz, are to be transmitted simultaneously by binary PCM. The maximum tolerable error in sample amplitudes is 0.2% of the peak signal amplitude. The signals must be sampled at least 20% above the Nyquist rate. Framing and synchronizing requires an additional 0.5% extra bits. Determine the minimum possible data rate (bits per second) that must be transmitted, and the minimum bandwidth required to transmit this signal. (12)

QUESTION 2 **[10]**

(a) What is the length of a folded dipole made with a 300Ω twin lead for a frequency of 216MHz (2)
(b) Calculate the length of a one-quarter wavelength vertical antenna at 450MHz (2)
(c) Calculate the length of the coaxial loop used in a coaxial balun for a frequency of 227 MHz Assume a velocity factor of 0.8. (2)
(d) What is the path attenuation between transmitter and receiver at a frequency of 1.2 GHz and a distance of 11000 miles? (2)
(e) A cell phone antenna tower 240 ft high uses spatial diversity. What is the minimum desirable antenna separation? (2)

QUESTION 3 **[12]**

Define the following terms as related to analog to digital conversion of a signal

(a) Nyquist sampling theorem (4)
(b) Quantization (4)
(c) Bandwidth and Signal power (4)

QUESTION 4 **[10]**

A wire dipole antenna has length of 27 ft.
(a) What is its frequency of operation? (3)
(b) What is its approximate bandwidth, using a 4% bandwidth (BW) variation (3)
(c) The power applied to an antenna with a gain of 4 dB is 5 W. What is the ERP? (4)
[10]

QUESTION 5 **[12]**

Define and explain the following with the aid of a sketch diagram as related to signal modulations

a) PAM, PWM, PPM & PCM (12)

QUESTION 6 **[8]**

In a certain telemetry system, there are eight analog measurement, each of bandwidth 2 kHz. Samples of these signals are time-division multiplexed, quantized, and binary coded. The error in sample amplitude cannot be greater than 1% of the peak amplitude.

(a) Determine L, the number of quantization levels. (4)

(b) Find the transmission bandwidth B_T if Nyquist criterion pulse with roll-off factor r=0.2 are used. The sampling rate must be at least 25% above the Nyquist rate. (4)

QUESTION 7 **[8]**

(a) A random binary data sequence 100110 is transmitted using a Manchester (split-phase) line code with the pulse p(t) shown in figure 2 below. Sketch the waveform y(t) (4)

(b) Derive Sy(w), the PSD of Manchester (split-phase) signal in part (a) assuming 1 and 0 equally likely. Roughly sketch and find its bandwidth. (4)

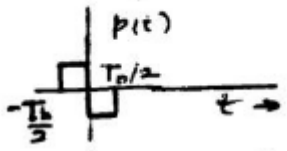

FIGURE 1

Total marks: 72
Full Marks: 100%