



**PROGRAM** : BACHELOR OF ENGINEERING TECHNOLOGY (BEngTech)  
: *ELECTRICAL*.

**SUBJECT** : **WAVE AND SIGNAL TECHNOLOGY 3A**

**CODE** : **WSTELA3**

**DATE & TIME** : **JUNE, 7TH 8:30am (MAIN EXAM) - 2019**

**DURATION** : 3 hours

**WEIGHT** : 60: 100

**TOTAL MARKS** : 70

**FULL MARKS** : **100%**

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**EXAMINER** : Dr. KA Ogudo

**MODERATOR** : Dr. Patrice Umenne

**NUMBER OF PAGES** : 3 PAGES

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**INSTRUCTIONS** : ANSWER ALL QUESTIONS NEATLY.  
: ONE NON-PROGRAMMABLE CALCULATOR PER  
CANDIDATE.

**REQUIREMENTS** : AT MOST: TWO ANSWER SHEETS PER CANDIDATE.

**QUESTION 1** **[8]**

With the aid of a sketch block diagram model a typical communication systems with the corresponding components of the communication systems (8)

**QUESTION 2** **[8]**

Determine the power and the root mean square (rms) value for each of the following signals

(a)  $10\cos\left(100t + \frac{\rho}{3}\right)$  (4)

(b)  $10\sin(5t)\cos(10t)$  (4)

**QUESTION 3** **[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 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 ( $B_w$ ) variation (3)

(c) The power applied to an antenna with a gain of 4 dB is 5 W. What is the ERP? (4)

**QUESTION 5** **[10]**

(a) What is the length of a folded dipole made with a  $300\Omega$  twin lead for a frequency of 216 MHz (2)

(b) Calculate the length of a one-quarter wavelength vertical antenna at 450 MHz (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 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)

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**QUESTION 7** **[14]**

Name and explain the three (3) basic paths that a radio signal can take through space (14)

**Total marks: 70**  
**Full Marks: 100%**