UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY (BEngTech) : *ELECTRICAL.*
SUBJECT	:	**WAVE AND SIGNAL TECHNOLOGY 2A**
CODE	:	**WSTELA2**
DATE & TIME	:	**JUNE 12th, 08:30am (MAIN EXAM)** -2018
DURATION	:	3 hours
WEIGHT	:	60: 100
TOTAL MARKS	:	60
FULL MARKS	:	**100%**

EXAMINER	:	Dr. KA Ogudo
MODERATOR	:	Dr. Mbuyu Sumbwanyambe
NUMBER OF PAGES	:	2 PAGES AND 1 APPENDIX

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

QUESTION 1 [6]

Define the following terminology as they relates to electronics communications

(a) Modulation (2)
(b) Intelligence signal (2)
(c) Demodulation (2)

QUESTION 2 [11]

Draw a large label diagram of a communication system block diagram and explain the function of each block. (11)

QUESTION 3 [12]

(a) A 500W carrier signal is to be modulated to a 90% level. Determine the total transmitted power: (3)
(b) An AM broadcast station operates at its maximum allowed total output of 50 kW and at 95% modulation. How much of its transmitted power is intelligence (sidebands) (3)
(c) A transmitter with a 10kW carrier transmits 11.2kW when modulated with a single sine wave. Calculate the modulation index (m). If the carrier is simultaneously modulated with another sine wave at 50% modulation, calculate the total transmitted power. (6)

QUESTION 4 [14]

An FM signal, $2000 \sin (2\pi \times 10^8 t + 2\sin \pi \times 10^4 t)$, is applied to a 50Ω antenna. Determine

(a) The carrier frequency. (2)
(b) The transmitted power (2)
(c) Frequency modulation index (m_f) (1)
(d) The intelligence signal (f_i) (1)
(e) BW (by two methods); Using the Carlson rule and by Bessel function (4)
(f) Power in the largest and smallest sidebands predicted by Bessel function Table. (4)

QUESTION 5 [9]

(a) With the aid of a block diagram, describe the STEREO FM transmitter systems (6)
(b) List 3 major categories were frequency modulation (FM) can be use? (3)

QUESTION 6 [8]

(a) With a sketch similar to the one discussed in UNIT 8, explain the basics of PAM, PWM, and PPM. Describe a means of generating and detecting PWM. (4)
(b) Draw a diagram to illustrate the demodulation of a PWM signal. (4)

Total marks: 60
Full marks: 100%

Appendix:

Table 2 FM Side Frequencies from Bessel Functions

	n OR ORDER																
× (Carrier) (m_f)	J_0	J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}	J_{11}	J_{12}	J_{13}	J_{14}	J_{15}	J_{16}
0.00	1.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.5	0.94	0.24	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1.0	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—
1.5	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—	—	—	—	—	—	—
2.0	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—	—	—	—	—	—	—
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	—	—	—	—	—	—	—	—	—	—	—
3.0	−0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—	—	—	—	—	—	—
4.0	−0.40	−0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—	—	—	—	—	—	—
5.0	−0.18	−0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02	—	—	—	—	—	—	—	—
6.0	0.15	−0.28	−0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—	—	—	—	—	—	—
7.0	0.30	0.00	−0.30	−0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02	—	—	—	—	—	—
8.0	0.17	0.23	−0.11	−0.29	−0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03	—	—	—	—	—
9.0	−0.09	0.24	0.14	−0.18	−0.27	−0.06	0.20	0.33	0.30	0.21	0.12	0.06	0.03	0.01	—	—	—
10.0	−0.25	0.04	0.25	0.06	−0.22	−0.23	−0.01	0.22	0.31	0.29	0.20	0.12	0.06	0.03	0.01	—	—
12.0	0.05	−0.22	−0.08	0.20	0.18	−0.07	−0.24	−0.17	0.05	0.23	0.30	0.27	0.20	0.12	0.07	0.03	0.01
15.0	−0.01	0.21	0.04	−0.19	−0.12	0.13	0.21	0.03	−0.17	−0.22	−0.09	0.10	0.24	0.28	0.25	0.18	0.12

Source: E. Cambi, *Bessel Functions*, Dover Publications, Inc., New York, 1948.