PROGRAM	:	B TECH *ELECTRICAL ENGINEERING*
SUBJECT	:	**RADIO ENGINEERING IV**
CODE	:	**EER411**
DATE	:	SUPPLEMENTARY EXAMINATION JULY 2019
DURATION	:	3 HOURS
WEIGHT	:	40 : 60
FULL MARKS	:	100
TOTAL MARKS	:	100

EXAMINERS	:	PROF THOKOZANI C SHONGWE
MODERATOR	:	DR EBENEZER ESENOGHO
NUMBER OF PAGES	:	4 PAGES, INCLUDING 1 PAGE OF FORMULAS

INSTRUCTIONS	:	CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)
	:	USE ONLY THE ANSWER SHEET PROVIDED WITH THIS PAPER

INSTRUCTIONS TO CANDIDATES:

1. 100 MARKS = 100%

2. ATTEMPT ALL QUESTIONS.

3. THEORY TYPE QUESTIONS MUST BE ANSWERED IN POINT FORM BY CAREFULLY CONSIDERING THE MARK ALLOCATION.

4. QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF QUESTION MUST BE KEPT TOGETHER.

5. ALL DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY AND IN PROPORTION.

6. ALL DIAGRAMS AND SKETCHES MUST BE LABELLED CLEARLY.

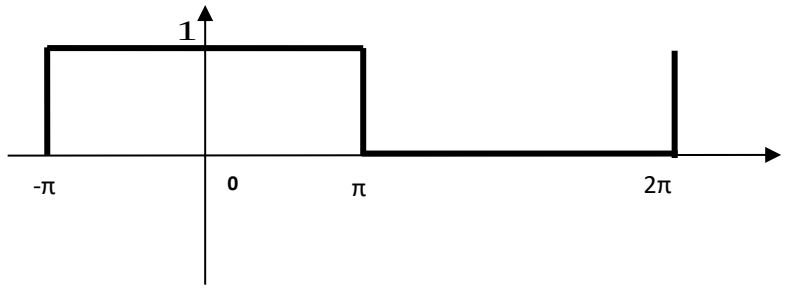
7. ALL WORK DONE IN PENCIL EXCEPT DIAGRAMS AND SKETCHES WILL BE CONSIDERED AS ROUGH WORK.

8. NOTE: MARKS WILL BE DEDUCTED FOR WORK WHICH IS POORLY PRESENTED.

9. NEGATIVE MARKING APPLIES IF YOUR ANSWER DOES NOT COMPLY WITH THE DETAIL REQUIRED AS REQUESTED IN CERTAIN QUESTIONS.

Question 1

Given the signal below,



calculate the:

(1) Fourier coefficients and hence give the Fourier series the signal.
(2) Exponential Fourier coefficients of the signal.

(30+20)

Question 2

(a) For a standard telephone circuit with a signal-to-noise power ratio of 1000 (30 dB) and a bandwidth of 2.7 kHz, determine the maximum information capacity, in bits/s of the channel.

(b) A communications channel can transmit up to 2 Mbps of data, given a bandwidth of 1 MHz, determine the signal-to-noise ratio.

(c) Determine (i) the peak frequency deviation, (ii) minimum bandwidth, and (iii) baud for a binary FSK signal with a mark frequency of 49 kHz, a space frequency of 51 kHz, and an input bit rate of 2 kbps.

(2+2+6)

Question 3

Determine the (i) baud and (ii) minimum bandwidth necessary to pass a 10 kbps binary signal using:

(a) Amplitude shift keying (ASK).
(b) Binary phase shift keying (BPSK).
(c) Binary frequency shift keying (BFSK).
(d) Quaternary (4) phase shift keying (QPSK).
(e) A digital modulation with $M = 8$ levels (M-ary modulation).

(4+4+4+4+4)

Question 4

a) Sketch and explain the construction of a log-periodic dipole array antenna.

b) An X-band (10 GHz) dish antenna must have a 1^0 beam width.

(i) What must be the diameter of the parabolic dish?
(ii) If 55% efficient, what will be the antenna gain?

(10+10)

TOTAL MARKS : 100

ANNEXURE

A. If the function x is assumed to be continuous over the range [-π, π], that is, period T= 2π, then we have

$$a_0 = \frac{1}{2\pi}\int_{-\pi}^{\pi} x(t)dt \qquad = \frac{1}{\pi}\int_{0}^{\pi} x(t)dt$$

$$a_k = \frac{1}{\pi}\int_{-\pi}^{\pi} x(t)\cos ktdt \qquad = \frac{2}{\pi}\int_{0}^{\pi} x(t)\cos ktdt$$

$$b_k = \frac{1}{\pi}\int_{-\pi}^{\pi} x(t)\sin ktdt \qquad = \frac{2}{\pi}\int_{0}^{\pi} x(t)\sin ktdt$$

B. EULER'S FORMULA

$$e^{\pm j\alpha} = \cos(\alpha) \pm j\sin(\alpha)$$

$$\cos(\alpha) = \frac{1}{2}\left(e^{j\alpha} + e^{-j\alpha}\right), \quad \sin(\alpha) = \frac{1}{2j}\left(e^{j\alpha} - e^{-j\alpha}\right)$$

where $\alpha = k\omega_o t$ in the signal Fourier series expansion formula