University of Eldoret

flame of knowledge and innovation

UNIVERSITY EXAMINATIONS

2016/2017 ACADEMIC YEAR

REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION IN TECHNOLOGY EDUCATION

COURSE CODE: **ELT 481**

COURSE TITLE: **COMMUNICATION SYSTEMS**

DATE: 7TH DECEMBER, 2016 **TIME:** 9.00 AM – 12.00 NOON

INSTRUCTIONS TO CANDIDATES

- Question **ONE** is compulsory
- Attempt any other three questions

THIS PAPER CONSISTS OF (4) PRINTED PAGES. PLEASE TURN OVER

Question One **ELT 481**

(a) Signals can be represented in three distinct forms. List these three forms. [3marks]

(b) (i) The energy and power classifications of signals are mutually exclusive. Explain what is understood by this statement? [2marks]

(ii) Delta function is widely used in the analysis of communication systems. List and precisely explain four properties of delta function. [8marks]

(iii) If $x_m(t)$ and $x_n(t)$ are finite-energy waveforms possibly of infinite duration, find their cross correlation function. [2marks]

(iv) Suppose they are infinite-energy, finite-power waveforms, periodic or aperiodic, find their cross correlation. [2marks]

(c) Several useful theorems relating to time domain signal processing operations to frequency domain operations involving Fourier transforms can be proved. Convolution is an important mathematical operation used by communication engineers as a tool. Establish that convolving two signals in the time domain is a product of their Fourier transforms in their frequency domain.

[8marks]

Question Two

(a) (i) Describe time invariant and time varying systems.

(ii) Causal and non causal systems. [4marks]

(b) (i) Find the spectra of the video pulses shown below in Figure Q2 (i) below;

$$s(t) = \begin{cases} 1, \text{ for } & |t| \le \frac{\tau_p}{2} \\ 0, \text{ for } & |t| > \frac{\tau_p}{2} \end{cases}$$

[11marks]

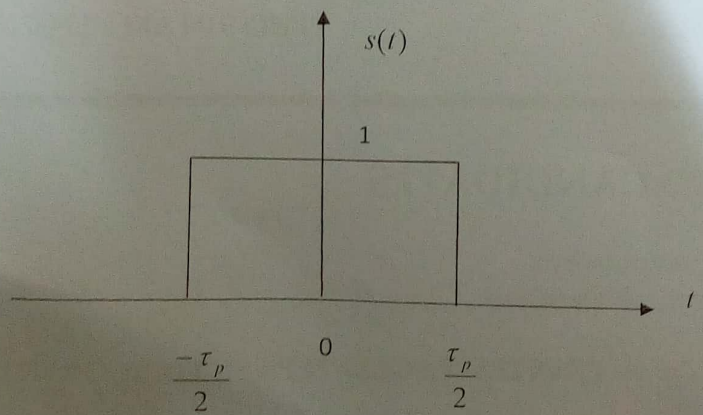

FIG Q2 (i)

Question Three

ELT 481

(a) (i) The requirement for distortionless transmission can be met if the overall transfer functions of the system between two points (a) and (b) takes a certain form; provide this form. [1mark]

$H(f) = K\exp(-2\pi f t_d)$

(ii) Clearly list three forms of distortion encountered in a communication channel. [3marks]

(b) (i) A message signal x(t) linearly modulates a high frequency carrier signal of the form $E_c\cos\omega_c t$. Compute the average power of the modulated waveform. [9marks]

(ii)Supposing the amplitude of the carrier is 7.5V and the resistance of the load is 5Ω, what is the average transmitted carrier power? [2marks]

Question Four

(a) With aid of sketches, describe the generation of a Suppressed Sideband (SSB) modulated signal by filtering a Double Sideband (DSB) signal [8marks]

(b) There is a method that can be used to generate an SSB signal without the need for a sideband filter. Clearly outline this method. [7marks]

Question Five

(a) A sinusoidal carrier voltage of frequency 2400 KHz is amplitude modulated by a sinusoidal voltage of 40 KHz, resulting in maximum and minimum carrier amplitudes of 220 volts and 180 volts respectively. Calculate,

(i) The frequency of the upper and lower sidebands,

(ii) The unmodulated carrier amplitude,

(iii) Modulation index,

(iv) Amplitude of each side band. [4marks]

(b) The recovery of a DSB signal requires that there be available at the receiver a local oscillator signal that is precisely synchronous with the carrier signal used in generating the modulated signal. Suppose that the local oscillator signal has a frequency offset of $\Delta\omega$ and a phase offset of θ. Provide an analysis of what is likely to happen to the signal during reception. [4marks]

(c) (i) State Five properties of a frequency modulated (FM) signal. [5marks]

(ii) For arbitrary message signals band limited to f_x, define the deviation ratio D and hence band width of an FM signal. [2marks]

Question Six

ELT 481

(a) With aid of a block diagram, describe the elements of a digital communication system. [6maks]

(b) Show that the dynamic representation in terms of delta function has the form;

$$s(t) = \int_{-\infty}^{\infty} s(\tau)\delta(t-\tau)d\tau$$

$R_{mn} = \int x_m(t)\, x_n(t+\tau)\, dt$

$= \int x_m(t+\tau) \cdot x_n(t)\, dt$

$= \lim_{T\to\infty} \frac{1}{T} \cdot \int x_m(t)\, x_n(t+\tau)\, dt$