(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SUPPLEMENTARY/SPECIAL EXAMINATIONS
YEAR TWO SEMESTER ONE EXAMINATIONS

FOR THE DEGREE OF
BACHELOR OF SCIENCE COMPUTER SCIENCE

COURSE CODE   :   CSC 216

COURSE TITLE   :   DIGITAL AND ANALOGUE
COMMUNICATION SYSTEM [B]

DATE: 21 / 07 /2022   TIME: 08.00 A.M – 10.00 A.M

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTIONS ONE AND ANY OTHER TWO.

QUESTION ONE (COMPULSORY) [30 MARKS]

a) Define sampling and state the sampling theorem [3 marks]

b) State two advantages and two disadvantages of frequency modulation over amplitude modulation? [4 marks]

c) In a certain DSB-FC AM scheme, the instantaneous voltages of modulating signal and carrier are $20 \sin \omega_m t$ and $40 \sin \omega_m t$, respectively. Determine:

    i.   the modulation index [2 marks]

    ii.   percentage modulation [1 mark]

    iii.   the maximum amplitude of the resulting upperside band. [2 marks]

d) Define Pulse Amplitude Modulation (PAM) and state two demerits of PAM. [4 marks]

e) With the help of a suitable, distinguish between an analogue signal and a digital signal. [4 marks]

f) Define baseband transmission [2 marks]

g)   i.   Define bandwidth [1 mark]

    ii.   Name and explain any two factors that influence the bandwidth of a signal. [4 marks]

h) Describe the following types of noise:

    i.   Thermal noise [2 marks]

    ii.   Shot noise [2 marks]

    iii.   Partition noise [2 marks]

QUESTION TWO [20 MARKS]

a) Describe Phase Modulation (PM) in analogue communication. Use suitable waveform of the carrier, message and modulated signals to illustrate. [6 marks]

b) Clearly, explain the following modulation techniques:

    i.   Frequency Division Multiplexing [2 marks]

    ii.   WDM [2 marks]

    iii.   TDM [2 marks]

c) A certain input signal is given as $x(t) = \frac{1}{2\pi} \cos(5000\pi t) \cos(2000\pi t)$. Noting that $2\cos\omega_1 t \cos\omega_2 t = \cos(\omega_1 t + \omega_2 t) + \cos(\omega_1 t - \omega_2 t)$, calculate:

    i.   the Nyquist rate [6 marks]

    ii.   the Nyquist interval for the signal [2 marks]

QUESTION THREE [20 MARKS]

a) State two merits of digital modulation techniques: [2 marks]

b) Highlight the following digital modulation techniques:

      i.   Synchronous Time Division Multiplexing   [2 marks]

      ii.   Asynchronous Time Division Multiplexing   [2 marks]

c) With the help of block diagrams, explain Pulse Code Modulation   [6 marks]

d) A certain radio station uses an FM carrier frequency of 99.5MHz that is modulated by 4kHz sine wave with a resulting frequency deviation of 20kHz. Determine:

      i.   the carrier swing of the FM signal   [2 marks]

      ii.   the highest frequency reached by the FM signal   [2 marks]

      iii.   the lowest frequency reached by the FM signal   [2 marks]

      iv.   the modulated index   [2 marks]

QUESTION FOUR [20 MARKS]

a) A given communication channel with an input resistance of 20kΩ has a bandwidth of 0.9MHz and operates at 300Kelvins. Take the Boltzmann's constant = 1.33×10^{-23} joule/kelvin. Calculate the:

      i.   Power spectrum density   [3 marks]

      ii.   average noise power, P_n [3 marks]

      iii.   r.m.s. noise voltage at input.   [3 marks]

b) Describe the following three sampling techniques. Include suitable diagrams to illustrate to answers.

      i.   Instantaneous (or ideal) sampling   [4 marks]

      ii.   Natural sampling   [4 marks]

      iii.   Flat-top sampling   [3 marks]

QUESTION FIVE [20 MARKS]

a)   i.   Draw a well labelled cross-sectional diagram of a fiber optic cable.   [2 marks]

      ii.   Explain the function of each part in the diagram above   [4 marks]

b) A 0.981MHz carrier frequency is modulated with two audio frequencies: 3.5 kHz and 2.1 kHz. Determine the frequencies present in the output signal.   [6 marks]

c) Describe the working principle of an R/2R Digital-to-Analogue Convertor (DAC)   [8 marks]