UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY 2018

COURSE NO: EL 376
COURSE NAME: **BASIC COMMUNICATION SYSTEMS**
CLASS: EL III **TIME:** 3 HOURS

Name**:** _____Index Number: _____

Attempt <u>ALL</u> questions in Section A and any <u>TWO</u> from Section B.
Answer both Sections in the Answer Booklet.

1. An example of communication service
   a. printer
   b. television
   c. both a. and b.
   d. none of these
2. Sampling an analog signal produces
   a. PAM
   b. AM
   c. FM
   d. PCM
3. Which of the following is NOT a major communications medium?
   a. Free space
   b. Water
   c. Wires
   d. Fibre-optic cable
4. Simultaneous two-way communications is called
   a. Half-duplex
   b. Bicomm
   c. Full-duplex
   d. Simplex
5. The process of modifying a high-frequency carrier with the information to be transmitted is
   a. Multiplexing
   b. Telemetry
   c. Detection
   d. Modulation
6. The process of transmitting two or more information signals simultaneously over the same channel is called
   a. Multiplexing
   b. Mixing
   c. Telemetry
   d. Modulation
7. What is the wavelength of light (nm) that has a frequency of 3.22×10^{14} Hz?
   a. 932
   b. 9.66×10^{22}
   c. 9.32×10^{-7}
   d. 1.07×10^{6}
8. The energy of a photon that has a wavelength of 9.0 m is _____ J.
   a. 2.2×10^{-26}
   b. 4.5×10^{-25}
   c. 6.0×10^{-23}
   d. 4.5×10^{25}

9. A frequency of 54 MHz has a wavelength of approximately

a. 162
c.54m
b. 56 m
d. 5.6m

10. The frequency of a photon that has an energy of 3.7×10^{-18}J is _____Hz.

a. 5.6×10^{15}
c. 2.5×10^{-15}
b. 1.8×10^{-16}
d. 2.5×10^{15}

11. The voice frequency range is

a. 30 to 300 Hz
c. 300 to 3000 Hz
b. 20 Hz to 20 kHz
d. 0 Hz to 15 kHz

12. Converting analog signals to digital is done by sampling and

a. Quantizing
c. Companding
b. Pre-emphasis
d. Mixing

13. Another name for signals in the HF range is

a. Microwave
c. Short waves
b. RF waves
d. Millimetre waves

14. Television broadcasting occurs in which ranges?

a. HF
c. UHF
b. VHF
d. EHF

15. For a given bandwidth signal, more channel space is available for signals in the range of

a. LF
c. HF
b. MF
d. VHF

16. The approximate wavelength of Red light is

a. 100 μm
c. 3500 Å
b. 7000 Å
d. 3000 Å

17. Radio signals are made up of

a. Voltages and currents
c. Electrons and Protons
b. Noise and data
d. Electric and magnetic fields

18. Electromagnetic waves produced primarily by heat are called

a. Infrared rays
c. Shortwaves
b. Microwaves
d. X-rays

19. Which of the following is not used for communications?

a. X-rays
c. Infrared
b. Millimeter waves
d. Microwaves

20. The ability of a receiver to separate one signal from others on closely adjacent frequencies is called the

a. Sensitivity
c. Selectivity
b. S/N ratio
d. Gain

21. The ratio of the peak modulating signal voltage to the peak carrier voltage is referred to as

a. The voltage ratio
c. The mix factor
b. The modulation index
d. Decibels

22. The two inputs to a mixer are the signal to be translated and a signal from a(n)

a. Modulator
c. Filter
b. Antenna
d. L.O.

23. Automatic gain control is used

a. to maintain the tuning correct
b. to reduce the voltage of loud passage of music
c. to maintain the same amount of output, when stations of different strength are received
d. to increase the amplification at high frequencies

24. For ideal AM, which of the following is true?

a. $m = 0$
c. $m < 1$
b. $m = 1$
d. $m > 1$

25. The outline of the peaks of a carrier has the shape of the modulating signal and is called the

a. Trace
c. Envelope
b. Waveshape
d. Carrier variation

26. AM is

a. An efficient modulation scheme in power terms.
b. Very wasteful in power terms but easy to demodulate
c. Inefficient and difficult to demodulate
d. Spectrally inefficient but easy to demodulate

27. Modulation is the technique used to translate low-frequency(base-band) signals like _____ to a higher frequency

a. Audio
c. Data
b. Video
d. All of these

28. Modulation reduces the size of antenna for higher frequencies with _____ frequency

a. Lower
c. Middle
b. Greater
d. None of these

29. The number of poles in a filter affect the

a. voltage gain
c. bandwidth
b. centre frequency
d. roll-off rate

30. Overmodulation occurs when

a. $V_m > V_c$
b. $V_m < V_c$
c. $V_m = V_c$
d. $V_m = V_c = 0$

31. The AGC circuit control the gain of the

a. Mixer
b. Detector
c. IF amplifiers
d. Audio amplifiers

32. A carrier of 15MHz is modulated by a 5kHz sine wave. The LSB and USB are respectively,

a. 14.95 and 15.05 kHz
b. 14.95 and 15.05 MHz
c. 14.995 and 15.005 kHz
d. 14.995 and 15.005 MHz

33. An AM signal has a carrier power of 5 W. If the percentage of modulation is 80%, what is the total sideband power?

a. 0.8 W
b. 1.6 W
c. 2.5 W
d. 4.0 W

34. For 100% modulation, what percentage of power is in both sidebands?

a. 25%
b. 33.3%
c. 50%
d. 100%

35. An unmodulated carrier current is 2.6 A. With modulation, the current rises to 2.9A. The percentage of modulation is

a. 35%
b. 42%
c. 70%
d. 89%

36. In an AM wave with 100% modulation, the carrier is suppressed. The percentage of power saving will be

a. 100%
b. 50%
c. 25%
d. 66.7%

37. In an AM signal, the transmitted information is contained within the

a. Carrier
b. Modulating signal
c. Sidebands
d. Envelope

38. Pulse code modulation is preferred to PAM because of its

a. Resistance to quantizing error
b. Simplicity
c. Lower cost
d. Superior noise immunity

39. The typical audio modulating frequency range used in radio and telephone communications is

a. 50 Hz to 5 kHz
b. 50 Hz to 10 kHz
c. 100 Hz to 10 kHz
d. 300 Hz to 3 kHz

40. The bandwidth of an SSB signal with a carrier frequency of 2.8 MHz and a modulating

signal with a frequency range of 250 Hz to 3.3 kHz is

a. 500 Hz
c. 3050 Hz
b. 6.6 kHz
d. 7.1 kHz

41. The circuit that recovers the original modulating information from an AM signal is known as

a. Modulator
c. Mixer
b. Demodulator
d. Crystal set

42. Both FM and PM are types of ……. modulation.

a. Amplitude
c. Frequency
b. Phase
d. Angle

43. The amount of frequency deviation from the carrier centre frequency in an FM transmitter is proportional to …… of the modulating signal.

a. Amplitude
c. Phase
b. Frequency
d. Shape

44. Carrier signal has

a. constant magnitude
c. variable frequency
b. constant frequency
d. variable time

45. FM signal is less affected by

a. loss
c. frequency
b. temperature
d. noise

46. What is the bandwidth of a signal that ranges from 4 KHz to 4 MHz?

a. 3.96 MHz
c. 3600 KHz
b. 3.996 MHz
d. 396 KHz

47. In frequency modulation, amplitude of the modulating signal is

a. constant
c. one
b. zero
d. variable

48. In FM, when the modulation index increases, transmitted power is

a. constant
c. decreased
b. increased
d. none of these

49. Frequency modulation has

a. one carrier with infinite frequencies
c. one carrier with two side band frequencies
b. one carrier
d. none of these

50. A telephone is

a. Full duplex
c. Simplex
b. Half duplex
d. Multiplex

51. A 100-MHz carrier is deviated 50 kHz by a 4-kHz signal. The modulation index is

a. 2
b. 8
c. 12.5
d. 25

52. A 70 kHz carrier has a deviation of 4 kHz with a 1000-Hz signal. How many significant sideband pairs are produced?

a. 4
b. 5
c. 6
d. 7

53. What is the bandwidth of the FM signal in Q. 39 above?

a. 4 kHz
b. 7 kHz
c. 14 kHz
d. 28 kHz

54. What is the relative amplitude of the third pair of sidebands of an FM signal with m = 6?

a. 0.11
b. 0.17
c. 0.24
d. 0.36

55. A 200-kHz carrier is modulated by a 2.5- kHz signal. The fourth pair of sidebands are spaced from the carrier by

a. 2.5 kHz
b. 5 kHz
c. 10 kHz
d. 15kHz

56. An FM transmitter has a maximum deviation of 12 kHz and a maximum modulating frequency of 12 kHz. The bandwidth by Carson's rule is

a. 24 kHz
b. 33.6 kHz
c. 36.8 kHz
d. 48 kHz

57. Which of the following is not a major benefit of FM over AM?

a. Greater efficiency
b. Noise immunity
c. Capture effect
d. Lower complexity and cost

58. The key conceptual circuit in a superhet receiver is the

a. Mixer
b. RF amplifier
c. Demodulator
d. AF Amplifier

59. Most of the gain and selectivity in a superhet is obtained in the

a. RF amplifier
b. Mixer
c. IF amplifier
d. AF amplifier

60. A network which attenuates a single band of frequencies and allows those on either side to pass through is called …… filter.

a. low-pass
b. high-pass
c. bandstop
d. bandpass

61. The term *pole* in filter terminology refers to

a. a high-gain op-amp
b. a single RC circuit
c. one complete active filter
d. the feedback circuit

62. A single resistor and a single capacitor can be connected to form a filter with a roll-off rate of

a. -20dB/decade
b. -40dB/decade
c. -6dB/octave
d. answers a. and c.

63. The lowest frequency passed by a low-pass filter is

a. 0 Hz
b. 1 Hz
c. 10 Hz
d. dependent on f_c

64. A band-pass response has

a. two critical frequencies
b. a flat curve in the passband
c. one critical frequency
d. a wide bandwidth

65. The Q of a band-pass filter depends on

a. the critical frequencies
b. only the centre frequency
c. only the bandwidth
d. the centre frequency and bandwidth

66. A receiver-transmitter station used to increase the communications range of VHF, UHF, and microwave signals is called a(n)

a. Transceiver
b. Remitter
c. Repeater
d. Amplifier

67. Which of the following is a microwave frequency?

a. 1.7MHz
b. 750 MHz
c. 0.98 GHz
d. 22 GHz

68. Which of the following is *not* a common microwave application?

a. Radar
b. Telephone
c. Mobile radio
d. Spacecraft communications

69. Which modulation technique involves tribits and one amplitude?

a. 16-PSK
b. ASK
c. 4-PSK
d. 8-PSK

70. The constellation diagram of QPSK has _____ dots.

a. 2
b. 4
c. 8
d. 1

71. MSK is:

a. equivalent to QPSK
b. binary FSK with the minimum distance between the two transmission frequencies
c. FSK with Gaussian pulse shaping
d. PSK with Gaussian pulse shaping

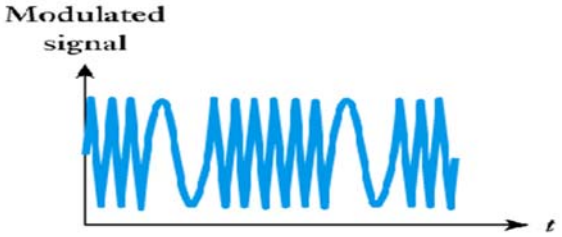
72. As the bit rate of an FSK signal increases, the bandwidth _____.

a. Remains the same
b. Decreases
c. Increases
d. Doubles

73. If the bit rate for an ASK signal is 1200 bps, the baud rate is _____.

a. 300
b. 2400
c. 600
d. 1200

74. What form of modulation is shown here?



a. Frequency shift keying
b. Phase shift keying
c. Amplitude shift keying
d. Quadrature Amplitude Modulation

75. For FSK, as the difference between the two carrier frequencies increases, the bandwidth _____.

a. Remains the same
b. Decreases
c. Increases
d. Halves

76. In QAM, both _____ of a carrier frequency are varied.

a. frequency and amplitude
b. phase and frequency
c. amplitude and phase
d. none of the above

77. Which of the following is most affected by noise?

a. PSK
b. FSK
c. QAM
d. ASK

78. ASK, PSK, FSK, and QAM are examples of _____ modulation.

a. Analog-to-analog
b. Analog-to-digital
c. Digital-to-digital
d. Digital-to-analog

79. In a dibit modulation, the number of points in the constellation is _____.

a. 2
b. 4
c. 8
d. 16

80. If the baud rate is 800 for a 4-PSK signal, the bit rate is _____ bps.

a. 1600
b. 800
c. 400
d. 100

SECTION B

Question 1

a) Explain the term Frequency Shift Keying **2 marks**

b) For the abbreviations below, construct a table by filling in the classification (full meaning of the abbreviations), the range of frequencies and their applications.
   i. VLF
   ii. MF
   iii. VHF
   iv. UHF **12 marks**

c) A sinusoidal carrier wave $50 \sin 200000\pi t$ was amplitude-modulated by an intelligence signal given by $30 \sin 5000\pi\, t$. Determine:
   (i) Modulation index
   (ii) Percent modulation
   (iii) Frequencies of signal and carrier
   (iv) Frequency spectrum of the modulated wave. **11 marks**

Question 2

a) Explain the following with respect to filters:
   i. Tuned filter
   ii. – 3 –dB frequency **4 marks**

b) With the aid of diagrams, explain QPSK. **6 marks**

c) i. What is a constellation diagram? **3 marks**
   ii. A constellation diagram consists of sixteen equally spaced points on a circle. If the baud rate is 4800 bps, what is the bit rate? **4 marks**

d) i) Determine the approximate broadcast bandwidth when an FM station with a modulation index of 4 transmits a 10 KHz tone, given that the significant sideband criterion is $J_n(M_f) >= 0.1J_0(0)$ **4 marks**

   ii) Using Carson's rule, determine the approximate broadcast bandwidth. **4 marks**

Question 3

a) Explain with the aid of a diagram a Bandpass filter **3 marks**

b) Draw the constellation diagram of 128 QAM **3 marks**

c) An FM signal, $2000 \sin(\pi \times 10^8 t + 3\sin 2\pi \times 10^4 t)$, is applied to a 50-Ω antenna.

   Determine
   i. The carrier frequency and the modulating frequency
   ii. The modulation index
   iii. The maximum deviation
   iv. The bandwidth (use both methods)
   v. The transmitted power **13 marks**

d) Calculate:
   i. the wavelength (in angstroms) of a photon that has energy of 4.38×10^{-18} J.
   ii. its frequency **6 marks**

Examiner: S. Ofori/ Dr C. K. Amuzuvi