

MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (M.E.S.) UNDER PUBLIC HEALTH DEPARTMENT, GOVERNMENT OF MIZORAM, MAY, 2019.

ELECTRONICS & COMMUNICATION ENGINEERING

PAPER - III

Time Allowed : 3 hours

FM : 200

SECTION - A (Multiple Choice questions)

(100 Marks)

All questions carry equal mark of 2 each. Attempt all questions.

This Section should be answered only on the OMR Response Sheet provided.

1. A phase-modulated signal is given by $s(t) = 2\cos(2\pi \times 10^6 t) + 5 \cos(1,000\pi t)$. The maximum frequency deviation of $s(t)$ is -
 - (a) 5 Hz
 - (b) 5,000 Hz
 - (c) 500 Hz
 - (d) 2,500 Hz
2. An AM transmitter is transmitting a power of 100 W. If the modulation index is 30%, the total power available in the side bands is -
 - (a) 4.3 W
 - (b) 8.6 W
 - (c) 2.15 W
 - (d) 21.5 W
3. An amplitude modulation scheme is working with a modulation index of 0.8. Power efficiency of this modulation scheme is -
 - (a) 24%
 - (b) 48%
 - (c) 12%
 - (d) 18%
4. Two signals have same frequency spectrum but different phase function. Their power spectrum density will be -
 - (a) Differ in phase
 - (b) Differ by $e^{j\theta_0}$
 - (c) Differ by w_0
 - (d) Be identical
5. Source coding in a data communication system is done in order to -
 - (a) Enhance the information transmission rate
 - (b) Reduce the transmission error
 - (c) Conserve the transmitted power
 - (d) Facilitate the clock recovery in the receiver
6. Encoder -
 - (a) Assigns quantized values.
 - (b) Changes quantized values to binary values.
 - (c) Changes quantized values to numerical values.
 - (d) Changes numerical values to binary values.

7. The condition for the carrier frequency f_c in FM to avoid the non-linear effects of channel is -
- (a) $f_c = 2\Delta f + 2w$ (b) $f_c > 2\Delta f + 3w$
(c) $f_c > 2\Delta f + 2w$ (d) $f_c > 3\Delta f + 2w$
8. Which of the following Analog modulation scheme requires the minimum transmitted power and minimum channel bandwidth?
- (a) VSB (b) DSB –SC
(c) SSB (d) AM
9. A frequency-modulated signal is given by $s(t) = 10\cos(2\pi \times 10^6 t + 3\sin(2,000\pi t) + 4\sin(4,000\pi t))$. The modulation index of given FM wave is -
- (a) 3 (b) 4
(c) 5 (d) 7
10. The transmission band width required to transmit a speech signal of highest frequency 4 kHz and modulation index $b = 10$ by using FM is -
- (a) 44 kHz (b) 80 kHz
(c) 88 kHz (d) 40 kHz
11. Kraft inequality is satisfied by -
- (a) Block code (b) Prefix code
(c) Hadamard code (d) Hamming code
12. If $m(t) = |10 \cos(2,000\pi t)|$ is pulse code modulated by using $P = 8$ bits to represent each sample, signal-to quantization noise ratio (SNR)_Q is given by -
- (a) 30 dB (b) 44 dB
(c) 56 dB (d) 60 dB
13. The Nyquist sampling rate for the signal $g(t) = \cos(4,500\pi t) \cos(9,000\pi t)$ is -
- (a) 4,500 samples/s (b) 5,500 samples/s
(c) 9,000 samples/s (d) 11,000 samples/s
14. The baud rate is -
- (a) Always equal to the bit transfer rate
(b) Equal to twice the bandwidth of the ideal channel
(c) Not equal to the signaling rate
(d) Equal to the one-half the bandwidth of ideal channel
15. In information theory, the entropy is -
- (a) Average mutual information (b) Average self information
(c) Average noise level (d) Average power of interference
16. The modulation scheme commonly used for transmission in GSM mobile terminals is -
- (a) Quadrature Phase Shift Keying (QPSK) (b) 16- Phase Shift Keying
(c) 4-QAM (d) Gaussian Minimum Shift Keying (GMSK)
17. If U and V are identical distributed independent random variables taking the value 1 and 2 with equal probability. The entropy of $H(U+V)$ is -
- (a) 1 bit (b) 1.5 bits
(c) 2 bits (d) 2.5 bits

18. In a binary symmetric channel, the probability of error is 0.5. The channel capacity of this channel is
- (a) 1 bit (b) 0.5 bits
(c) 0.25 bits (d) 0
19. If X & Y are two random variables, which of the following statement is true?
- (a) $H(X+Y) = H(X) + H(Y)$ (b) $H(X+Y) > H(X) + H(Y)$
(c) $H(X+Y) \leq H(X)+H(Y)$ (d) $H(X+Y) \geq H(X) + H(Y)$
20. The most noise immune system is -
- (a) SSB (b) PCM
(c) DM (d) PWM
21. In Time Division Multiplexing (TDM) non-essential frequency components of the modulating signal are removed by -
- (a) Sampler (b) Attenuator
(c) Pre-align filter (d) Modulator
22. In Frequency Division Multiplexing (FDM) system, cross talk occurs due to -
- (a) Imperfect time synchronization between transmitter and receiver
(b) Imperfect filtering at the receiver front end
(c) Imperfect carrier recovery at the receiver
(d) Channel noise
23. The cladding which surrounds the fiber core -
- (a) Is used to protect the fiber (b) Is used to reduce optical interference
(c) Helps to guide the light in the core (d) Ensures the refractive index remains unaltered
24. The orbital velocity of the satellite -
- (a) Is directly proportional to its distance from earth's surface.
(b) Is inversely proportional to square root of its distance from earth's center.
(c) Depends upon the thrust with which is launched.
(d) Is continuously changing as the satellite revolves.
25. The overall noise temperature (T_e), absolute temperature (T) and noise figure (F) are related as-
- (a) $T_e = T (F-1)$ (b) $T_e = F (T-1)$
(c) $T = T_e (F-1)$ (d) $T_e = T * F$
26. A wave guide operated below the cut off frequency can be used as -
- (a) Phase shifter (b) Attenuator
(c) Isolator (d) Oscillator
27. A rectangular wave guide having a cut-off frequency of 18 GHz for TE_{30} mode. The inner broad wall dimension of wave guide is -
- (a) 1.67 cm (b) 2.5 cm
(c) 3.75 cm (d) 5 cm
28. As a result of reflection from a plane conducting wall, electromagnetic waves acquire an apparent velocity greater than the velocity of light in space. This is called -
- (a) Velocity of propagation (b) Normal velocity
(c) Group velocity (d) Phase velocity

29. For TE or TM modes of propagation in bounded media, the phase velocity -
- (a) Is independent of frequency
 - (b) Is linear function of frequency
 - (c) Is non-linear function of frequency
 - (d) Can be frequency dependent or independent depending on the source
30. Which of the following is the dominant mode in rectangular wave guides?
- (a) TE₁₀
 - (b) TE₁₁
 - (c) TE₀₁
 - (d) TE₀₀
31. An antenna having a directivity of 2 at a frequency of 300 MHz will have a maximum effective aperture of -
- (a) $\frac{1}{80\pi} m^2$
 - (b) $\frac{1}{4\pi} m^2$
 - (c) $\frac{1}{2\pi} m^2$
 - (d) $\frac{1}{\pi} m^2$
32. The radiation pattern of an antenna in spherical coordinates is given by $U(\theta) = \cos^4\theta$; $0 \leq \theta \leq \frac{\pi}{2}$. Directivity of the antenna is -
- (a) 10 dB
 - (b) 12.6 dB
 - (c) 1.5 dB
 - (d) 18 dB
33. For taking antenna far field pattern, what must be the distance R between transmitting and receiving antennas?
- (a) $R > \frac{2d^2}{\lambda}$
 - (b) $R > \frac{4d^2\lambda^2}{3}$
 - (c) $R > \frac{D^2}{2\lambda^2}$
 - (d) $R > \frac{2D^2}{\lambda^2}$
34. Which of the following is not a $\frac{\lambda}{2}$ dipole antenna?
- (a) Yagi-Uda antenna
 - (b) Rhombic antenna
 - (c) Parabolic antenna
 - (d) Horn antenna
35. The gain G of an antenna of effective area A is given by -
- (a) $G = \frac{4\pi\lambda}{A^2}$
 - (b) $G = \frac{4\pi A}{\lambda}$
 - (c) $G = \frac{4\pi A}{\lambda^2}$
 - (d) $G = \frac{4\pi\lambda^2}{A}$
36. The directivity of an antenna array can be increased by adding more antenna elements, as a large number of elements -
- (a) Improves the radiation efficiency
 - (b) Increases the effective area of the antenna
 - (c) Results in a better impedance matching
 - (d) Allows more power to be transmitted by the antenna

37. In a circularly polarized wave travelling in Z direction -
- (a) E_x and E_y are in phase
 - (b) E_x and E_y are 90° out of phase and unequal in magnitude
 - (c) E_x and E_y are 90° out of phase and equal in magnitude
 - (d) $E_x = E_y$
38. In microwave communication links, the rain drop attenuation experienced mainly due to -
- (a) Absorption of microwave energy by water vapour.
 - (b) Resonance absorption of atomic vibration in water molecules.
 - (c) Scattering of microwaves by collecting the water drops.
 - (d) Refraction of microwaves through liquid-drop lenses formed by rain.
39. Where the maximum radiation for end-fire array does occurs?
- (a) Perpendicular to the line of the array only.
 - (b) Along the line of the array only.
 - (c) At 45° of the line of the array.
 - (d) At 180° of the line of the array.
40. In a magnetron oscillator, the improvement of stability and efficiency is achieved by which technique?
- (a) Strapping
 - (b) Cross coupling
 - (c) Bunching
 - (d) Bouncing
41. For communication from satellite to earth station, microwave frequency are used because -
- (a) Loss is minimum
 - (b) Noise added to signal is low in this frequency
 - (c) These do not get reflected back by ionosphere
 - (d) Many channels can be used
42. A satellite channel can be accurately modeled as a -
- (a) Random delay channel
 - (b) Panic button channel
 - (c) Additive white Gaussian noise channel
 - (d) Fading channel
43. The hexadecimal representation of $(567)_8$ is -
- (a) 1AF
 - (b) D77
 - (c) 177
 - (d) 133
44. A CPU of a computer has 48-bit instructions. A programme starts at $(600)_{10}$. Which one of the following is a legal programme counter value in decimal?
- (a) 610
 - (b) 650
 - (c) 672
 - (d) 693
45. In which of the following addressing mode, the address of the operand is inside the instruction?
- (a) Implied mode
 - (b) Absolute addressing mode
 - (c) Immediate addressing mode
 - (d) Register addressing mode
46. Aliasing in the context of programming language refers to -
- (a) Multiple variables having the same memory location.
 - (b) Multiple variables having the same value.
 - (c) Multiple variables having the same identifier.
 - (d) Multiple uses of same variable.

47. If an array is declared as `char a[10][12]`; what is referred to by `a[5]`?
- (a) Pointer to 3rd row. (b) Pointer to 4th row.
(c) Pointer to 5th row. (d) Pointer to 6th row.
48. In a microprocessor, the service routine for a certain interrupt starts from a fixed location of memory that cannot be externally set, but the interrupt can be delayed or rejected. Such an interrupt is -
- (a) Non-maskable and non-vectored (b) Maskable and non-vectored
(c) Non-maskable and vectored (d) Maskable and vectored
49. The content of accumulator after the execution of instruction
- ```
MVI A A7H
ORA A
RLC
```
- (a) CFH (b) 4FH  
(c) 4EH (d) CEH
50. The last address location of a 1 kB memory chip is given as F080. The starting address will be-
- (a) EC 80H (b) EC 81H  
(c) F000H (d) EC00H

**SECTION - B (Short answer type question)**  
**(100 Marks)**

*All questions carry equal marks of 5 each.*

*This Section should be answered only on the **Answer Sheet** provided.*

1. What is narrow band FM (NBFM)? Derive the equation of single tone NBFM.
2. The total power content of an AM signal is 1000 W. Determine the power being transmitted at the carrier frequency and at each of the sidebands when the modulation index is 100%.
3. With neat diagram explain the SSB-SC signal generation using Phase-shift method.
4. Find the signal to noise ratio for linear quantization of pulse code modulation (PCM).
5. A PCM system with 512 quantization level is used to transmit a television signal with bandwidth of 8 MHz. Find :
  - (i) code word length
  - (ii) transmission bandwidth
  - (iii) output bit rate
  - (iv) Output signal to quantization noise ratio
6. Explain the generation and reception process of QPSK signal.
7. A source is generating 8 symbols with probabilities 0.25, 0.2, 0.2, 0.1, 0.1, 0.05, 0.05, 0.05. Determine the entropy and information rate if there are 16 outcomes per second.

8. Derive the expression for orbital velocity of a satellite.
9. For a silica optical fiber the refractive index of core and cladding is 1.56 and 1.35 respectively. Find:
  - (i) critical angle
  - (ii) relative refractive index difference
  - (iii) numerical aperture
  - (iv) acceptance angle
10. Calculate the ratio of the cross section of a circular waveguide to that of rectangular one if each is to have the same cut-off wavelength for its dominant mode.
11. An air filled rectangular waveguide of inside dimensions  $7 \times 3.5$  cm operates in the dominant TE<sub>10</sub> mode. Find :
  - (i) cut-off frequency
  - (ii) guided wavelength at 3.5 GHz
12. The parameters of a two-cavity klystron amplifier are Beam voltage: 1200V, beam current = 28 mA, frequency = 8 GHz, gap spacing in either cavity  $d = 1$  mm and spacing between two cavities  $L = 4$ cm. Find maximum input voltage, gap transit angle, beam coupling co-efficient, DC transit angle.
13. State the principle of operation of Moving Target Indication (MTI) radar.
14. Derive the Friis power transmission formula.
15. For a satellite earth station receiver working at 12 GHz frequency with equivalent noise temperature of  $200^\circ\text{K}$ , a noise bandwidth of 18 MHz and receiving antenna gain of 50 dB, determine gain to equivalent noise temperature ratio, noise density and total noise power.
16. Explain the burst mode data transfer and cycle stealing in context of DMA data transfer scheme.
17. Draw the timing diagram for LDA instruction.
18. Briefly explain the different mechanisms of Asynchronous Data Transfer.
19. Explain the function of different types of control and status signals of 8085 mP.
20. What are the main functions performed by BIU and EU unit of 8086 mP.

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