MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (COMBINED) UNDER VARIOUS DEPARTMENT, GOVERNMENT OF MIZORAM, JULY-2024

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. In a typical satellite communication system, which of the following could be the up-link and down-link frequencies respectively?
   (a) 40 GHz and 60 GHz (b) 60 GHz and 40 GHz
   (c) 6 GHz and 4 GHz (d) 4 GHz and 6 GHz
2. The spectrum of a band-pass signal spans from 20 kHz to 30 kHz. The signal can be recovered ideally from the sampled values when the sampling rate is atleast-
   (a) 20 kHz (b) 40 kHz
   (c) 50 kHz (d) 60 kHz
3. A balanced modulator is used in the generation of which of the following?
   (a) DSB-SC signal (b) FM signal
   (c) PM signal (d) PAM signal
4. During power measurement the output power measured was -90 dBm. What is the measured power?
   (a) 1 pW (b) 1 mW
   (c) 1 W (d) 10 W
5. 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) $R > \frac{D^2}{2\lambda}$ (d) $R > \frac{2D^2}{\lambda^2}$
6. Why does an FM radio station perform better than an AM station radiating the same total power?
   (a) FM is immune to noise
   (b) AM has only two sidebands while FM has more
   (c) FM uses larger bandwidth for large modulation depth
   (d) Capture effect appears in FM

7. Which one of the following blocks is not common in both AM and FM receiver?
   (a) RF amplifier
   (b) Mixer
   (c) Slope Detector
   (d) IF amplifier

8. An analog signal has significant spectral components from 1 kHz to 5 kHz. What is the Nyquist sampling rate for this signal?
   (a) 4 k samples/s
   (b) 5 k samples/s
   (c) 8 k samples/s
   (d) 10 k samples/s

9. Which one of the following is represented by $v(t) = 5\,[\cos(10^6 \pi t) - \sin(10^3 \pi t) \times (10^6 \pi t)]$?
   (a) SSB under sideband signal
   (b) DSB suppressed carrier signal
   (c) AM signal
   (d) Narrow band FM signal

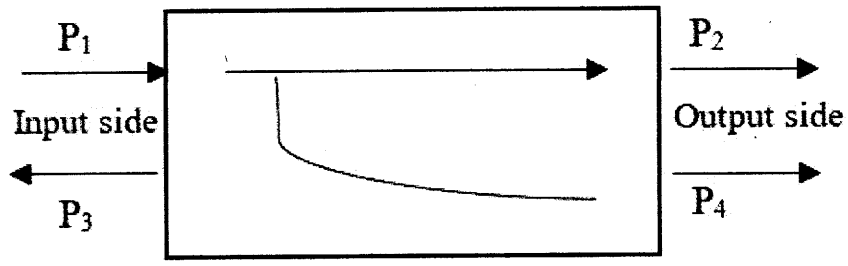
10. Which of the following pulse modulations is analog?
   (a) PCM
   (b) Differential PCM
   (c) PWM
   (d) Delta

11. A 8 kHz communication channel has an SNR of 30 dB. If the channel bandwidth is doubled, keeping the signal power constant, the SNR for the modified channel will be -
   (a) 27 dB
   (b) 30 dB
   (c) 33 dB
   (d) 60 dB

12. For 10-bit PCM system, the signal to quantization noise ratio is 62 dB. If the number of bits is increased by 2, then the signal to quantization noise ratio will -
   (a) increase by 6 dB
   (b) decrease by 6 dB
   (c) increase by 12 dB
   (d) decrease by 12 dB

13. The main disadvantage of using coaxial cable for microwave signals is its -
   (a) low selectivity
   (b) low distortion
   (c) high attenuation
   (d) high sensitivity

14. For directional coupler shown below, a coupling factor in dB is -



   (a) $10 \log_{10}(P_1 / P_4)$
   (b) $10 \log_{10}(P_1 / P_2)$
   (c) $10 \log_{10}(P_2 / P_4)$
   (d) $10 \log_{10}(P_1 / P_3)$

15. Consider a transmission line of length 37.5 cm, which is terminated into zero resistance. This line is being excited by a source of 1 GHz which has an internal impedance of $50\,\Omega$. What is the input impedance of the line as seen by the source?
   (a) Zero
   (b) $50\,\Omega$
   (c) $100\,\Omega$
   (d) Infinite

16. Which device can detect the presence of both forward and backward waves in a waveguide?
(a) Filter
(b) Directional coupler
(c) Detector
(d) Magic T

17. If the reflection coefficient is 1/5, what is the corresponding VSWR?
(a) 3/2
(b) 2/3
(c) 5/2
(d) 2/5

18. By measuring the VSWR values in the main and ancillary waveguides of a directional coupler, we can determine its -
(a) phase co-relation and efficiency
(b) frequency shift and phase variations
(c) attenuation and radiation efficiency
(d) directivity and coupling factor

19. In Gunn diode, out of its various modes of operation, one mode is independent of domain transit time and hence, can be used at high frequency and for very high output powers. Which is this mode?
(a) Transit time mode
(b) Quenched domain mode
(c) LSA mode
(d) Delay domain mode

20. If a height of the waveguide is halved, its cut-off wavelength will -
(a) be halved
(b) be doubled
(c) remain unchanged
(d) be one-fourth of the previous value

21. The variation of resistance of an element with absorption of microwave power is the underlying principle of operation of a/an -
(a) Attenuator
(b) Bolometer
(c) Wave filter
(d) Phase shifter

22. In microwave communication links, path-diversity and frequency-diversity are adopted to overcome fading in the path due to -
(a) polarization shifting
(b) rain attenuation
(c) phase lagging
(d) fog accumulation

23. At microwave frequencies, a varactor diode may not be useful -
(a) for electronic tuning
(b) for frequency multiplication
(c) as an oscillator
(d) as a parametric amplifier

24. If the peak power of pulsed microwave system is 10^4 W and average power is 800 W, then the duty cycle will be -
(a) 0.08%
(b) 0.8%
(c) 8%
(d) 80%

25. Which of the following instructions copies a byte of data into the accumulator from the memory address given in the instruction?
(a) LDA address
(b) LDAX B
(c) LHLD address
(d) STA address

26. The 8085 has two registers known as primary data pointers. These are registers -
(a) B and C
(b) D and E
(c) H and L
(d) C and D

27. What is the address space of 8086 CPU?
(a) 1 Mbyte
(b) 256 kbyte
(c) 10 Mbyte
(d) 64 kbyte

28. If 8085 adds 87H and 79H, then -

(a) both CARRY and ZERO flags will be set to 0

(b) CARRY flag will be set to 0, ZERO flag to 1

(c) CARRY flag will be set to 1, ZERO flag to 0

(d) both CARRY and ZERO flags will be set to 1

29. A memory system of size 32 kbyte is required to be designed using memory chips which have 12 address lines and 4 data lines each. What is the number of such chips required to design the memory system?

(a) 4 (b) 8

(c) 16 (d) 32

30. In 8085, if the clock frequency is 5 MHz, the time required to execute an instruction of 18T states is-

(a) 3.0 μs (b) 3.6 μs

(c) 4.0 μs (d) 6.0 μs

31. Which one of the following interrupts is both level and edge sensitive?

(a) RDT 7.5 (b) RST 5.5

(c) TRAP (d) INTR

32. If $(2.3)_{base4} + (1.2)_{base4} = (y)_{base4}$; what is the value of y?

(a) 10.1 (b) 10.01

(c) 10.2 (d) 1.02

33. The first machine cycle of an instruction is always -

(a) a memory read cycle (b) a fetch cycle

(c) an IN/OUT read cycle (d) a memory write cycle

34. In an assembler, which one of the following is required for variable names in symbol table?

(a) Addresses (b) Values

(c) Registers (d) Storage

35. Which of the following correctly declares a pointer to an array of integers in C?

(a) int *P[20]; (b) int (*P)[20];

(c) int *(P[20]); (d) int P*[20];

36. The different classes of formal parameters used in PASCAL are -

(a) value and variable parameters

(b) procedure and function parameters

(c) value, variable, procedure and function parameters

(d) variable, procedure and function parameters

37. The signal to quantization noise ratio in an n-bit PCM system -

(a) depends upon the sampling frequency employed (b) is independent of the value of 'n'

(c) increases with increasing value of 'n' (d) decreases with the increasing value of 'n'

38. In delta modulation, the slope overload distortion can be reduced by -

(a) decreasing the step size (b) decreasing the granular noise

(c) decreasing the sampling noise (d) increasing the step size

39. Satellite communication links are preferred over submarine cables because

(a) they involve lesser costs (b) they are faster

(c) of their multiple access capability (d) they offer a wide range of communication services

40. Consider an FM wave is $\cos [2\pi f_c t + \beta_1 \sin 2\pi f_1 t + \beta_2 \sin 2\pi f_2 t]$. The maximum deviation of the instantaneous frequency from the carrier frequency f_c is -

(a) $\beta_1 f_1 + \beta_2 f_2$ (b) $\beta_1 f_2 + \beta_2 f_1$

(c) $\beta_1 + \beta_2$ (d) $f_1 + f_2$

41. A 10 MHz carrier is frequency modulated by a sinusoidal signal of 500 Hz, the maximum frequency deviation being 50 KHz. The bandwidth required as given by the Carson's rule is -

(a) 500 Hz (b) 500 KHz

(c) 10 MHz (d) 101 KHz

42. There are three methods for the microwave frequency measurement. They are -

(a) Slotted line technique, Wave meter technique and Electronic technique

(b) Bolometric technique, Slotted line technique and Electrical technique

(c) Calorimeter-Wattmeter technique, Wave meter technique and Electronic technique

(d) Bolometric technique, Calorimeter-Wattmeter technique and Electrical technique

43. VHF waves travel as -

(a) Sky waves (b) Ground waves

(c) Space waves (d) Surface waves

44. Typical efficiency of TWT amplifier is -

(a) 60 to 80 % (b) 30 to 70 %

(c) 40 to 50 % (d) 10 to 40 %

45. The Klystron tube operates on which principle?

(a) Velocity modulation (b) Current density modulation

(c) Amplitude modulation (d) Frequency modulation

46. The skin depth (δ) is equal to -

(a) $(2/\omega\mu a)^{1/2}$ (b) $(2\,\omega\mu a)^{1/2}$

(c) $(2/\omega\mu a)^{1/3}$ (d) $(2\,\omega\mu a)^{1/3}$

47. I/O mapped systems identify their input/output devices by giving them a(n) -

(a) 8-bit instruction (b) 8-bit buffer number

(c) 16-bit port number (d) 8-bit port number

48. A register in the microprocessor that keeps track of the answer or results of any arithmetic or logic operation is the -

(a) stack pointer (b) program counter

(c) instruction pointer (d) accumulator

49. The measured value of the positive RF peak amplitude levels of an AM envelope on an ordinary oscilloscope rise to a maximum value of 12 V and drop to a minimum value of 4 V. The modulation index is -

(a) 3 (b) 1/3

(c) 1/4 (d) 1/2

50. 8085 has five flags they are designated as -

(a) Z, CY, S, P and AC (b) CY, D, Y, S and P

(c) CY, AC, D, E, and P (d) S, P, D, E and Y

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. Draw the time domain representation of a voice signal, a carrier signal, and an amplitude modulated (AM) signal.
2. For a medium of transmission having a bandwidth of 100 kHz, what is the maximum number of channels we can have for signals modulated with audio signals of effective bandwidth of 3 kHz, provided the first carrier frequency is taken to be 40 KHz?
3. Derive the expression for power efficiency of an AM wave. What is the maximum efficiency obtainable at critical modulation?
4. An audio signal is transmitted using PCM system with a sampling rate of 40 kHz and 14 bits per sample. Calculate the transmission data rate of the system.
5. A load with an impedance of $40 + j30\,\Omega$ is to be matched to a $100\,\Omega$ lossless line with a shorted stub. Determine the required stub admittance and distance between the stub and the load.
6. Determine the wave impedance of TE and TM wave in a rectangular waveguide.
7. What are pseudo-instructions? Mention three pseudo-instructions used in assembly language program.
8. Write short notes on RISC and CISC.
9. What are machine language and assembly language? Write an assembly language program to subtract two numbers.
10. Sketch the refraction index profile and ray transmission in single mode step-index fibre.
11. An earth station with a transmitter power of 120W, a frequency of 6 GHz and an antenna gain of 42 dB transmits to a satellite repeater. The receiving antenna on the satellite has a gain of 31 dB. If the satellite is in geosynchronous orbit of 35900 km above earth, what is the receiving power in dBm?
12. Determine the internal noise power (P_n) of a microwave amplifier operating with a bandwidth of 500 MHz and a specified noise figure of 2.5 dB.
13. Consider a source with three messages having symbol probabilities 0.5, 0.4 and 0.1, respectively. Obtain Shannon-Fano code and calculate its efficiency.
14. A transmission line of $72\,\Omega$ is connected to a $100\,\Omega$ load. Calculate (a) standing wave ratio due to this mismatch, and (b) ratio of the reflected and the incident powers at the load.
15. In a binary PCM, if 0 occurs with probability ¼ and 1 occurs with probability equals to ¾, then calculate the amount of information carried by each bit.
16. Explain how frequency modulation may be obtained from a phase modulator.
17. Mention the two independent functional units in the 8086 microprocessor and explain their basic functions.
18. State the functions of the following pins in 8085 microprocessor: (a) READY, (b) ALE, (c) HOLD, and (d) TRAP.
19. Distinguish between (a) Call by value and call by reference, and (b) clock cycle, machine cycle and instruction cycle.
20. Draw the timing diagram for instruction STA 4000H which is stored at address 2000H.

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