ENTRANCE EXAMINATION FOR ADMISSION, MAY 2013.

Ph.D. (ELECTRONICS AND COMMUNICATION ENGINEERING)

COURSE CODE : 138

Register Number :

Signature of the Invigilator
(with date)

COURSE CODE : 138

Time : 2 Hours Max : 400 Marks

Instructions to Candidates :

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each of the question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.
4. Avoid blind guessing. A wrong answer will fetch you –1 mark and the correct answer will fetch 4 marks.
5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.
6. Do not open the question paper until the start signal is given.
7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.
8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.
9. Use of Calculators, Tables, etc. are prohibited.

1. Spectral efficiency of QPSK null to null having bandwidth 4Hz, will be

(A) 1/2 (B) 1/4 (C) 3/4 (D) 1

2. What is the bit error of a non-coherent FSK system modulated by a PCM signal bit stream and operating at 10MHz? Frequency deviation is 850Hz, system data rate is 100 bits/sec, peak to peak carrier amplitude is 2 volts and double noise spectral density is 1×10^{-4} volts/Hz.

(A) 2.74×10^{-6} (B) 4.74×10^{-6}

(C) 3.74×10^{-6} (D) 5.74×10^{-6}

3. Frequency Shift Keying is mostly used in

(A) radio transmission (B) telegraphy

(C) telephony (D) none of these

4. What is the average probability of error in a coherent FSK (1 bit decoding) system transmitting binary data at 2.5×10^6 bits/sec, while Gaussian noise of zero mean and spectral density 10-20 volts/Hz added and with no noise, amplitude of required signal is 1μv.

(A) 0.55×10^{-3} (B) 0.75×10^{-3} (C) 0.65×10^{-3} (D) 0.85×10^{-3}

5. The bit rate of a digital communication system is 34 Mbits/sec. The modulation scheme is QPSK. The baud rate of the system is

(A) 68 Mbits/sec (B) 34 Mbits/sec (C) 17 Mbits/sec (D) 8.5 Mbits/sec

6. If a carrier modulated by a digital bit stream had one of the possible phases of 0, 90, 180, and 270 degrees, then modulation is called

(A) BPSK (B) QPSK (C) QAM (D) MSK

7. Transmitted power S_T = 200mW, L = 90 dB, n = 10^{-15} W/Hz and Pe = 10^{-4}. The maximum allowable bit rate using non-coherent FSK, will be

(A) 10 bps (B) 12 bps (C) 11 bps (D) 13 bps

8. If binary PSK modulation is used for transmission, the required minimum bandwidth is 9600 Hz. To reduce transmission bandwidth to 2400 Hz, the modulation scheme to be adopted should be

(A) QPSK (B) MSK (C) 16-ary QAM (D) 8-ary PSK

9. Which of the following is not correct for DS-SS.?

(A) Modulation technique used is BPSK coherent

(B) Variable chip rate

(C) Long acquisition time is required

(D) Effect of distance is high

10. The chip rate for slow hopping FH-SS is given by

(A) $R_c = R_s$ (B) $R_c = R_h$

(C) $R_c = 1/T_c$ (D) $R_c = T_c$

11. The linear modulation technique is characterized by

(A) good power efficiency (B) constant envelope

(C) uses non-linear amplifiers (D) requires small bandwidth

12. Temporal diversity can be realized by the following.

(A) Repetition coding

(B) Automatic repeat request

(C) Combination of interleaving and coding

(D) All the above

13. Macro diversity techniques are used to combat

(A) Small scale fading (B) Large scale fading

(C) Small and large scale fading (D) None of the above

14. Intersymbol Interference could be overcome by which of the following technique.

(A) Equalization technique (B) Diversity technique

(C) Channel coding (D) None of the above

15. Which of the following causes fast fading?

(A) Slow variation in the signal strength

(B) Mobile station moves slowly

(C) Large reflectors and diffracting objects along the transmission paths are distant from the terminal

(D) User terminal moves for short distances

16. In a block encoder, if k information bits are encoded into n code bits. The code rate is given by

(A) k/n (B) n/k (C) n.k (D) n+k

17. The received power at a receiver depends on

(A) Average bit energy (B) Transmission bit rate

(C) Both (A) and (B) (D) None of the above

18. What is the purpose of Random Access Channel(RACH) in wireless communication?
(A) To transmit the payload data
(B) To transmit the signalling information that is necessary during a connection
(C) To request for incoming connection from the subscriber
(D) To transmit and receive bursts appropriately

19. GSM system uses carrier frequencies around
(A) 10 MHz (B) 90 MHz (C) 900 MHz (D) 9000 MHz

20. Which of the following statement is not correct regarding CDMA?
(A) Many users of a system share the same frequency
(B) The code sequence must be orthogonal
(C) The powers of all signals arriving at the BS should be different
(D) CDMA requires accurate power control

21. Frequency diversity is achieved by
(A) Transmitting signals through two orthogonally polarized propagation path
(B) Transmitting signals from several transmitter antenna
(C) Enhancing the signals for closely spaced antennas
(D) Transmitting information on more than one or more carrier frequencies

22. In $\pi/4$ QPSK, the maximum phase is limited to
(A) $\pm 45°$ (B) $\pm 90°$ (C) $\pm 135°$ (D) $\pm 180°$

23. The resulting change in frequency due to Doppler shift is given by
(A) $f_D = f_r - f_t$ (B) $f_D = f_t - f_r$ (C) $f_D = f_r + f_t$ (D) $f_D = f_r \times f_t$

24. Which of the following is the merit of Okumara's model?
(A) Accuracy in parameter prediction
(B) Suitable for modern land mobile radio system
(C) Urban and Suburban areas are analysed
(D) All the above

25. The factors influencing small scale fading is
(A) Multipath propagation
(B) Speed of the mobile
(C) Transmission bandwidth of the signal
(D) All the above

26. Numerical aperture is used to obtain

(A) Angle of incidence

(B) Acceptance angle

(C) Refractive indexes

(D) Relation between acceptance angle and refractive indexes of core

27. The path followed by skew rays through the fiber is

(A) Parabolic path (B) Spherical path

(C) Helical path (D) Circular path

28. The mode value for a step index fiber is related to the normalized frequency as

(A) $M_s = 0.5V_2$ (B) $M_s = 0.25V_2$

(C) $Ms = 2V_2$ (D) $M_s = 4V_2$

29. Rayleigh scattering produces an attenuation proportional to

(A) $1/\lambda^4$ (B) λ^4 (C) λ^3 (D) $1/\lambda^3$

30. Group Velocity Dispersion arises due to

(A) Variation of the refractive index of the core material as a function of wavelength

(B) Finite spectral emission width of an optical source

(C) 20% of light propagating in the cladding travels faster than the light confined to the core

(D) All the above

31. Intermodal dispersion can be minimized with the use of

(A) Monomode step index fiber

(B) Multimode step index fiber

(C) Multimode graded index fiber

(D) All the above

32. Given core refractive index is 1.5 and cladding refractive index 1.47. The Numerical Aperture of the fiber is

(A) 0.25 (B) 0.30 (C) 0.35 (D) 0.40

33. A graded index fiber has a core with a parabolic refractive index profile which has a diameter of 50μm. The fiber has a Numerical Aperture of 0.2. What is the normalized frequency when it is operating at a wavelength of 1μm.

(A) 21.4 (B) 31.4 (C) 41.4 (D) 51.4

34. Two polarization maintaining fibers operating at a wavelength of 1.3μm have beat length of 0.7mm. The modal birefringence is

(A) 1.86×10^{60} (B) 1.86×10^{3} (C) 1.86×10^{-3} (D) 1.86×10^{-6}

35. A photodiode is constructed at GaAs, which has a band-gap of 1.53eV at 300°K . The cut-off wavelength is given by

(A) 0.81μm (B) 1.81μm (C) 0.081μm (D) 8.1μm

36. Solitons are pulses that travel along the fiber

(A) Without change in shape and with change in amplitude

(B) With change in shape and without change in amplitude

(C) Without change in shape and amplitude

(D) None of the above

37. The intrachannel crosstalk arises due to

(A) interfering signal is at the same wavelength as the desired signal

(B) interfering signal comes from a neighbouring channel that operates at a different wavelength

(C) Both due to (A) and (B)

(D) None of the above.

38. The error rates for optical fiber telecommunication systems ranges from

(A) 10^{-3} to 10^{-6} (B) 10^{-6} to 10^{-9} (C) 10^{-9} to 10^{-12} (D) 10^{-12} to 10^{-15}

39. Intersymbol Interference occurs due to

(A) discrete nature of current flow in the device

(B) pulse spreading in the optical fiber

(C) detector load resistor and amplifier

(D) none of the above

40. Find the technique used for determination of fiber numerical aperture.

(A) farfield angle from fiber using a scanning photodetector and a rotating stage

(B) farfield pattern by trigonometric fiber

(C) farfield pattern of NA measurement using a rotating stage

(D) all the above

41. The bulk dark current noise is due to

(A) thermally generated electrons and holes in the pn junction of the photodiode

(B) surface defects, bias voltage and surface area

(C) statistical nature of the production and collection of photo-electrons, when an optical signal is incident on a photodetector

(D) bias circuit when no light is incident on the diode

42. The response time of a photodiode depends on

(A) Transit time of photo carriers within the depletion region

(B) Diffusion time of photo carriers outside the depletion region

(C) RC time constant of the photodiode and its associated ciruit

(D) All the above

43. The radiative and non-radiative recombination life times of the minority carriers in the active region of a double heterojunction LED are 60 ns and 100 ns respectively. Determine the total carrier recombination lifetime.

(A) 27.5 ns (B) 37.5 ns (C) 47.5 ns (D) 17.5 ns

44. An avalanche photodiode produces a multiplied photocurrent of 12μA. Calculate the multiplication factor if the primary photo current is 0.25μA.

(A) 46 (B) 48 (C) 50 (D) 52

45. Which of the following is not the characteristic of LED?

(A) Optical output is coherent

(B) No optical resonant cavity

(C) Output radiation has broad spectral width

(D) No spatial and temporal coherence

46. The process of joining two fibers is called as

(A) Connecting (B) Splicing (C) Coupling (D) Filtering

47. Microscopic bending losses can be minimized by

(A) Introducing compressible jacket over the fiber

(B) Designing fibers with large relative refractive index difference

(C) Operating at the shortest wavelength possible

(D) None of the above

48. The total rms pulse broadening is given by the expression

(A) $\sigma_T = \sqrt{\sigma_c^2 + \sigma_n^2}$ (B) $\sigma_T = \sqrt{\sigma_c + \sigma_n}$

(C) $\sigma_T = \sigma_c^2 + \sigma_n^2$ (D) $\sigma_T = \sigma_{c+\sigma_n}$

49. Insertion loss in FBT structure is defined as

(A) Ratio of power input to power output

(B) Ratio of back scattered power received at the second input port to the input power

(C) Loss obtained for a particular port to port optical path

(D) None of the above

50. If there are 10 output ports, calculate the splitting loss that occurs in star coupler.

(A) 5 (B) 10 (C) 15 (D) 20

51. An exponential signal represented by $x(t) = e^{st}$, in which if $\sigma = 0$ then the signal x(t) is

(A) DC signal

(B) Sinusoidal signal

(C) Exponentially decaying sinusoid

(D) Exponentially increasing sinusoid

52. Find the result of the following summation $\sum_{-\infty}^{5} [\delta(n-2)\cos 2n + \delta(n-1)\sin 2n]$

(A) Cos 4 + Sin 2 (B) Cos 2 + Sin 4

(C) Cos 2 + Sin 2 (D) Cos 4. Sin 2

53. A filter that has a constant magnitude response for all frequencies is known as

(A) Comb filter (B) Band pass filter

(C) All pass filter (D) Low pass filter

54. Aliasing can be prevented if the highest frequency component Ωm in the signal is

(A) Greater than or equal to T/π

(B) Greater than or equal to π/T

(C) Less than or equal to T/π

(D) Less than or equal to π/T

55. The Fourier transform of the sequence x(n) =1 ; for $-2 \leq n \leq 2$

(A) $1 + \sin \omega + \sin 2\omega$ (B) $1 + 2\text{Cos } \omega + 2\text{Cos } 2\omega$

(C) $1 + \text{Cos } \omega + \text{Cos } 2\omega$ (D) $1 + \text{Cos } 2\omega + 2\text{Cos } 4\omega$

56. Which realization is less sensitive to the process of quantization?

(A) Cascade form (B) Parallel form

(C) Transversal form (D) Lattice form

57. FIR filters are

(A) Stable and do not have linear phase

(B) Unstable and do not have linear phase

(C) Stable and have linear phase

(D) Unstable and have linear phase

58. The poles of the Chebyshev filter lie on

(A) Ellipse (B) Parabola (C) Circle (D) Rectangle

59. The number of multiplications needed in the calculation of 1024 point FFT are

(A) 4608 (B) 10240 (C) 5632 (D) 5120

60. A low pass filter circuit is basically

(A) a differentiating circuit with low time constant

(B) a differentiating circuit with large time constant

(C) a integrating circuit with low time constant

(D) a integrating circuit with large time constant

61. Which of the following represent a stable system?

(A) Impulse response of the system decreases exponentially

(B) Area within the impulse response is finite

(C) Eigen value of the system are positive and real

(D) Roots of the characteristic equation of the system are real and negative

62. The Z-Transform of an anti-causal system is $X(Z) = \frac{12 - 21Z}{3 - 7Z + 12Z^2}$. The value of x[0] is

(A) –7/4 (B) 0 (C) 4 (D) None of these

63. Double integration of a unit step function would lead to

(A) an impulse (B) a parabola (C) a ramp (D) a doublet

64. The transfer function of a system is given by $H(z) = \frac{Z(3z-2)}{z^2 - z - 0.25}$. The system is

(A) Causal and stable
(B) Causal, stable and minimum phase
(C) Minimum phase
(D) None of these

65. The impulse response h(n) for a realizable filter is

(A) Zero for $n \leq 0$
(B) Zero for $n \geq 0$
(C) One for $n \leq 0$
(D) One for $n \geq 0$

66. The Butterworth filter is characterized by

(A) The number of poles are less when compared to the Chebyshev filter
(B) Transition band is less when compared to the Chebyshev filter
(C) The magnitude response decreases monotonically as the frequency Ω increases from 0 to ∞
(D) The order of the filter is more when compared to the Chebyshev filter

67. The frequency response of a causal and stable LTI system is $H(j\omega) = \frac{1-j\omega}{1+j\omega}$. The group delay of the system is

(A) $\frac{2}{1+\omega^2}$
(B) $\frac{-2}{1+\omega^2}$
(C) $2\tan^{-1}\omega$
(D) $-2\tan^{-1}\omega$

68. Errors due to round off noise are less severe in

(A) IIR filter
(B) FIR filter
(C) Butterworth filter
(D) Chebyshev filter

69. The condition for impulse response to be symmetry is

(A) h(n) = h(N-1-n)
(B) h(n) = -h(N-1-n)
(C) h(n) = h(n-1-N)
(D) h(n) = -h(n-1-N)

70. Which of the following is the desirable characteristic of the windows?

(A) The central lobe of the frequency response of the window should contain most of the energy and should be narrow
(B) The highest side lobe level of the frequency response should be small
(C) The side lobes of the frequency response should decrease in energy rapidly as ω tends to π
(D) All the above

71. The frequency response of N-point rectangular window is given by

(A) $W_R(e^{jw}) = \dfrac{\sin\frac{\omega N}{2}}{\sin\frac{\omega}{2}}$ (B) $W_R(e^{jw}) = \dfrac{\sin\frac{\omega N}{2}}{\cos\frac{\omega}{2}}$

(C) $W_R(e^{jw}) = \dfrac{\cos\frac{\omega N}{2}}{\sin\frac{\omega}{2}}$ (D) $W_R(e^{jw}) = \dfrac{\cos\frac{\omega N}{2}}{\cos\frac{\omega}{2}}$

72. The main lobe width of Hamming window is equal to

(A) $\frac{2\pi}{2}$ (B) $\frac{8\pi}{N}$ (C) $\frac{4\pi}{N}$ (D) $\frac{16\pi}{N}$

73. Overflow does not arise in

(A) Fixed point arithmetic

(B) Floating point arithmetic

(C) Block floating arithmetic

(D) Both fixed point and floating point arithmetic

74. If b = 3 bits, then quantization step size is

(A) 0.25 (B) 0.5 (C) 0.125 (D) 0.75

75. The input – output relation of a factor-of-2 upsampler in the frequency domain is given by

(A) $Y(e^{j\omega}) = X(e^{2j\omega})$ (B) $Y(e^{j\omega}) = 2X(e^{j\omega})$

(C) $Y(e^{j\omega}) = X(e^{j\,0.5\,\omega})$ (D) $Y(e^{j\omega}) = 2X(e^{j\,0.5\,\omega})$

76. The perceptual attribute of colour is given by

(A) Brightness (B) Hue (C) Saturation (D) All the above

77. Which of the following statement is not correct?

(A) Entropy is defined as the average information generated by the source

(B) The maximum entropy is 8 bit, which occurs when both the messages are equally likely

(C) The entropy of a source gives the lower bound on the number of bits required to encode its output

(D) For a digital image considered as a source of independent pixels, its entropy can be estimated from its histogram

78. Light received from an object depends on

(A) Reflectivity of the object
(B) Incident energy distribution
(C) Both (A) and (B)
(D) None of the above

79. Which of the following is not the property of Cosine transform?

(A) Real, symmetric and orthogonal
(B) It is not the real part of the unitary DFT
(C) It is a fast transform
(D) It has excellent energy compaction for highly correlated data

80. Which of the following transform does not require multiplication for its representation?

(A) Haar transform
(B) Hadamard transform
(C) Sine transform
(D) SVD transform

81. Haar transforms are useful

(A) for highly correlated data
(B) for small block sizes
(C) if higher spatial frequencies are to be emphasized
(D) if use of frequency domain is mandatory

82. Image restoration is concerned with

(A) removal or minimization of known degradations in an image
(B) making quantitative measurements from an image
(C) accentuate certain image features for subsequent analysis or for image display
(D) characterization of the quantity that each pixel represents

83. According to root law, contrast and luminance are related as

(A) $c = f^n$ (B) $c = f^{1/n}$ (C) $c = \alpha_n f^{1/n}$ (D) $c = 50 \log_{10} f$

84. If a mixture of colour c_1 and c_2 matches a mixture of colour c_1' and c_2', then according to colour subtraction which of the following is correct if $[c_2] = [c_2']$.

(A) $[c_1] = [c_2]$
(B) $[c_1] = [c_2']$
(C) $[c_1'] = [c_2]$
(D) $[c_1] = [c_1']$

85. A common method of image sampling is to

(A) compress the image
(B) segment the image
(C) scan the image
(D) watermark the image

86. The enhancement process is helpful in

(A) increasing the inherent information content in the data

(B) increasing the dynamic range of the inherent information content in the data

(C) both (A) and (B)

(D) none of the above

87. Which of the following property of median filter is not correct?

(A) It is a linear filter

(B) It is useful for removing isolated lines or pixels while preserving spatial resolutions

(C) Its performance is poor when the number of noise pixels in the window is greater than number of pixels in the window

(D) None of the above

88. The contrast ratio is defined as

(A) $\gamma = \sigma/\mu$ (B) $\gamma = \mu/\sigma$ (C) $\gamma = \sigma \times \mu$ (D) $\gamma = (\sigma \times \mu)^2$

89. According to Shannon's noiseless coding theorem, the maximum achievable compression c, is given by

(A) $c = B \times H$ (B) $c = H + \varepsilon$ (C) $c = B / H$ (D) $c = H / B$

90. In Transform coding, compression is achieved by

(A) exploiting redundancy in the data

(B) ignoring the inter pixel dependencies

(C) transforming the given image into another array

(D) none of the above

91. Run-length coding fall under the following image compression technique?

(A) Pixel coding (B) Predictive coding

(C) Transform coding (D) Hybrid coding

92. The quantizer should be designed to limit the

(A) Granularity (B) Slope overload

(C) Edge-busyness (D) All the above

93. The feasible region represented by the constraints $x_1 - x_2 <= 1$, $x_1 + x_2 >= 3$, $x_1 >= 0$, $x_2 >= 0$ of the objective function Max $Z = 3x_1 + 2x_2$ is

(A) A polygon (B) Unbounded feasible region

(C) A point (D) None of these

94. If the pixels of an image are shuffled then the parameter that may change is

(A) Histogram
(B) Mean
(C) Entropy
(D) Covariance

95. The quantiser in an image-compression system is a

(A) Lossy element which exploits the psychovisual redundancy
(B) Lossless element which exploits the psychovisual redundancy
(C) Lossy element which exploits the statistical redundancy
(D) Lossless element which exploits the statistical redundancy

96. The colour of an object is largely determined by its diffuse reflection coefficient. If Kd = (0.8, 0.4, 0), then what shall be the colour of the object, if the light used is blue and magenta ?

(A) White and Red
(B) Red and Blue
(C) Black and White
(D) Black and Red

97. Separating the object from the background of an image is called

(A) Smoothing
(B) Spatial filtering
(C) Thresholding
(D) Spatial averaging

98. The process of recovering the input of a system from its output is called

(A) Inverse filtering
(B) Wiener filtering
(C) Median filtering
(D) Mean filtering

99. The spatial interaction of luminances from an object and its surround creates a phenomenon called the

(A) Photopic vision
(B) Scotopic vision
(C) Match band effect
(D) Dithering

100. Reduction in number of bits in an image is called

(A) Image restoration
(B) Image compression
(C) Image enhancement
(D) Image segmentation