ENTRANCE EXAMINATION FOR ADMISSION, MAY 2012.

Ph.D. (ELECTRONICS & 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. Satellite tracking stations are located in remote areas in order to minimize the effect of

(A) solar noise (B) manmade noise

(C) cosmic noise (D) thermal noise

2. 24 hour satellite (synchronous satellite) should be placed in an equatorial orbit with a approximate height of

(A) 1500 km (B) 2000 km (C) 5000 km (D) 36000 km

3. A satellite that simply reflects back the signals from one region of the earth to the other region is known as

(A) orbiting satellite (B) geostationary satellite

(C) active satellite (D) passive satellite

4. A radio communication link is to be established via the ionosphere. The virtual height at the midpoint of the path is 300 km and the critical frequency is 9 MHz. The maximum usable frequency for the link between the stations of the distance 800 km assuming the flat earth is

(A) 11.25 MHz (B) 12 MHz (C) 15 MHz (D) 25.5 MHz

5. If a sky wave with a frequency of 50 MHz is incident on the D-region at an angle of 30° then the angle of refraction is

(A) 15° (B) 60° (C) 30° (D) 5.5°

6. In a satellite ground station, the received signal is directly amplified in a low noise parametric amplifier followed by a FET amplifier. The gains and effective noise temperatures of the amplifiers are 20 dB, 9 K and 10 dB, 200 K respectively. The effective noise temperature of the combination is

(A) 11 K (B) 20 K (C) 29 K (D) 39 K

7. If a satellite is launched at an orbital radius of twice that of a geostationary satellite, how much time will the launched satellite take to travel around the earth?

(A) 48 hrs (B) 12 hrs (C) 96 hrs (D) 6 hrs

8. Communication satellites are allotted bandwidth of 500MHz. This can be increased by using

(A) Frequency and polarization reuse

(B) Time division multiplexing

(C) Frequency division multiplexing

(D) Triple modular redundancy

9. The power transmitted by a synchronous orbit satellite antenna is 480 W. The antenna has a gain of 40 dB at 15 GHz. The earth station is located at distance of 24,567 km. If the antenna of earth station has a gain of 32 dB, the power received is

(A) 32 pW (B) 3.2 fW (C) 10.2 pW (D) 1.3 fW

10. Antenna elevation angle at the ground station for satellite communication is always kept above 5° to

(A) Minimize the sky noise temperature

(B) Reduce the effect of oxygen and water vapour absorption on the antenna noise temperature

(C) Minimize the slant range

(D) Increase the visibility of the satellite

11. The RST 5.5 interrupt service routine start from location

(A) 0020H (B) 0024H (C) 0028H (D) 002CH

12. The instruction, that does not clear the accumulator of 8085, is

(A) XRA A (B) ANI 00H

(C) MVI A,00H (D) None of the above

13. An 8085 microprocessor based system drives a multiplexed 5-digits 7-segment display. The digits are refreshed at a rate of 500 Hz. The ON time for each digit is

(A) 4 ms (B) 0.4 ms (C) 10 ms (D) 25 ms

14. The content of Accumulator of 8085 microprocessor after execution of the following instructions will be

```
MVI A, A7H
ORA A
RLC
```

(A) FFh (B) 4Fh (C) 3Fh (D) CEh

15. A microprocessor with 12-bit address bus will be to access -------- kilobytes of memory

(A) 0.4 (B) 2 (C) 10 (D) 4

16. Consider the following loop

```
XRA A
LXI B, 0007H
LOOP: DCX B
JNZ LOOP
```

The loop will be executed

(A) 1 times (B) 8 times (C) 7 times (D) Infinite times

17. How many and what are the machine cycles needed for execution of PUSH B?

(A) 2 fetch and 1 memory write (B) 3 fetch and 2 memory write

(C) 3 fetch and 1 memory write and read (D) 3 fetch and 2 memory read

18. The total number of memory access involved (inclusive of the opcode fetch) when an 8085 processor executes the instruction LDA 2003 is

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

19. A memory system of size 26 K bytes is required to be designed using memory chips which have 12 addresses and 4 data lines each. The number of such chips required to design the memory system is

(A) 2 (B) 4 (C) 8 (D) 16

20. The number of memory cycles required to execute the following 8085 instructions

(i) LDA 3000H

(ii) LXI D, FOF 1 H

would be

(A) 2 for (i) and 2 for (ii) (B) 4 for (i) and 3 for (ii)

(C) 3 for (i) and 3 for (ii) (D) 3 for (i) and 4 for (ii)

21. For a Gunn diode oscillator, the drift velocity of the electron is 10^7 cm/s and the active region length is 10×10^{-4} cm. The natural frequency of oscillation would be

(A) 1 MHz (B) 10 MHz (C) 1 GHz (D) 10 GHz

22. For a parabolic reflector antenna with diameter of 3 m, the far field pattern measurement at 10 GHz should be carried out at a distance of a least

(A) 30 m (B) 200 m (C) 400 m (D) 600 m

23. In a microwave measurement setup, the power reaching to the load is found to be 50 mW. If a 3 dB coupler is placed before the load, the power to the load will be

(A) 50 mW (B) 25 mW (C) 12.5 mW (D) 6.25 mW

24. For rectangular waveguide of dimensions: 1.732 a × a cm, the cut off frequency for the TE_{10} mode is 2 GHz. What is the cut off frequency for TM_{11} mode in the waveguide?

(A) 1 GHz (B) 3.46 GHz (C) 4 GHz (D) 6 GHz

25. Two microwave signals travelling in the space have a path length difference of 3 cm when operating at 10 GHz. What is the relative phase difference of the signals?

(A) 2π (B) π (C) 3π (D) 4π

26. In measuring pulsed microwave power, the pulse duration is 1.5 μs with PRF of 1 kHz. If the CW power sensor reads 15 mW, what is the average signal power during the pulse

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

27. An IMPATT diode has a drift length of 4μm. The drift velocity of Si is 10^5m/s. The operating frequency of IMPATT diode is

(A) 25 GHz (B) 20 GHz (C) 12.5 GHz (D) 125 GHz

28. On a micro strip line, the wavelength measures are 12 mm for a 10 GHz signal. The dielectric constant of the equivalent homogeneous line is

(A) 3.5 (B) 5.5 (C) 6.25 (D) 7

29. A cylindrical cavity operating in TE_{111} mode has a 3 dB bandwidth of 2.4 MHz and its quality factor is 4000. Its resonant frequency would be

(A) 9.6 GHz (B) 6.789 GHz (C) 5.543 GHz (D) 3.92 GHz

30. If the peak power of a pulsed microwave system is 10^4 W and the average power is 800 W, then the duty cycle will be

(A) 80% (B) 8% (C) 0.8% (D) 0.08%

31. An antenna has a gain of 44 dB. Assuming that the main beam of the antenna is circular in cross section, the beam width will be

(A) 0.4456° (B) 1.4456° (C) 2.4456° (D) 3.4456°

32. A dipole antenna of λ/8 length has an equivalent total loss resistance of 1.5 Ω. The efficiency of the antenna is

(A) 0.89159% (B) 8.9159% (C) 89.159% (D) 891.59%

33. A transmitting antenna has a gain of 10. It is fed with a signal power of 1 W. Assuming free space propagation, what power would be captured by a receiving antenna of effective area 1 m^2 in the bore sight direction at a distance of 1 m?

(A) 10 W (B) 1 W (C) 2 W (D) 0.8 W

34. An earth station employs a 1 kW high power amplifier (HPA) and a 20 m Cass grain antenna whose transmitted gain is 65 dB at a free space wavelength of 2.1 cm. If the loss of the wavelength that connects HPA to the feed is 1 dB, than the earth station EIRP is

(A) 29 dBm (B) 59 dBm (C) 94 dBm (D) 124 dBm

35. Two identical antennas 1 km apart and operating at λ=10 cm in an LOS link, have an obstacle 10m high midway between them. The height of the antennas such that the fist Fresnel zone is free of any obstacle, should be

(A) 15 m (B) 18 m (C) 20 m (D) 25 m

36. A parabolic dish antenna has a diameter of 1 m. The maximum possible (ideal) gain of the antenna at a wavelength of 3.14 cm is

(A) 20 dB (B) 30 dB (C) 40 dB (D) 50 dB

37. A transmitting antenna with a 300 MHz carrier frequency produces 2 kW of power. If both antennas has unity power gain, the power received by another antenna at a distance of 1 km is

(A) 11.8 mW (B) 18.4 W (C) 18.4 μW (D) 12.7 μW

38. A thin dipole antenna is $\lambda/15$ long. If its loss resistance is 1.2 Ω, the efficiency is

(A) 41.1% (B) 59% (C) 74.5% (D) 25.5%

39. An antenna can be modelled as an electric dipole of length 4 m at 3 MHz. if current is uniform over its length, then radiation resistance of the antenna is

(A) 1.974 Ω (B) 1.263 Ω (C) 2.186 Ω (D) 2.693 Ω

40. For a Hertz dipole antenna, the half power beam width (HPBW) in the E-plane is

(A) 360° (B) 180° (C) 90° (D) 45°

41. An ideal pulse radar receiver

(A) should have very large bandwidth
(B) should have very small bandwidth
(C) both (A) and (B)
(D) none of these

42. In case the ratio of the antenna diameter to the wavelength in a radar system is high, this likely not to result in

(A) increased capture area (B) good target discrimination
(C) difficult target acquisition (D) large maximum range

43. Radar detection is limited to line of sight because

(A) of curvature of the earth
(B) the waves are not reflected by the ionosphere
(C) long wavelengths are used
(D) short wavelengths are used

44. In a radar system, if the peak transmitted power is increased by a factor of 16 and the antenna diameter is power is increased by a factor of 2, then the maximum range will increase by a factor of

(A) 16 (B) 8 (C) 4 (D) 2.828

45. A received signal in a radar system occupies an IF bandwidth of 12 MHz. If the transmitted signal was a pulsed carrier of 10 GHz with duty ratio 1:0.5 @ 400 Hz, the received signal power will contain the

(A) Frequency component at 400 Hz

(B) Frequency spread over the whole IF bandwidth

(C) Dc or average value of the IF

(D) RF signals at 10 GHz and 12 MHz

46. If the average power of radar transmitter is 2 kW and the peak power of the transmitter is 1000 kW, what will be the duty cycle?

(A) 0.002 (B) 0.02 (C) 0.001 (D) 0.01

47. Radar receives an echo from a target 20μs after sending the signal. The approximate range of the target is

(A) 300 m (B) 3000 m (C) 600 m (D) 6000 m

48. In precipitation mode, how often are NWS radar images updates:

(A) every 5 seconds (B) every 50 seconds

(C) every minute (D) every 5 minutes

49. Radar beacons are used for

(A) Target identification

(B) Navigation

(C) Causing significant extensions of the maximum range

(D) All the above

50. In a radar in case the return echo arrives after the allowed pulse interval, then

(A) It will not be received

(B) The receiver will get overloaded

(C) It may interface with the operation of the transmitter

(D) The target will appear closer than it really is

51. If a common emitter amplifier with an emitter resistance Re has an overall Trans conductance gain of –1 mA/V, a voltage gain of –4 and desensitivity of 50, then the value of the emitter resistance Re would be

(A) 50 kΩ (B) 0.98 kΩ

(C) 50 MΩ (D) 0.98 MΩ

52. The voltage gain of an amplifier without feedback and with negative feedback respectively is 100 and 20. The percentage of negative feedback(β) would be

(A) 4% (B) 5% (C) 20% (D) 80%

53. An amplifier using BJT has two identical stages each having a lower cut-off (3 dB) frequency of 64 Hz due to coupling capacitor. The emitter bypass capacitor also provides a lower cut-off (3 dB) frequency due to emitter degeneration alone of 64 Hz. The lower (3 dB) frequency of the overall amplifier is nearly

(A) 100 Hz (B) 128 Hz

(C) 156 Hz (D) 244 Hz

54. The input voltage of zener regulator varies from 20 V to 30 V. The load current varies from 10 mA to 15 mA. If the zener voltage is 5 V, the value of series resistor will be

(A) 1 kΩ (B) 1.5 kΩ (C) 1.66 MΩ (D) 2.5 MΩ

55. A dc-dc converter has an efficiency of 80% and is supplying a load of 24 W at 240 V. What is the current drawn from the battery if the converter is working from a battery of 12 V?

(A) 0.1 A (B) 2.0 A (C) 2.5 A (D) 10 A

56. What is the value of R_s required to self bias an N channel JFET with $V_p = -10$ V, $I_{DSS} = 40$ mA and $V_{GSQ} = -5$ V?

(A) 250 Ω (B) 500 Ω

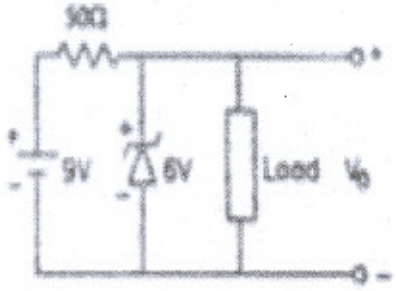
(C) 750 Ω (D) 1500 Ω

57. A half wave rectifier having a resistance load of 1 kΩ rectifiers an A.C voltage of 325 V peak value and the diode has a forward resistance of 100 Ω. What is the RMS value of the current?

(A) 295.4 mA (B) 94 mA

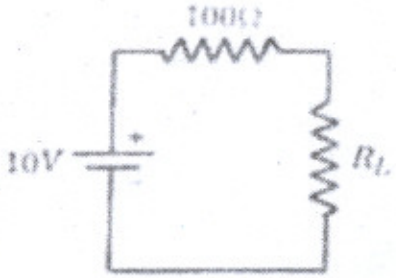
(C) 147.7 mA (D) 208 mA

58. A zener diode in the circuit shown in the figure is has a knee current of 5 mA, and a maximum allowed power dissipation of 300 mW. What are the minimum and maximum load currents that can be drawn safely from the circuit, keeping the output voltage v_o constant at 6 V?



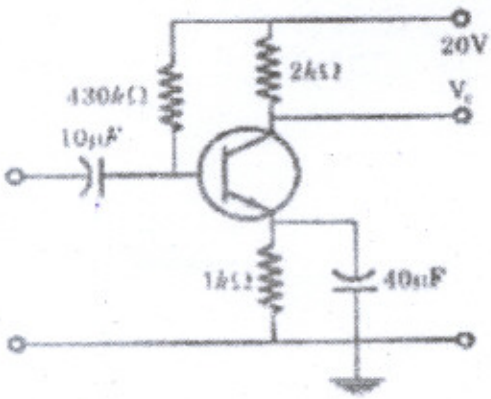
(A) 0 mA, 180 mA
(B) 5 mA, 110 mA
(C) 10 mA, 55 mA
(D) 60 mA, 180 mA

59. The maximum power that can be transferred to the load resistor R_L from the voltage source in the figure is



(A) 1 W
(B) 10 W
(C) 0.25 W
(D) 0.5 W

60. The circuit using a BJT with $\beta = 50$ and $V_{BE}=0.7$ V is shown in the figure. The base current I_B and collector voltage V_C are respectively



(A) 43 μA and 11.4 V
(B) 40 μA and 16 V
(C) 45 μA and 11 V
(D) 50 μA and 10 V

61. For a single mode optical cable with 0.25 dB/km loss, the optical power 100 km from a 0.1 mW source will be

(A) 31.6 μW (B) 316.22 μW (C) 0.316 mW (D) 31.6 mW

62. A GaAs optical source with a refractive index of 3.6 is coupled to a silica fibre that has a refractive index of 1.48. If the fibre end and source are in close physical contact, then the Fresnel reflection at the interface is

(A) 2.3 (B) 1.9 (C) 1.5 (D) 0.174

63. A glass fibre has refractive indices n_1 of 1.5 and n_2 of 1. Assuming $c = 3 \times 10^8$ m/s the multipath time dispersion will be

(A) 2.5 ns/m (B) 2.55 μs/m (C) 5 ns/m (D) 55 μs/m

64. A certain optical fibre has refractive index of clad (n_1)=1.4 and that of core (n_2)=1.05. Its numerical aperture will be

(A) 0.8575 (B) 0.9260 (C) 0.3500 (D) 0.15885

65. What is the responsitivity of the photodiode having quantum efficiency of 65% with photons of energy 1.5×10^{-19}J incident upon it?

(A) 0.832 AW^{-1} (B) 0.714 AW^{-1} (C) 0.694 AW^{-1} (D) 0.452 AW^{-1}

66. The normalized frequency of a step index fibre is 28 and 1300 nm wavelength. What is the total number (approximately) of guided modes that can be supported by the fibre?

(A) 50 (B) 200 (C) 400 (D) 800

67. For a MMS fibre n_1=1.5 and n_2=1.46, than the critical angle and acceptance angle will be

(A) 20.12° and 76.73° (B) 76.73° and 20.12°

(C) 29.12° and 78.73° (D) 78.73° and 29.12°

68. Photons of energy 1.53×10^{-19} J are incident on a photo diode which has a responsivity of 0.65 A/W. If the optical power level is 10 μW, then the generated photo current is

(A) 2.3 μA (B) 6.5 μA (C) 6.3 μA (D) 6.1 μA

69. A single mode optical fibre has a beat length of 8 cm at 1300 nm, then the birefringence will be

(A) 3.61×10^{-5} (B) 1.89×10^{8} (C) 6.55×10^{-8} (D) 1.63×10^{-5}

70. A double hetro junction InGaAsP LED emitting at a peak wavelength of 1310 nm has radiative and non-radiative recombination times of 30 and 100 ns, respectively. The drive current is 40 mA then the bulk recombination life time will be

(A) 231 ns (B) 23.1 ns (C) 2.31 ns (D) 0.231 ns

71. What is the nyquist rate for the signal $x(t) = \cos 2000\pi t + 3\sin 6000\pi t$?

(A) 2 kHz (B) 4 kHz (C) 12 kHz (D) 6 kHz

72. Which one of the following is correct? Energy of a power signal is

(A) finite (B) 0

(C) infinite (D) between 1 and 2

73. A system has poles at 0.01 Hz, 1 Hz and 80 Hz; zeroes at 5 Hz, 100 Hz and 200 Hz. The approximate phase of the system response at 20 Hz is

(A) $-90°$ (B) $0°$ (C) $90°$ (D) $-180°$

74. A 1 kHz sinusoidal signal is ideally sampled at 1500 samples/sec and the sampled signal is passed through an ideal low-pass filter with cut-off frequency 800 Hz. The output signal has the frequency

(A) 0 Hz (B) 0.75 kHz (C) 0.5 kHz (D) 0.25 kHz

75. What is the period of the sinusoidal signal $x(n)=5\cos[0.2\pi n]$?

(A) 10 (B) 5 (C) 1 (D) 0

76. Consider the following statements

(i) If S_1 and S_2 are linear, the S is linear

(ii) If S_1 and S_2 are non-linear, the S is non-linear

(iii) If S_1 and S_2 are causal, the S is causal

(iv) If S_1 and S_2 are time in-varient, the S is in-varient

True statements are,

(A) (i), (ii), (iii) (B) (ii), (iii), (iv)

(C) (i), (iii), (iv) (D) All

77. The sinusoidal signal has fundamental period N=10 samples. The smallest angular frequency, for which x(n) is periodic, is

(A) 1/10 rad/cycle (B) 10 rad/cycle

(C) 5 rad/cycle (D) π/5 rad/cycle

78. If a function f(t) u(t) is shifted to right side by t_0, then the function can be expressed as,

(A) $f(t- t_0)\ u(t)$ (B) $f(t)\ u(t- t_0)$

(C) $f(t- t_0)\ u(t- t_0)$ (D) $f(t+ t_0)\ u(t+ t_0)$

79. The average value of the full wave rectified sine wave with period π, and peak value of V_m is

(A) $0.707\ V_m$ (B) $0.500\ V_m$ (C) $0.637\ V_m$ (D) $0.318\ V_m$

80. Two rectangular waveforms of duration T_1 and T_2 second are convolved. What is the shape of the resulting waveform?

(A) Triangular (B) Rectangular

(C) Trapezoidal (D) Semi-circular

81. A typical number of diffusions used in making epitaxial diffused silicon integrated circuit is

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

82. The gate oxide thickness in the MOS capacitor is

(A) 50 nm (B) 143 nm (C) 350 nm (D) 1 μm

83. The maximum depletion layer width in silicon is

(A) 0.143 μm (B) 0.857 μm

(C) 1 μm (D) 1.143 μm

84. The source of a silicon ($n_i=10^{10}/cm^3$)n-channel MOS transistor has an Area of 1 sq μm and a depth of 1 μm. If the dopant density in the soured is $10^{19}/cm^3$, the number of holes in the source region with the above volume is approximately

(A) 10^7 (B) 100 (C) 10 (D) 0

85. In the NMOS inverter

(A) The driver and active load are enhancement type

(B) The driver and is enhancement type and load depletion type

(C) The drive is depletion type and load enhancement type

(D) Both driver and load are depletion type

86. A depletion type NMOS is operated in enhancement mode , $V_P = -4$ V. For $V_{GS} = 3$ V as V_{DS} is increased I_D becomes nearly constant when V_{DS} equals

(A) 1 V (B) 3 V (C) 4 V (D) 7 V

87. Electron mobility and life time in a semi-conductor at room temperature are respectively 0.36 $m^2/(Vs)$ and 340 μs. The diffusion length is

(A) 3.13 nm (B) 1.77 nm (C) 3.55 nm (D) 3.13 nm

88. An intrinsic semi-conductor with energy gap 1 eV has a carrier concentration N at temperature 200 K. Another intrinsic semi-conductor has the same value of carrier concentration N at temperature 600 K. What is the energy gap value for the second semiconductor?

(A) (1/3) eV (B) (3/2) eV (C) 3 eV (D) 9 eV

89. Isolation diffusion in a monolithic IC creates concentration of acceptor atoms in the region between the isolation islands of the order of

(A) $10^{15}\,cm^{-3}$ (B) $10^{20}\,cm^{-3}$ (C) $10^{25}\,cm^{-3}$ (D) $10^{35}\,cm^{-3}$

90. The chemical reaction involved in epitaxial growth in IC chips takes place at a temperature of about

(A) 500°C (B) 800°C (C) 1200°C (D) 2000°C

91. The number of bits required to store a 256 × 256 image with 32 gray levels

(A) 1732 bits (B) 327680 bits

(C) 1896 bits (D) 4567 bits

92. Intensity range of 8 bit pixel image is

(A) 0 to 7 (B) 0 to 15 (C) 0 to 31 (D) 0 to 255

93. The effect, caused by the use of an insufficient number of gray levels in smooth areas of a digital image is called

(A) false countering (B) gray level slicing

(C) bit plane (D) thinning

94. Sampling of an image required for

(A) quantization (B) sharpening

(C) smoothing (D) digitization

95. An image function f(x,y) is characterized by $f(x,y) = i(x,y)\, r(x,y)$ where

(A) $0 < i(x,y) < 1 \;\&\; 0 < r(x,y) < \infty$

(B) $0 < i(x,y) < 1 \;\&\; 0 < r(x,y) < 1$

(C) $0 < i(x,y) < \infty \;\&\; 0 < r(x,y) < \infty$

(D) $0 < i(x,y) < \infty \;\&\; 0 < r(x,y) < 1$

96. Consider an image of size M × N with 64 gray levels. The total number of bits required to store this digitizes image is

(A) M × N × 64 (B) M × N × 63 (C) M × N × 6 (D) M × N × 8

97. A pixel P at coordinates (x,y) has four horizontal and vertical neighbours whose coordinates are given by

(A) (x-1, y-1), (x-1,y), (x,y-1), (x,y+1)

(B) (x+1, y), (x-1,y), (x,y+1), (x,y-1)

(C) (x-1, y+1), (x-1,y), (x,y-1), (x,y-1)

(D) (x+1, y-1), (x+1,y), (x,y+1), (x-1,y+1)

98. An image of size 1024 × 1024 pixels in which the intensity of each pixel is an 8-bit quantity requires the storage space (if not compressed)

(A) 1 KB (B) 1 MB (C) 2 KB (D) 2 MB

99. In 8-distance measurement system distance between centre pixel and corner pixel is

(A) 2 unit (B) 1 unit (C) 1.5 unit (D) 1.75 unit

100. The D8 distance (chess board distance) between p and q with coordinates (x, y), (s, t) is defined as

(A) (x-s)+(y-t) (B) max (|x-s| , |y-t|)

(C) $[(x-s)+(y-t)]^2$ (D) min (|x-s| , |y-t|)