PAPER-2001

Q.1 A cylindrical block of a certain material has a resistance R as measured between its circular faces. To have the resistance, all the dimensions of the block must be

(a) doubled (b) halved

(c) decreased by $\sqrt{2\pi}$ (d) increased by $\sqrt{2\pi}$

Q.2 A series connection of a 10-volt battery , a resistor and an air-dielectric capacitor is in the steady state when suddenly, the capacitor plates are brought closer to half their original distance.

Then

(a) The capacitor voltage suddenly changes

(b) The charge in the capacitor suddenly changes

(c) The circuit current is momentarily unbounded

(d) The capacitor's stored energy eventually reaches half its initial value.

Q.3 The following is generally true

(a) A capacitor using air as dielectric has grearer capacitance than one using other material as dielectric

(b) An air cored inductor has a highly linear B/H characteristic

(c) The voltage across an inductor will decrease with increasing frequency of the applied current.

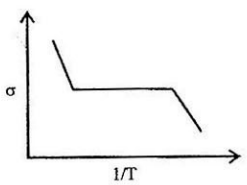
(d) The current in a capacitor will decreases with increasing frequency of the applied voltage.

Q.4 Two ceramic capacitors have the following parameters. One has capacitance C_1 and ceramic thickness d_1. The other has capacitance C_2 and ceramic thickness d_2. When the two are connected in parallel, the combination has a capacitance of

(a) $C = d_1 + d_2$ (b) $C = d_1 d_2/(d_1 + d_2)$

(c) $C = C_1 + C_2$ (d) $C = C_1 C_2/(C_1 + C_2)$

Q.5 The conductivity σ as a function of 1/T, where Tis the temperature, for a semiconducting material varies as shown in the figure. Using this information, state whether a resistance made from intrinsic semiconductor will have



(a) Positive tempreature coefficient of resistance

(b) Negative tempreature coefficient of resistance

(c) Zero temperature coefficient of resistance

(d) Initially positive and later negative temperature coefficient of resistance

Q.6 The time rate of change of a voltage applied across a 1μF capacitor is 2V/s. This means that the current flowing through the capacitor is

(a) 2×10^{-6} A (b) 2 A

(c) 0.5×10^{-6} A (d) 0.5 A

Q.7 The time rate of change of a current passed through a 1mH inductor is 2mA/s. This means that the voltage across the inductor is

(a) 0.5×10^{-6} V (b) 0.5 V

(c) 2×10^{-6} V (d) 2 V

Q.8 Which of the following statements is true?

(a) Both refrigerators and thermocouples can be made using the Peltier effect.

(b) Both refrigerators and thermocouples can be made using the Seebeck effect.

(c) Refrigerators can be made using the Peltier effect and thermocouples can be made using the Seebeck effect.

(d) Refrigerators can be made using the Seebeck effect and thermocouples can be made using the Peltier effect.

Q.9 For a voltage follower circuit using an op-amp, which of the following is true?

(a) both input and output impedance are very large

(b) input impedance is very large and the output impedance is very small

(c) input impedance is very small and the output impedance is very large

(d) both input and output impedance are very small

Q.10 The electron density profile in a piece of semiconductor at equilibrium is such that $n(x_1) = 10\,n(x_2)$. The hole density profile will be such that

(a) $p(x_1) = 10\,p(x_2)$

(b) $p(x_2) = 10\,p(x_1)$

(c) $p(x_1) = 100\,p(x_2)$

(d) insufficient information to answer

Q.11 A semiconductor is uniformly doped with N_A acceptors and N_D donors. Let the free electron and hole concentrations be n and p respectively. Assume that the sem conductor is at thermal equilibrium

and that 100% ionisation has taken place. Then which of the following is true?

(a) $N_A+N_D = p+n$ (b) $N_A-N_D = n-p$

(c) $N_AN_D = p\,n$ (d) $N_D-N_A = n-p$

Q.12 In a unifrom doped abrupt p-n junction, the doping level of the p-side is ten times the doping level of the n-side. The rat io w_p/w_n of the duplication layer widths in the p- and n-regions respectively is

(a) 0.1 (b) 1

(c) 2 (d) 10

Q.13 The breakdown in a Bipolar Transistor is characterised by two parameters; breakdown voltage with base open (BV_{CBO}) and breakdown voltage with emitter open (BV_{CEO}). Which one of the following is true?

a) $BV_{CBO} > BV_{CEO}$

(b) $BV_{CBO} < BV_{CEO}$

(c) $BV_{CBO} = BV_{CEO}$

(d) Can be larger or smaller depending on other factors

Q.14 An NPN Bipolar Transistor with a current gain of 100 is biased in saturation mode. If the base current is increased by

(a) $\Delta I_C > 100\Delta I_b$ (b) $\Delta I_C = 100\Delta I_b$

(c) $\Delta I_C < 100\Delta I_b$ (d) $\Delta I_C = \Delta I_b$

Q.15 Let β be the short circuit commonemitter current gain of a BJT biased in normal active mode. Let I_c be the collector current. Is this β

(a) a monotonically increasing function of Ic?

(b) a monotonically decreasing function of I_c?

(c) initially an increasing function of I_c, which reaches ε plateau, and then decreases with increasing I_c ?

(d) independent of I_c?

Q.16 An N-channel enhancement mode MOSFET with threshold voltage of 1V is biased at $V_{GS} = 2V$ and $V_{DS} = 2V$. If th drain voltage is doubled to 4V, the drain to source current will

(a) double

(b) more than double

(c) increase only slightly

(d) become half

Q.17 To double the drain current of an N-channel enhancement mode MOSFET biased in saturation

(a) Channel length should be doubled

(b) Channel width should be halved

(c) Channel length should be halved

(d) Oxide thickness should be doubled

Q.18 Consider the linear, constant coefficient, first order differential equation $dy/dt + ay = x$. The following is generally true.

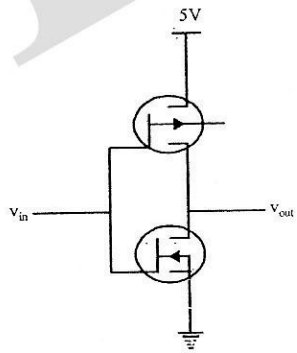
(a) The equation has a unique solution when $x = 0$

(b) The solution is unique for a given x only if he initial condition is not specified

(c) The solution is proportional to x for zero initial condition

(d) The solution for $x = 0$ is not proportional to the initial condition

Q.19 A CMOS Inverter is shown below in the figure For $V_{in} = V_{out} = 2.5$, which one of the following is true if the threshold voltage of the NMOS transistor is 1V and that of PMOS transistor is –1V.



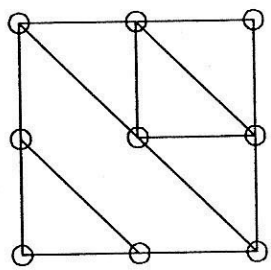
(a) NMOS is Linear region , PMOS in saturation

(b) NMOS in saturation region, PMOS in saturation

(c) NMOS is saturation, PMOS in linear region

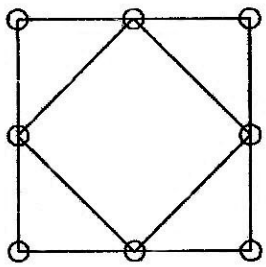
(d) NMOS in Linear region, PMOS in Linear region

Q.20 The number of node equation for a network with the graph shown below



(a) depends on the choice of datum node
(b) is less than 8
(c) is exactly 8
(d) is exactly 9

Q.21 Shown below in the graph of a network. The number of independent mesh currents that may be assigned in it is



(a) 4
(b) 5
(c) 6
(d) not fixed : it depends on the actual choice of the meshes

Q.22 The Laplace Transform
(a) is a real valued function of a complex argument
(b) is a complex valued function of a complex argument
(c) is a real valued function of a real argument
(d) is a complex valued function of a real argument

Q.23 For a pair of lossless inagnetically coupled coils with respective self inductances L_1 , L_2 (with $L_1 < L_2$) and mutual inductance M, the following is generally true.
(a) $M < L_1 + L_2$ (b) $M^2 < L_1 L_2$
(c) $M < \min(L_1, L_2)$ (d) $L_1 < M < L_2$

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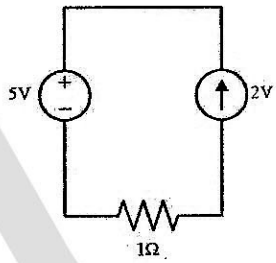
Q.24 The roll-off of a second order filter (in dB/decade) i equal to
(a) 6 (b) 8
(c) 20 (d) 40

Q.25 The secondary coil of an ideal 2 : 1 transformer has a 1 Farad capacitor connected across its terminals. The component that needs to be put in series with the primary coil in or der that the effective power factor of the combination on the primary side is zero is
(a) L=4H
(b) C=0.5F
(c) R=0.5Ω
(d) there is insufficient information to answer the question

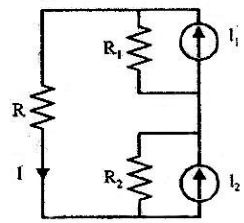
Q.26 Two linear capacitor, C_2 ,(with V volts across it initially) and a resistor R are wired into a series circuit which is closed at t = 0
(a) The initial series current depends on V but not on R
(b) The final current is inversely proportional to R
(c) The final charges on the two capacitors will be of equal magnitude
(d) The final voltage on the two capacitors will be of equal magnitude

Q.27 For the circuit shown in figure



(a) The current depends on the resistor
(b) The voltage across the current source depends on the resistor
(c) The current depends on the voltage source
(d) If the resistor were zero, the current would tend to infinity.

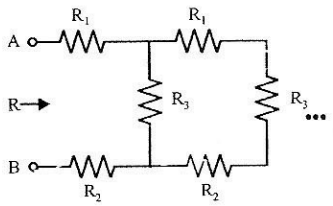
Q.28 For the circuit shown in figure, the following is true in general



(a) The current I through R is 0
(b) The voltage across he two current sources are equal
(c) The voltage across R will tend to increase without limit as R increases
(d) The superposition theorem is valid in the present case

Q.29 The circuit shown in figure is an intinite ladder of

identical repeating sections R_1, R_2, R_3 . L et R be the ner resistance as seen from AB.



(a) R is independent of R_3
(b) Given R. it uniquely determines the values of R_1, R_2, R_3
(c) R increase as R_3 decreases
(d) R depends only on the sum R_1+R_2, and not upon their individual values

Q.30 A peak detector comprises a capacitor and and ideal diode and an ac source in series. The following is true of the circuit
(a) The instantaneous current depends only on the instantaneous source voltage
(b) The diode voltage is always zero
(c) The instantaneous current depends only on the diode
(d) The energy stored in the capacitor can never decrease with time

Q.31 A capacitive divider network has an input/output voltage ratio under no load of 1 : 0.2. If its input and output and output terminals are interchanged the new output voltage, when compared to the new input voltage under no load is
(a) one - fifith (b) five times
(c) equal (d) zero

Q.32 Let x(t) = u(t)* v(t) where* denotes the convolution operation. The following is false
(a) x(t) is nonnegative when both u(t) and v(t) are nonnative
(b) the area under x(t) equals the product of the areas under u(t) and v(t).
(c) $u(-t) * v(-t) = x(-t)$
(d) $u(t-t_0) * v(t-t_0) = x(t-t_0)$

Q.33 If the electric field vector is $\bar{E} = -2\bar{a}_x + 3\bar{a}_y + 5\bar{a}_z$ and the magnetic field vector is $\bar{H} = \bar{a}_x + 3\bar{a}_y - 4\bar{a}_z$,then $\bar{E} \times \bar{H}$ is equal to
(a) $-27\bar{a}_x - 3\bar{a}_y - 9\bar{a}_z$ (b) $-2\bar{a}_x - 9\bar{a}_y - 20\bar{a}_z$
(c) $5\bar{a}_x + 3\bar{a}_y - 10\bar{a}_z$ (d) $\bar{a}_x + \bar{a}_y - \bar{a}_z$

Q.34 The relationship between electric field strength $(\bar{E})$ and the potential difference (V) at any point is given by
(a) $\bar{E} = V\bar{a}_r$ (b) $\bar{E} = -\nabla V$
(c) $V = \nabla \cdot \bar{E}$ (d) $\bar{E} = \nabla \times \nabla V$

Q.35 The concept of electromagnetic propagation was first introduced by
(a) Faraday (b) Ampere
(c) Coulomb (d) Maxwell

Q.36 If $\bar{A} \cdot \bar{B} = \bar{A} \cdot \bar{C}$ and $\bar{A} \times \bar{B} = \bar{A} \times \bar{C}$. where $\bar{A}$ is nor a null vector, then
(a) $\bar{B} = 0$ (b) $\bar{A} = \bar{C}$
(c) $\bar{B} = \bar{C}$ (d) $\bar{C} = 0$

Q.37 The boundary condition for electrostatic field at an interface between a conductor and a dielectric with permittivity ε is [Note : $\bar{E}_t$ and $\bar{E}_n$ are tangential and normal components of electric field at the interface]
(a) $\bar{E}_t = \infty$ (b) $\bar{E}_n = 0$
(c) $\bar{E}_t = 0$ (d) $\bar{E}_n = \infty$

Q.38 The governing equation for steady current density $\bar{J}$ in the absence of non-conservative energy sources is
(a) $\nabla \cdot \bar{J} = 0$ (b) $\nabla \cdot \bar{J} = -\partial\rho/\partial t$
(c) $\nabla \times \bar{H} = \bar{J} + \partial\bar{D}/\partial t$ (d) $\bar{J} = 0$

Q.39 The fundametal postulate of magnetostatic $\nabla \bar{B} = 0$ in free space is based on
(a) Biot Savant Law
(b) Ampere's Law
(c) Faraday's Law
(d) Law of conservation of magnetic flux

Q.40 A plane wave with the following instantaneous expression for electric field is

$E(z,t) = a_x E_{10} \sin(\omega t - kz) + a_y E_{20} \sin(\omega t - kz)$

(a) Linear polarized
(b) right-hand circular polarized
(c) left hand circular polarised
(d) elliptically polarised

Q.41 Two identical resistive loads consume W watts each when connected in parallel acrose n ideal current source of I amperes. If, instead, they were connected in series with the same source, their total consumption
(a) would halve
(b) would double
(c) would remain the same
(d) would increases by a factor of 4

Q.42 A waitmeters will read zero under the following condition
(a) The voltage and current are exactly in phase
(b) The voltage and current have the same time periods but the voltage is sinusoidal whereas the current is square wave
(c) The voltage frequency is twice the current frequency
(d) The current is dc and the voltage is sinusodial

Q.43 On an induction type energy meter, is written "600 rev/kWh". If it is to be used an approximate wattmeter which is read off in rpm, a 600 watt load would read as
(a) 10 rpm (b) 6 rpm
(c) 1 rpm (d) 36 rpm

Q.44 We are given a delay line of unknown delay. If a 100kHz sinusoid ia applied as input, the output lags the input by 90^0. if an 80kHz sinusoid is applied as input, the output is seen to b exactly in phas with the input. The delay introduced by the line is
(a) 32.5 μ s (b) 25 μ s
(c) 50 μ s (d) 12.5 μ s

Q.45 A system is said to be BIBO stable if Bounded inputs always yield Bounded Output . By this criterion,
(a) an integrator is stable but a differentiator is not
(b) a differentiator is stable but an integrator is not
(c) neither the differentiator nor the integrator is stable
(d) both the differentiator and integrator and integrator are stable

Q.46 In a three-phase delta-connected balanced load
(a) line current is equal to the phase current
(b) line current is three times the phase current
(c) line current is $\sqrt{3}$ times the phase current
(d) line current is the sum of the three phase currents

Q.47 A 440 V 6-pole 50 Hz three-phase induction motor is operating from a 440 V supply and driving a finding mill, supplying rated HP. The rpm of the motor is approximately equal to
(a) 960 (b) 1000
(c) 1440 (d) 1500

Q.48 For a single phase fully controlled converter bridge operating with continuous load current, the converter will operate in inverting mode for triggering angle, α , such that:
(a) $0 < \alpha < \pi/2$ (b) $\pi/2 < \alpha < \pi$
(c) $\pi/4 < \alpha < 3\pi/4$ (d) $\alpha > \pi$

Q.49 The following is generally true. RC snubber is used to protect the SCR
(a) against device overvoltage
(b) against device over current
(c) against forward dv/dt
(d) against di/dt

Q.50 For a 50 Hz ac input, the ripple frequency in the output that a full-wave rectifier produces in equal to
(a) 25 Hz (b) 50 Hz
(c) 100 Hz (d) 200 Hz

Section - B

Q.51 An opamp based inverting amplifier has a gain of -10 and a bandwidth of 100kHz . If th gain of the amplifier is reduced to unity, its bandwidth will changes to
(a) 10 kHz (b) 100 kHz
(c) 1MHz (d) 10 MHz

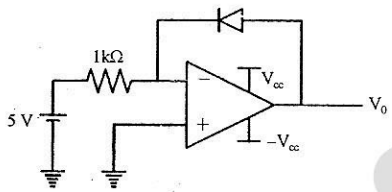
Q.52 As compared to a BJT amplifier , an amplifier made using a JFET is likely to have
(a) very high voltage gain
(b) very high bandwidth
(c) very high voltage swing
(d) very high input resistance

Q.53 The voltage gain of a common emitter amplifier is
(a) directly proportional to collector bias current
(b) inversely proportional to collector bias current

(c) independent of collector bias current
(d) proportional to square of collector bias current

Q.54 If the emitter bypass capacitor in a common emitter amplifier is removed, then
(a) input resistance will decrease
(b) lower cut-off frequency will increase
(c) voltage gain will decrease
(d) upper cut-off frequency will decrease

Q.55 When the diode is ideal in the circuit shown below, the output voltage will be close to



(a) 0.7 volts (b) +5V
(c) 0 volts (d) $-V_{cc}$

Q.56 Use of a series-shunt negative feedback in an amplifier will
(a) increase input impedance & decrease output impedance
(b) decrease input impedance & decrease output impedance
(c) decrease input impedance & increase output impedance
(d) increase input impedance & increase output impedance

Q.57 A power amplifier can safely deliver a load power of 10 W at an ambient temperature of 25° C. If the maximum allowable junction temperature is 125°C, how much power can be safely delivered to the load if the ambient temperature increase to 75° C?
(a) 7.5W (b) 2.5 W
(c) 8 W (d) 5 W

Q.58 Difference amplifier has a differential mode gain of 100 and a common mode rejection ratio of 1000. If the two applied input voltage are v_1 and v_2 the output voltage will be

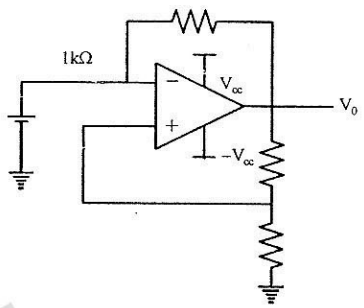
(a) $100(v_1 - v_2) + 0.1\dfrac{(v_1 + v_2)}{2}$

(b) $100\dfrac{(v_1 + v_2)}{2} + 0.1(v_1 - v_2)$

(c) $100(v_1 - v_2) + 10^5\dfrac{(v_1 + v_2)}{2}$

(d) $100\dfrac{(v_1 + v_2)}{2} + 100(v_1 - v_2)$

Q.59 The voltage at the output of he circuit shown below will be

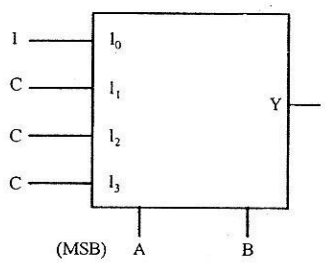


(a) zero (b) $+V_{cc}$
(c) triangular wave (d) square wave

Q.60 The number of different Boolean functions of 4 variables is
(a) 2^{16} (b) 16^2
(c) 4^2 (d) 16^4

Q.61 The delay of single TTL inverter is approximately equal to
(a) 500 ns (b) less than 10 ns
(c) 1 μs (d) 10 μs

Q.62 Expression for Y(A, B, C) in figure, where A, B, and C are Boolean variables is

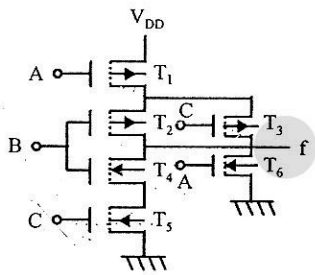


(a) $\overline{AB} - \overline{A}BC$ (b) $A + BC$
(c) $\overline{AB} + BC$ (d) $\left(AB + A\overline{B}\right)C$

Q.63 A 10 bit ADC has a range of ±5 V. The resolution of the ADC is approximately
(a) 10mV (b) 100 mV
(c) 0.5 V (d) 1 V

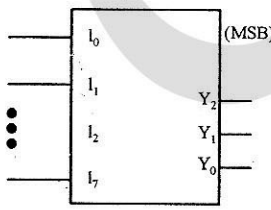
Q.64 The number of address lines in a 8 bit 4k ROM isa
(a) 8 (b) 10
(c) 12 (d) 16

Q.65 If figure, T_1, T_2, and T_3 are p-channel MOS transistors, and T_4, T_5 ant T_6 are n-channel MOS transistors. A, B and C are binary signals. The output f (A, B, C) is



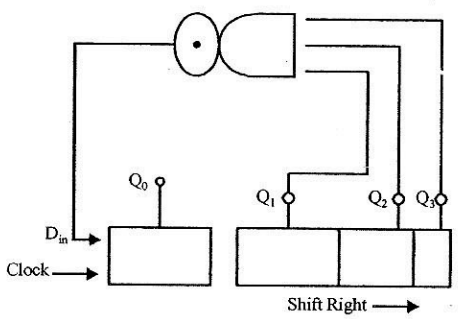
(a) $\overline{A}(\overline{B}+\overline{C})$ (b) $A+BC$
(c) $A(B+C)$ (d) ABC

Q.66 An eight lines to three lines encoder is shown in figure. The output Y_1 is



(a) $I_1+I_3+I_5+I_7$ (b) $I_2+I_3+I_6+I_7$
(c) $I_4+I_5+I_6+I_7$ (d) $I_1+I_3+I_4+I_7$

Q.67 The initial state of the shift register in figure is '$Q_0Q_1Q_2Q_3$' = 1100. The sequence appearing on Q_0 if a periodic clock is applied



(a) 111001 (b) 100111
(c) 100110 (d) 110011

Q.68 The use of PI controllers
(a) reduces oscillations
(b) results in zero steady-states error for step input
(c) lowers peak overshoot
(d) improve relative stability

Q.69 The system described by the state equation

$$x=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}x+bu$$

is completely controller is b is given by

(a) $b=\begin{bmatrix}1\\1\\0\end{bmatrix}$ (b) $b=\begin{bmatrix}0\\1\\0\end{bmatrix}$

(c) $b=\begin{bmatrix}1\\0\\0\end{bmatrix}$ (d) $b=\begin{bmatrix}0\\0\\1\end{bmatrix}$

Q.70 The root locus branches of the system with characteristic equation

$$1+\frac{-50}{s^5+2s^4+24s^3+48s^2-25s}=0$$

cross the $j\omega-$axis at
(a) $\pm j3$ (b) $\pm j5$
(c) $\pm j4$ (d) $\pm j\sqrt{5}$

Q.71 In feedback control system with G(s) = 16/[s(s + 4)] and H(s) = 1 + Ks, the damping ratio of 0.6 will be achieved for K equal to
(a) 0.1 (b) 0.02
(c) 0.025 (d) 0.05

Q.72 A single input single output linear time invariant system described by nth order differential equation is adequately described in state space by
(a) n + 2 state equations
(b) n + 1 state equations
(c) n state equations
(d) n – 1 state equations

Q.73 Identify the matrix that can be a state transition matrix.

(a) $\Phi = \begin{bmatrix} e^{-t} & 0 \\ 1 & e^{-2t} \end{bmatrix}$

(b) $\Phi = \begin{bmatrix} e^{-t} & t \\ 1 & 2e^{-t} \end{bmatrix}$

(c) $\Phi = \begin{bmatrix} e^{t} + e^{-t} & 0 \\ 0 & 2e^{-t} \end{bmatrix}$

(d) $\Phi = \begin{bmatrix} e^{-t} & 0 \\ 0 & e^{-2t} \end{bmatrix}$

Q.74 The number of roots of the equation $s^6 - 2s^5 - s^4 - 2s^2 + 8s + 8 = 0$ in the right half plane is

(a) Two (b) Zero
(c) Three (d) four

Q.75 AM broadcast systems use a MW band which extends from

(a) 30 MHz to 300 MHz
(b) 1 MHz to 300 MHz
(c) 540 kHz to 1.6 MHz
(d) 330 kHz to 960 kHz

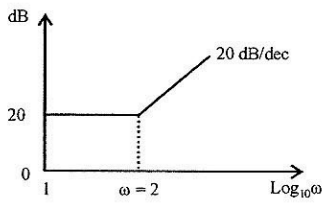
Q.76 In Indian TV, video signal bandwidth is

(a) 15 kHz (b) 5 MHz
(c) 5.5 MHz (d) 7 MHz

Q.77 Two random variables U and V are distributed according to $f_{u,v}(u,v) = (C/3)e^{-u-v}$ (for $u \geq 0, v \geq 0$),and = 0 (otherwise) where C, a constant, is equal to

(a) 3 (b) 2
(c) 1 (d) 1/2

Q.78 Identify the transfer function corresponding th the dB plot of minimum phase system in figure.



(a) $5(s+2)$ (b) $10(0.5s+1)$
(c) $10(2s+1)$ (d) $20(1+2s)$

Q.79 Hilbert transform of $[A\cos(2\pi f_o t + \theta)]$ is

(a) $-A\sin(2\pi f_o t + \theta)$ (b) $A\cos(2\pi f_o t + \theta)$
(c) $-A\cos(2\pi f_o t + \theta)$ (d) $A\sin(2\pi f_o t + \theta)$

Q.80 The signalling information in a 30-channel PCM system has a bit rate of

(a) 2.048 Mbps (b) 64 kbps
(c) 8 kbps (d) 2 kbps

Q.81 The modulated carrier average power in an FM system is equal to the

(a) modulating signal power
(b) sum of the modulated signal power and the unmodulated carrier power
(c) difference between the modulating signal power and the unmodulated carrier power
(d) unmodulated carrier power

Q.82 In superheterodyne radio receiver, the RF amplifier

(a) removes the need for the mixer stage
(b) improves sensitivity of the receiver
(c) creates image channel interference
(d) removes the need for the detector stage

Q.83 A low-pass signal having a bandwidth of 3500 Hz is sampled such that a guard band is available for ease in filtering. Th sampling frequency used in 7500 Hz. The guard bandwidth is

(a) 500 Hz (b) 1000 Hz
(c) 250 Hz (d) 4000 Hz

Q.84 The output of a system is $y(t) = x(0) - x(t)$, where $x(t)$ is the input to the system. The system is

(a) linear and time varying
(b) non-linear and time varying
(c) linear and time invariant
(d) non-linear and time invariant

Q.85 For the modulated carrier

$s(t) = 200\sin(\omega_c + 200\pi)t + 1000$

$\cos(\omega_c t) - 200\sin(\omega_c - 200\pi)t,$

where $1000\cos(\omega_c t)$ is the unmodulated carrier, the complex envelop is

(a) $1000 + 400\sin(200\pi t)$

(b) $1000+200\sin(200\pi t)$

(c) $1000-200\sin(200\pi t)$

(d) $400\sin(200\pi t)$

Q.86 Carson's bandwidth for an angle modulated carrier

$s(t) = A\cos\cos[2\pi\times10^6 t + 0.5\sin(1000\pi t)]$

is given by

(a) 2 MHz (b) 500 Hz

(c) 1000 Hz (d) 1500 Hz

Q.87 In a binary PCM system, the maximum tolerable error in sample amplitudes is 0.25% of the peak input signal amplitude. The input signal bandwidth is 5 MHz. The minimum rate of transmission of the PCM coded bits is

(a) 70 Mbits/sec (b) 80 Mbits/sec

(c) 90 Mbits/sec (d) 1000 Mbits/sec

Q.88 The input to a linear delta modulator is a sinusodial signal having a peak amplitude of 1 volt. The maximum input signal frequency is 4000 Hz. The input signal is sampled at 8 times the Nyquist rate. The step size for a 800 Hz input, assuming no slope overload, is

(a) $\pi/40$ volts (b) $\pi/8$ volts

(c) $\pi/20$ volts (d) $\pi/4$ volts

Q.89 A uniform sinusoidal plane wave in air has the following phasor expression for electric field:

$\bar{E}(x,z) = \bar{a}_y 10e^{j(6x+8z)}\,v/m$

The frequency of operation will be

(a) 4.78×10^8 Hz (b) 2×10^8 Hz

(c) 10^9 Hz (d) 3.82×10^8 Hz

Q.90 If a loosless line is terminated with a load impedance $40 + j30\,\Omega$, then the characteristic impedance of the line for minimum possible standing wave ratio (SWR) will be

(a) $70\,\Omega$ (b) $25\,\Omega$

(c) $50\,\Omega$ (d) $100\,\Omega$

Q.91 A standard air-filled rectangular waveguide has dimensions a = 7.21 cm and b = 3.4 cm. The type of mode that can be used to transmit electromagnetic wave with wavelength $\lambda = 10$ cm is

(a) TE_{10} (b) TE_{11}

(c) TE_{20} (d) TM_{11}

Q.92 An antenna at the earth station of a satellite communication link having a gain of 55dB at 14 GHz is aimed at a geostationary satellite 36,500 km away. The receiving antenna on the satellite has a gain of 35dB. The earth station transmitted power, for receiving a signal power of 2.1877×10^{-9} W at the output of the receiving antenna, is

(a) 0.1 kW (b) 0.5 kW

(c) 1 kW (d) 10 kW

Q.93 A parabolic dish antenna with an efficiently of 55% and an operating frequency of 10GHz has a gain of 43.82 dB. Its diameter is

(a) 1 m (b) 2 m

(c) 4 m (d) 8 m

Q.94 The binary number 111 represents

(a) –3 in sign magnitude system and –1 in two's complement system

(b) 7 in sign magnitude system and –1 in two's complement system

(c) –3 in sign magnitude system and –3 in two's complement system

(d) 7 in sign magnitude system and –3 in two's complement system

Q.95 Microprogramming is a technique commonly used of implement

(a) data path of a processor

(b) cache memory

(c) control unit of a processor

(d) none of the above

Q.96 Compared to a CISC Processor, a RISC processor has

(a) reduced Cache memory

(b) reduced number of interrupts

(c) less number of instructions

(d) reduced address lines

Q.97 An 8085 processor has register contents SP = 5FF8H, B = 34H, and C = 7 FH before the execution of instruction PUSH B. The value of SP and the content of the Stack Top after the execution of the instruction respectively are

(a) 5FFAH and 7FH (b) 5FF6H and 34H

(c) 5FF6H and 7FH (d) 5FF8H and 34H

Q.98 Which instruction in an 8085 processor can set a flag ?
(a) MOV B, C (b) JNZ 21 00H
(c) STA 20 00H (d) ADD B

Q.99 How amny machine cycles will the execution of instruction STA 20 00H instruction take in an 8085 processor
(a) 3 (b) 4
(c) 5 (d) 6

Q.100 The following instruction have been executed by an 8085 processor:

Address (Hex)	Instruction
6000	MVI A, 78 H
6002	RLC
6003	JC 70 00 H

The next address will be
(a) 6004 H (b) 6006 H
(c) 7000 H (d) none of the above

SECTION - C

Directions:- Read the following passage carefully and answer Questions 101 to 103 on the basis of the information contained in the passage.

One simple physical concept lies behind the formation of the star gravitational instability. The concept is not new; Newion first perceived it late in the 17th century.

Imagine a uniform, static cloud of gas in space. Imagine that the gas in somehow disturbed so that one small spherical region becomes a little denser than the gas around it so that the small regions's gravitational field becomes slightly stronger. It now attract's more matter to it and its gravity increases further, causing it to begin to contract. As it contracts its density increases. which increase its gravity even more, so that it picks up even more matter and contracts even further. The process continues until the small region of gas finally forms a gravitatonally bound object.

Q.101 The primary purpose of the passage is to
(a) demonstrate the evolution of the meaning of a term
(b) depict the successive stages of a phenomenon
(c) establish the pervasiveness of a process
(d) support a theory considered outmoded.

Q.102 It can be inferred from the passage that the author considers the information contained within it as
(a) Controversial but irrefutable
(b) Speculative out profitable
(c) Uncompleted and traditional
(d) Original but obscure

Q.103 The author provides information that answers which of the following questions
i. How does the small regions increasing density affects its gravitational field?
ii. What causes the disturbance that changes the cloud from its original static state?
iii. What is the end result of the gradually increasing concentration of a small region of gas ?
(a) i only (b) ii only
(c) i and iii only (d) All of them

Directions :- Each sentence (questions 104 - 110) below has one or two blanks indicating that something has been omitted. Beneath the sentence are four lettered words or set of words. Choose the word or set of words or set of words for each blank that best fit the meaning of the sentence.

Q.104 Criticism that tears down without suggesting areas of improvement is not _____and should be avoided if possible.
(a) Representative (b) Constructive
(c) Sagacious (d) Mandatory

Q.105 An essential purpose of the criminal justices system is to enable purgation to take place; that is. to provide a _____ by which a community expresses its collective _____ the transgression of the criminal.
(a) catharsis ..... outrage at
(b) disclaimer .....forgiveness of
(c) means ..... empathy with
(d) document ..... disapprobation of

Q.106 Unable to _____ his wholehearted distaste for media events and unnecessary publicity, Dean Brower continued to make _____ comments throughout the ceremony.
(a) control ..... garbled
(b) maintain ..... copious
(c) conceal ..... effusive
(d) disguise ..... caustic

Q.107 Despite her_____ unwillingness, the promoters were still hopeful that, given sufficient diplomacy and flattery on their part, they could _____ her into signing the recording

contract.
(a) patent .....entrap (b) extreme ..... intimidate
(c) apparent .....shame (d) obvious ..... inveigle

Q.108 The perpetual spinning of particles is much like that of a top, with one significant difference: unlike the top, the particles have no need to be wound up, for _____ is one of their ____ properties.
(a) revolution ..... radical
(b) motion ..... intangible
(c) rotation ..... intrinsic
(d) collision ..... hypothetical

Q.109 He conducted the interrogation not only with dispatch but also with _____ being who is _____in manner yet subtle in discrimination.
(a) Finesse ..... expeditious
(b) Elan ..... enthusiastic
(c) Equanimity ..... abrupt
(d) Trepidation ..... cursory

Q.110 His employers could not complain about her work because she was _____ in the _____ of her duties.
(a) derelict ..... performance
(b) meticulous ..... postponement
(c) hidebound ..... conception
(d) assiduous ..... execution

Directions :- Select the best answer from the lettered choices given below each of items 111 - 120.

Q.111 For which of the following is capillarity NOT the only reason ?
(a) Rising of sub-soil water
(b) Blotting of ink
(c) Spread of water drop on a cotton cloth
(d) Rising of sap in plants

Q.112 Consider the following statements regarding a motor car battery
(i) The voltage is approximately 1.5 volts
(ii) Electrodes are lead and copper
(iii) Electrolyte used is hydrochloric add
(iv) Rating is expressed as Ampere hours
(a) I only (b) II only
(c) IV only (d) II , III and IV only

Q.113 Match quantities in List - I with units in List - II

List - I	List - II
A. Speed	1. Mach number
B. Wavelength	2. Angstrom
C. Pressure	3. Pascal
D. Energy	4. Joule

Codes:

TABLE

Q.114 Wireless Application Protocol (WAP) is an emerging protocol that enables communication between
(a) Wireless in Local Loop (WLL) devices
(b) Mobile and wired devices
(c) Between different kinds of mobile devices
(d) All of the above

Q.115 Convergence Act 2000 aims to intograte the following functions :
(a) Brodcasting, telecommunications and interne
(b) Railways , road transport and shipping
(c) All India Radio and Doordarshan
(d) Land and mobile telephony

Q.116 What is the name of Doordarshan's educational channel?
(a) Guru Kool (b) Gyan Darshan
(c) Gyan Bharati (d) Gyan Samriti

Q.117 Sardar Sarovar is situated on which river?
(a) Tapti (b) Godavari
(c) Kaveri (d) Narmada

Q.118 Sheiharikota is situated in which state?
(a) Tamilnadu (b) Karnataka
(c) Kerala (d) Andhra Pradesh

Q.119 Jaya Prakash Narayan proposed the following movement:
(a) Total revolution
(b) Presidential government
(c) Antodaya
(d) Sarvodaya

Q.120 Mahatma Gandhi was assassinated at which place?
(a) Teen Murti House (b) Birla House
(c) Birla Mandir (d) Raj Ghat

EXPLANATIONS

Q.1 *Ans.(a)*

$$R = \frac{\rho \ell}{A} = \frac{\rho \ell}{\pi r^2}$$

$$\Rightarrow \quad R \propto \ell$$

$$\& \quad R \propto \frac{1}{r^2}$$

Q.2 *Ans.(d)*

$\therefore \quad v_c(0-) = v_c(0+)$

$\therefore$ The capacitor voltage does not changes suddenly.

$$C = \frac{\varepsilon A}{d}$$

$$d = \frac{d}{2}$$

$$C = \frac{\varepsilon A}{d}$$

$$= \frac{\varepsilon A}{d/2}$$

$$= 2C$$

capacitor's stored energy, $E = \frac{1}{2}\frac{Q^2}{C}$

charge on the capacitor will remain same.

$$C = 2C$$

$$\Rightarrow \quad E = E/2$$

Q.3 *Ans.(b)*

$$C = \varepsilon_r C \text{ where } t_r > 1$$

$$v_L = j\omega L \cdot i_L$$

$$\Rightarrow \quad v_L \propto \omega$$

$$i_c = j\omega C \cdot v_c$$

$$i_c \propto \omega$$

Q.4 *Ans.(c)*

In parallel connection, $C = C_1 + C_2$

In series connection., $C = \frac{C_1 C_2}{C_1 + C_2}$

Q.5 *Ans.(b)*

Intrinsic semiconductor has negative temperature coefficient of resistane.

Q.6 *Ans.(a)*

$$i_c = C\frac{dv_c}{dt}$$

$$= 1 \times 10^{-6} \times 2$$

$$= 2 \times 10^{-6} A$$

Q.7 *Ans.(c)*

$$v_L = L\frac{di_L}{dt}$$

$$= 1 \times 10^{-3} \times 2 \times 10^{-3}$$

$$= 2 \times 10^{-6} V$$

Q.8 *Ans.(c)*

Note: Reversion of the seeback effect is Peltier effect.

Q.9 *Ans.(b)*

Voltage follower circuit is common collector configuration.

Q.10 *Ans.(b)*

At equilibrium,

$$n_1 p_1 = n_2 p_2$$

Q.11 *Ans.(d)*

Since the semionductor is eletrically neutral, therefore, at thermal equilibrium.

$$N_D + P = N_A + n$$

$$\Rightarrow \quad N_D - N_A = n - p$$

Q.12 *Ans.(a)*

Since the net charge must be zero, therefore

$$N_A W_P = N_D W_n$$

$$\Rightarrow \quad \frac{W_P}{W_n} = \frac{N_D}{N_A} = \frac{1}{10} = 0.1$$

Q.13 *Ans.(a)*

The breakdown voltage in the common base BV_{CBO} is significantly greater than BV_{CEO}.

Q.14 *Ans.(c)*

In saturation mode,

$$h_{fe} I_B \geq i_{cs}$$

Q.15 *Ans.(c)*

fig. page no. 22

At low injection levels β is degraded by poor emitter injection efficiency. At high currents, β decreases due to excess majority charge in the base.

Q.16 *Ans.(b)*

$$I_D = K(V_{GS} - V_T)^2$$

Q.20 *Ans.(c)*

Number of node equations = n – 1

where n = number of nodes

Q.21 *Ans.(b)*

Number of independent mesh current,

$$\ell = b - n + 1$$

$$= 12 - 8 + 1$$

$$= 5$$

Q.22 *Ans.(b)*

is a complex valued function of a complex argument

Q.23 *Ans.(b)*

$$M = K\sqrt{L_1 L_2}$$

where K = coupling coefficient

& $0 \leq K \leq 1$

Q.24 *Ans.(d)*

Q.25 *Ans.(*)*

Q.26 *Ans.(c)*

Q.27 *Ans.(b)*

Voltage across current source is $5-2\times1=3$ V with the polarity 3s shown in the diagram.

fig. page no. 23

Q.28 *Ans.(d)*

Superpositon theorem is applicable to lienear network which comprise independent sources, linear dependent source and linear passive elements like resistor, inductor, capacitor and transformer.

Q.29 *Ans.(d)*

fig. page no. 29

$$R = R_1 + \frac{R_3 R}{R_3 + R} R_2$$

$$R_3R + R^2 = R_1R_2 + R_1R + R_3R + R_2R_3 + R_2R$$

$$\Rightarrow R^2 - (R_1R_2)R - (R_1R_3 + R_2R_3) = 0$$

$$\Rightarrow R = \frac{R_1 + R_2 \pm \sqrt{(R_1+R_2)^2 + 4(R_1+R_2)R_3}}{2}$$

Hence, R depends only on the sum $R_1 + R_2$ and not upon their individual values.

Q.30 *Ans.(d)*

The capacitor gets charged to the most positive value of the input.

Q.31 *Ans.(b)*

$1:0.2 \Rightarrow 5:1$

On interchanging.

$$\frac{\text{input}}{\text{cutput}} = \frac{1}{5}$$

Q.32 *Ans.(d)*

$$u(t-t_0) \times v(t-t_0) = x(t-2t_0)$$

Q.33 *Ans.(a)*

Q.34 *Ans.(b)*

Q.35 *Ans.(d)*

Q.36 *Ans.(c)*

Q.37 *Ans.(c)*

Q.38 *Ans.(b)*

Q.39 *Ans.(d)*

Q.40 *Ans.(d)*

Q.41 *Ans.(d)*

In parallel connection, current through each resistor is 1/2.

$$W = \left(\frac{1}{2}\right)^2 R = \frac{I^2R}{4}$$

In series connection

$$W = I^2R = 4\text{ W}$$

Q.42 *Ans.(d)*

Q.43 *Ans.(b)*

$$\text{Wattmeter reading} = \frac{600\times600}{1000\times60} = 6\text{ rpm}$$

Q.44 *Ans.(d)*

Q.45 *Ans.(b)*

Q.46 *Ans.(c)*

Q.47 *Ans.(b)*

$$\text{Speed of motor} = \frac{120f}{p}$$

$$= \frac{120\times50}{6}$$

$$= 1000\text{ rpm}$$

Q.50 *Ans.(c)*

The ripple frequency in the output of a full-wave rectifiler is double to the line frequency.

Q.51 *Ans.(c)*

Gain × Bandwidth = Constant

$$BW' = \frac{10\times100\times10^3}{1} = 1\text{MHZ}$$

Q.53 *Ans.(a)*

$$A_V = \frac{V_0}{V_i} = \frac{-I_cR_L}{V_i}$$

$$\Rightarrow \quad A_V \propto I_C$$

Q.54 *Ans.(c)*

Q.55 *Ans.(c)*

Q.56 *Ans.(d)*

Q.57 *Ans.(d)*

$$T_1 - T_2 = KP$$

where K = Constant

$$K = \frac{125-25}{10}10\,^{\circ}\text{C/W}$$

$$P = \frac{125-75}{10}5\text{W}$$

Q.58 *Ans.(a)*

Q.59 *Ans.(a)*

Q.60 *Ans.(a)*

Number of Boolean functions = 2^{2^n}

where n = number of variables

Q.61 *Ans.(b)*

Q.62 *Ans.(c)*

$$Y = \overline{A}\,\overline{B} + \overline{A}BC + ABC$$

or $$Y = \overline{A}\,\overline{B} + BC$$

Q.63 **Ans.(a)**

$$\text{Resolution} = \frac{V_{max} - V_{min}}{2^n}$$

where n = number of bits

$$\text{Resoution} = \frac{5-(-5)}{2^{10}}$$

$$= \frac{10}{1024}$$

$$\approx 10\,\text{mV}$$

Q.64 **Ans.(c)**

Q.65 **Ans.(*)**

Q.66 **Ans.(a)**

Q.67 **Ans.(a)**

Q.68 **Ans.(b)**

Q.69 **Ans.(d)**

Q.70 **Ans.(b)**

Q.71 **Ans.(d)**

$$\frac{G(s)}{1+G(s)H(s)} = 1\frac{\frac{16/s(s+4)}{16(1+Ks)}}{s(s+4)}$$

$$= \frac{16}{s^2+4s+16Ks+16}$$

Comparing with $\frac{\omega_n^2}{s^2+2\xi\omega_n s+\omega_n^2}$

$$\omega_n^2 = 16 \Rightarrow \omega_n = 4$$

$$2\xi\omega_n = 16K + 4$$

$$\Rightarrow \quad 2\times 0.6\times 4 = 16K + 4$$

$$\Rightarrow \quad K = 0.05$$

Q.72 **Ans.(c)**

Q.73 **Ans.(d)**

State transition matrix $\phi(t)$ has the property that

$$\phi(0) = e^{A0} = 1$$

Q.74 **Ans.(a)**

Q.75 **Ans.(c)**

Q.76 **Ans.(d)**

Q.77 **Ans.(a)**

$$\int_{-\infty}^{\infty} f_{u,v}(u,v)\,du\,dv = 1$$

For $u \geq 0, v \geq 0$,

$$\int_{0}^{\infty} f_{u,v}(u,v)\,du\,dv = 1$$

$$\Rightarrow \int_0^{\infty}\frac{C}{3}e^{-u}\cdot e^{-v}\,du\,dv = 1$$

$$\Rightarrow \quad \frac{C}{3} = 1 \Rightarrow C = 3$$

Q.78 **Ans.(b)**

Transfer function = $K\left(1+\frac{s}{2}\right)$

where K = gain at $\omega = 1$

$$= \text{anti}\left(\frac{20}{20}\right)$$

Q.79 **Ans.(d)**

A Hilbert transformer is an ideai phse shifter that shifts the phase of every spectral component by $-\pi/2$.

$$m_h(t) = A\cos(2\pi f_0 t + \theta - \frac{\pi}{2})$$

$$= A\sin(2\pi f_0 t + \theta)$$

Q.80 **Ans.(b)**

For sinalling information, there is only one channel required. So bit rate of signalling information = 64 Kbps.

Q.81 **Ans.(d)**

In FM, power remains unchanged.

Q.82 **Ans.(b)**

Q.83 **Ans.(a)**

fig,. page no. 27

$f_m = 3500\,\text{Hz}$

$f_s = 7500\,\text{Hz}$

Guard band width

$= (f_s - f_m) - f_m$

$= (7500 - 3500) - 3500$

$= 500\,\text{Hz}$

Q.84 **Ans.(d)**

Q.85 **Ans.(a)**

Q.86 **Ans.(d)**

$$f_m = \frac{1000\pi}{2\pi} = 500\text{Hz}$$

$m_f = 0.5$

Carson's bandwidth

$= 2(m_f + 1)f_m$

$= 2(0.5+1)\,500$

$= 1500\,\text{Hz}$

Q.87 **Ans.(c)**

Minimum rate of transmission of PCM coded bits,

$$C = BW\log_2\left(1+\frac{S}{N}\right)$$

$$S = \frac{V_i^2}{2} = \text{input signal power}$$

$$\text{Noise, } N = \frac{s^2}{12} \text{ where s = step size}$$

Given that $\frac{s}{12} = \frac{0.25}{100} v_i$

$\Rightarrow \quad s = \frac{0.5 v_i}{100} = 0.005 v_i$

Solving $C = 90$ M bits/sec

Q.88 ***Ans.(a)***

Step size, $\sigma = \frac{A_{max}\omega}{f_s}$

where A_{max} = peak amplitude
ω = reference angular freq.
f_s = sampling frequency
$f_s = 8 \times 2 \times 4000$ Hz

$$\sigma = \frac{1 \times 2\pi \times 800}{8 \times 2 \times 4000}$$

$$= \pi/40 \text{ volts}$$

Q.89 ***Ans.(d)***

$$\beta = 8 = 2\pi/\lambda$$

$$\Rightarrow \quad \lambda = 2\pi/8$$

$$\Rightarrow \quad f = \frac{C}{\lambda}$$

$$= \frac{3 \times 10^8}{2\pi/8}$$

$$= 3.82 \times 10^8 \text{ Hz}$$

Q.90 ***Ans.(c)***

Minimum possible SWR = 1

$$SWR = Z_L/Z_C$$

Q.91 ***Ans.(a)***

Could wavelength, $\lambda_c = \frac{2}{\sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}}$

Q.92 ***Ans.(c)***

Received Power, $P_r = P_t G_t G_r \left(\frac{\lambda}{4\pi d}\right)^2$

where P_t = transmitted power
G_t = transmitting antenna gain
G_r = receiving antenna gain
d = distance between anteena of earth station and
λ = wavelength

Q.93 ***Ans.(b)***

Gain of parabolic dish antenna

$$G \approx 6\left(\frac{D}{\lambda}\right)^2$$

where $10 \log G = 43.82$

$G = (10)^{(43.82/10)}$

$$X = \frac{3 \times 10^8}{10 \times 10^9} \text{ m}$$

Q.94 ***Ans.(a)***

Q.95 ***Ans.(c)***

Q.96 ***Ans.(c)***

Q.97 ***Ans.(c)***

where executing the instruction PUSH B, the current of register pair B,C s pusha into the stack
[[SP – 1]–1]←[m]
[[SP – 2]–2]←[n]
[SP]←[SP]–2

Q.98 ***Ans.(d)***

Q.99 ***Ans.(b)***

Q.100 ***Ans.(b)***

JC 7000 H is a three byte instruction. Therefore, next address will be 6003 + 3 = 6006.