Mock Test 2

Number of Questions: 65 **Total Marks: 100**

Wrong answer for MCQ will result in negative marks, (-1/3) for 1 Mark Questions and (-2/3) for 2 Marks Question.

GENERAL APTITUDE

Directions for question 1: Select the word most similar in meaning to the given word:

1. Risque
(A) Risky (B) Lascivious
(C) Queasy (D) Pompous

***Directions for questions 2 and 3*:** Select the correct alternative from the given choices.

2. In a certain code language, GOOGLE is coded as HNPFMD. How is the word APPLE coded in that language?
(A) BOGKE (B) BQOKF
(C) BOQKF (D) None of these

3. The numbers a, b, c, d and e form a geometric progression. Which of the following also form a geometric progression?
(i) a^2, b^2, c^2, d^2, e^2
(ii) $a - 1, b + 2, c - 3, d + 4, e - 5$
(iii) $3a, 3b, 3c, 3d, 3e$
(A) Only (i) (B) Only (i) and (ii)
(C) Only (iii) and (i) (D) None of these

***Directions for question 4*:** Select the most suitable one word substitute for the following expression:

4. A place where everything is perfect
(A) Heaven (B) Cosmos
(C) Synagogue (D) Utopia

***Direction for question* 5:** Select the appropriate word/phrase out of the given options to complete the following sentence:

5. Neither the teacher nor the students __________ any clue as to who could have stolen the keys to the office treasury.
(A) was (B) has
(C) have (D) were

***Directions for question 6*:** Select the correct alternative from the given choices.

6. Consider a function $f(x) = 3 - |x|$, where $-2 \le x \le 2$. The minimum and maximum values of $f(x)$ are:
(A) 0, 2 (B) 0, –2
(C) 1, 3 (D) 0, –4

***Directions for question* 7:** In the following sentence certain parts are underlined and marked P, Q, and R. One of the parts may contain a certain error or may not be acceptable in standard written communication. Select the part containing the error. Choose D as your answer if there is no error.

7. <u>There are no machineries</u> for resolving (P)
these <u>disputes and this has,</u> in no small (Q)
measure, compounded <u>the present situation</u>. (R)
(A) P (B) Q
(C) R (D) No error

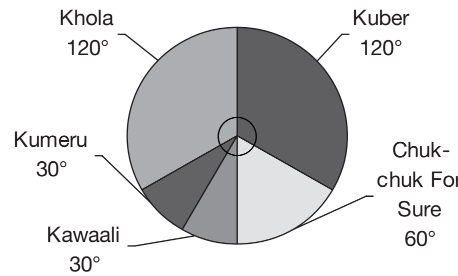
***Directions for question* 8:** Which one of the statements given below the passage is logically valid and can be inferred from the passage below?

8. Napoleon Bonaparte was one of the world's youngest generals. At the age of 24 he was master of the art of war, a military general and a cruel dictator at heart. He had the magnetism of the great and he won devoted friendship from many. His glance, like Akbar's, was magnetic. He often said that he had won many battles with his eyes, not the sword. A strange statement for a man who had plunged Europe into war. And it appears, during his last years when he was imprisoned at St. Helena, he had a change of heart. Good thoughts came to him during the fading years of life, his painful period of exile. He was much chastened, and perhaps wrote to influence posterity in his favour. He wrote that the conquest of the spirit is greater than the conquest of the sword.
(A) Napoleon Bonaparte was not the world's youngest general.
(B) Napoleon Bonaparte was not the world's youngest dictator.
(C) Napoleon Bonaparte believed that some day victories would be won without cannons and bayonets.
(D) Napoleon Bonaparte was thoroughly irreligious but he encouraged religion.

***Directions for questions 9 and 10*:** Select the correct the alternative from the given choices.

9. The chairman of a multinational corporation desires to appoint four of the five selected persons A, B, C, D and E to lead the four different domains of the organization, which are Operations, Marketing, Finance and $R\&D$. C doesn't want to get hitched to one specific domain as he desires to have an exposure to all the four domains.
B is given the designation of Operations head. Neither D nor A is posted as Marketing heads.
Which of the following can be a valid assignment of heads to the domains?
(A) A – Marketing, B – Operations, C – Finance, D – $R\&D$
(B) A – Finance, B – Operations, D – $R\&D$, E – Marketing
(C) A – Operations, B – Finance, C – $R\&D$, D – Marketing
(D) None of these

10. The pie chart below gives the breakup of market share by volume of five different fleet management companies in the year 2015. The proportion of male to female customers of each company is 5 : 1. If the total number of customers of the five companies in 2015 is 216000. The Number of customers of Chuk-chuk for Sure are females is _____.



ELECTRONICS AND COMMUNICATION ENGINEERING

Direction for questions 1 to 55: Select the correct alternative form the given choices

11. The third term in the Taylor's series expansion of the function $f(x) = 5x^2 + \cos x$ about $x = \pi$ is ______.

(A) 0 (B) $\frac{9}{2}(x-\pi)^2$

(C) $\frac{11}{2}(x-\pi)^2$ (D) $\frac{13}{6}(x-\pi)^3$

12. If A and B are two square matrices of same order such that $AB = A$, $BA = B$, then

(A) both A and B are idempotent

(B) both A and B are involutory

(C) A is idempotent and B is involutory

(D) A is involutory and B is idempotent

13. If X is a continuous random variable with probability density function $f(x)$ given by

$$f(x) = \begin{cases} ax(1-x); & 0 \le x \le 1 \\ 0 \quad ; & otherwise \end{cases}$$

Then the mean of X is ______.

14. The directional derivative of $f(x, y, z) = 4xz^3 - 3x^2yz^2$ at the point $P(2, -1, 2)$ in the direction of x-axis is ______.

(A) 80 (B) –48

(C) 48 (D) 144

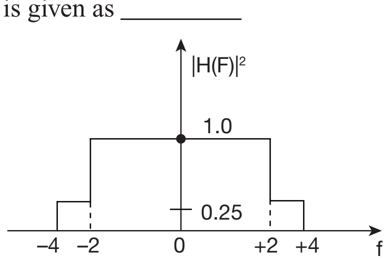
15. The first approximation to the reciprocal value of 8 when calculated by Newton - Raphson method with initial approximation $x_0 = 0.2$ is ________.

16. Thermal noise form of resistors is usually well modeled as

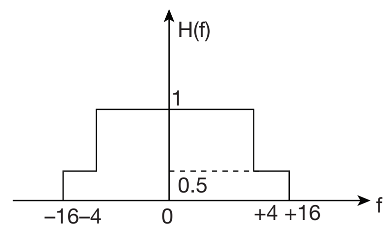
(A) Gaussian (B) not Gaussian

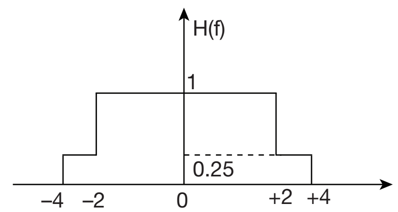
(C) Resistor noise (D) None of these

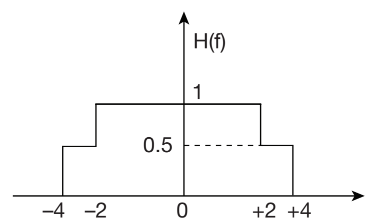
17. For the linear channel squared magnitude response $|H(f)|^2$ is given as _________



The $H(f)$ will be

(A) 

(B) 

(C) 

(D) None of these

18. The peak input value 2 volts is given to 7 – bit PCM coder. The signal to quantization noise power for an input of $\cos\omega_m t$ is _______ dB.

19. Find the current leaving the cube $0 < x, y, z < 0.5$. Current density in cube is defined as $J = -10 \nabla V$ A/cm^2 and $V = 5e^{-y}\cos x$ V.

(A) 10^6 A (B) 2.5×10^5 A

(C) 4×10^5 A (D) zero

20. If 50m length non-magnetic wire carries 0.5×10^3 Amp in $\hat{a}_z$ then calculate k when $H = k\rho\,\hat{a}\phi$ and radius of wire is 0.5cm.

(A) 3.18×10^6 A/m^2

(B) 1.6×10^6 A/m^2

(C) 2.54×10^6 A/m^2

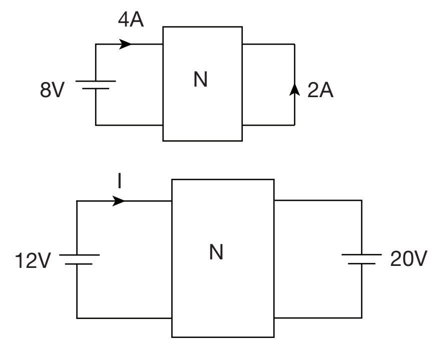
(D) 4.18×10^6 A/m^2

21. Let $X(s) = \frac{4s+3}{s^2+7s+21}$ be the laplace transform of a signal $x(t)$. Then $x(0^+)$ is ______.

22. Time Period of the signal $x(t) = 2\cos\left(0.2\pi t + \frac{\pi}{3}\right)$ is

(A) 0.1 s (B) 0.2 s
(C) 10 s (D) 20 s

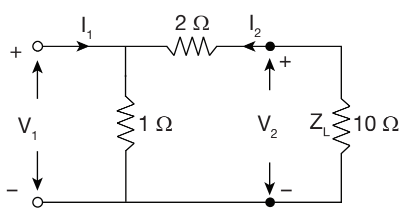
23. The network '*N*' contains only passive elements



The current *I*(In Amp) is ______.

24. The current $i(t)$ through a 8 Ω resistor in series with an inductance, is given by $i(t) = 5 + 3\sin(100t + 45^o) + 4\cos(300t + 60^o)A$. Then the power dissipated in the circuit is _____ watts.

25. Consider the network shown in below



The Transmission parameters of the network is

(A) $\begin{bmatrix} 3 & 2 \\ 1 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 1 \\ 2 & 3 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix}$ (D) $\begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$

26. For an n-channel silicon FET with a = 3×10^{-4} cm and $N_D = 10^{15}$ atoms/cm^3. The pinch off voltage V_P is _______ volt. (Consider $\in_s = 12\in_0$).

27. A sample of *n*-type semiconductor has a resistivity of 0.5 Ω-cm and Hall coefficient of 8 cm^3/coulmb. Then the majority charge carrier density _______ atoms/cm^3.

(A) 6.8×10^{15} (B) 3.2×10^{17}
(C) 7.8×10^{17} (D) None of these

28. Increasing order of input impedances for *CB*, *CE* and *CC* and Darlington Amplifier is

(A) Darlington → *CC* → *CE* → *CB*
(B) *CB* → *CE* → *CC* → Darlington
(C) *CC* – Darlington – *CE* – *CB*
(D) *CB* → *CC* → *CE* → Darlington

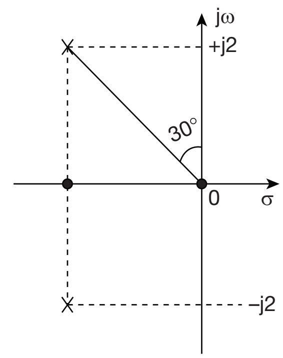
29. The transfer function of a particular system is $T(s) = \frac{(0.5s+1)}{(0.05s+1)(s^2+s+2)}$.

The approximation of *T*(*s*) using the dominant pole concept is.

(A) $\frac{(0.5s+1)}{(0.05s+1)(s^2+s+2)}$ (B) $\frac{(0.5s+1)}{(s^2+s+2)}$

(C) $\frac{10(s+2)}{(s^2+s+2)}$ (D) $\frac{10}{(s^2+s+2)}$

30. Consider the pole plot for an under damped second order system.



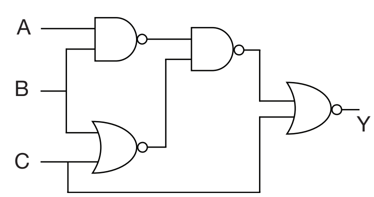
The 2% settling time of the system (in sec) is ______.

31. In a Two stage cascaded Amplifier, consider Stage 1 and stage 2 gains are 20 and 40 respectively and output voltage is 300 V.
Then the input voltage is ______Volt.

32. Find five stage amplifier lower cut off frequency, when single stage amplifier lower cut off frequency is 30 kHz

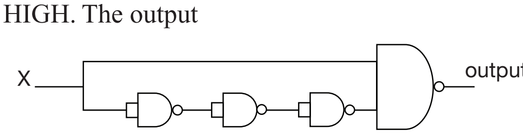
(A) 11.568 kHz (B) 77.8 kHz
(C) 5.388 kHz (D) 167.032 kHz

33. How many number of NAND gates are required to implement the following circuit, by using only NAND gates?



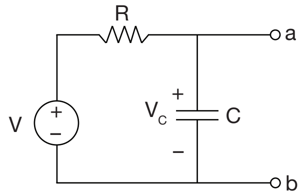
(A) 4 (B) 3
(C) 1 (D) 0

34. Consider the logic circuit with input signal *X* shown is the figure. All the gates in the figure shown have identical non-zero delay. The signal *X* which was at logic Low is switched to logic HIGH and maintained at logic HIGH. The output



(A) Stays HIGH throughout
(B) Stays LOW throughout
(C) pulses from LOW to HIGH to LOW
(D) pulses from HIGH to LOW to HIGH

35. Consider the following set of values of V, R and C of the circuit shown in the figure.



Which of the following set of V, R and C values will ensure that the state equation, $\frac{dV_c}{dt} = -2V_c + 3$ is valid?

(A) 1.5V, $R = 2\ \Omega$ and $C = \frac{1}{4}F$

(B) 1.5V, $R = 0.25\ \Omega$ and $C = 2$F

(C) 6V, $R = 2\ \Omega$ and $C = 0.5$F

(D) A and B only

36. If 1, 4 and 5 are the eigenvalue of 3 × 3 matrix A, then the matrix $A^2 - 5A + 6I_3$ has _________.

(A) three distinct eigenvalue

(B) two distinct eigenvalue

(C) all the three eigenvalue which are equal

(D) zero which is an eigenvalue.

37. The value of the double integral $\iint_R (4xy - y^2)dx\,dy$ where R is the region bounded by the lines $y = x$, $y = 2x$ and $x = 1$ in the first quadrant is _______

(A) $\frac{11}{12}$ (B) $\frac{14}{15}$

(C) $\frac{17}{18}$ (D) $\frac{20}{21}$

38. A fair die is rolled thrice. The outcomes of the first, second and third rolls are taken as a, b and c respectively and formed a quadratic equation $f(x) = ax^2 + bx + c = 0$. Probability that the roots of $f(x) = 0$ are real and equal is ________.

39. The particular integral of the differential equation $\frac{d^3.y}{dx^3} - 5\frac{dy}{dx} = 3x^2 - 4$ is __________.

(A) $\frac{14}{25} - \frac{3x^2}{5}$ (B) $x^3 - 14x$

(C) $\frac{14x}{25} - \frac{x^3}{5}$ (D) $\frac{3x^2}{5} - \frac{4}{5}$

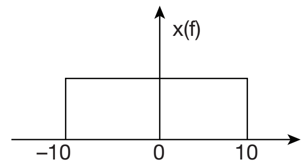
40. The residue of the complex function

$f(z) = \frac{5}{(z-3)^2(z^2+1)}$ at $z = 3$ is ________.

(A) 3/10 (B) –3/10

(C) 3/100 (D) –3/100

41. The spectrum of the signal $x(t)$ is given in figure is sampled at Nyquist rate with a periodic train of rectangular pulses of duration 0.2secs. How many replicas of $X(f)$ will present till 40Hz.



(A) 4 (B) 5

(C) 6 (D) None of above

42. A data transmission system with two equally probable symbols uses the signals.

$$S_o(t) = \begin{cases} \frac{At}{T}; & 0 \le t \le T \\ 0\ ; & elsewhere \end{cases}$$

$$S_1(t) = \begin{cases} -\frac{At}{T}; & 0 \le t \le T \\ 0\ ; & elsewhere \end{cases}$$

If $\frac{E}{N_0}$ is given as 17dB, then the symbol error rate is _______

(A) $Q(7.07)$ (B) $Q(50)$

(C) $Q(0.7)$ (D) None of these

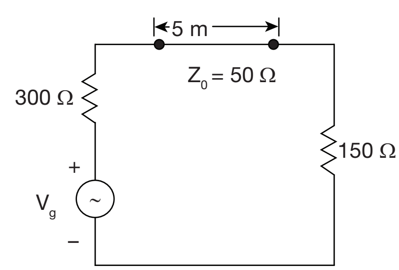
43. A binary random variable X takes the value of 1 with probability $\frac{1}{4}$. X is input to a cascade of 3 independent identical binary symmetric channels (BSCs) each with cross over probability $\frac{1}{2}$.

The value of $H(Y) + H(Z) + H(W)$ in bits is/are

(A) 3bits (B) 2bits

(C) 1bit (D) 0bits

44.



A 150 sin (10 × 10^7t) generator is feeding lossless transmission, calculate maximum power delivered to the load?

(A) 15.2∠44.62°W (B) 0.465 – 4.38°W

(C) 7.068 ∠40.24°W (D) 32.7 ∠49°W

45. If a transmitting antenna operating on a wavelength of 250 m has effective height of 50 m and 150 A of current is measured. Then calculate the field strength at 100 *km*.

(A) 80 V/m (B) 160 mV/m
(C) 113 m V/m (D) 138 m V/m

46. A rectangular waveguide has 2.5cm × 1.25cm dimensions and it is operating in dominant mode. If the waveguide is filled with a dielectric whose $\in_r = 2.89$, then the cut-off frequency of dominant mode is

(A) 6 GHz (B) 3.53 GHz
(C) 5.38 GHz (D) 4.87 GHz

47. Calculate voltage minima nearest to the load if the transmission line is terminated with $(125 + j75)\Omega$, $Z_o = 75\Omega$ and it is working at 450 MHz?

(A) 5m from the load (B) 5m from the source
(C) 0.2m from the load (D) 0.2m from the source

48. Two causal discrete time signals $x[n]$ and $y[n]$ are related as $y[n] = \sum_{m=-\infty}^{n} x[m]$. If the Z-transform of $y[n]$ is $\frac{4}{z(z-1)^2}$, the value of $x[2]$ is _____

(A) 0 (B) 1
(C) $\frac{1}{2}$ (D) –1

49. If $x[n] = \sin\left[\frac{\pi n}{6}\right]$, then the DTFS coefficients of sequence $y[n] = x[2n]$ and period N_0^1 _____

(A) $b_1 = \frac{1}{j}$, $b_{-1} = \frac{-1}{j}$; $N_0^1 = 12$

(B) $b_1 = \frac{1}{j}$, $b_{-1} = \frac{-1}{j}$; $N_0^1 = 6$

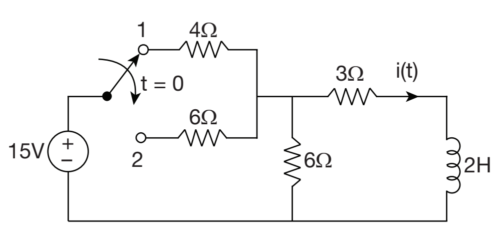
(C) $b_1 = \frac{1}{4j}$, $b_{-1} = \frac{-1}{4j}$; $N_0^1 = 12$

(D) $b_1 = \frac{1}{4j}$, $b_{-1} = \frac{-1}{4j}$; $N_0^1 = 6$

50. The ratio of Nyquist sampling rate of sinc^2 $(200\pi t)$ to the sampling rate of 0.5 sinc $(300\pi t)$ is equal to _______.

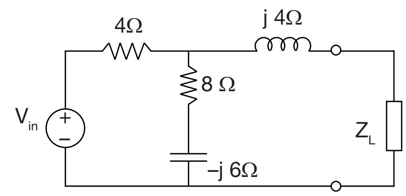
51. A series resonant circuit has an inductive reactance of 500Ω at resonance, capacitance of 1μ*F* and resistance of 10Ω. Then the B.W of the circuit will be ______ Hz.

52. Consider the circuit shown in below



Initially switch is connected to long time at position '1' and it is moved to position 2 at $t = 0$. Then the value of $i(t)$ for $t = 2.5$ sec in Amp is ____.

53. Consider the circuit show in below



If $V_{in} = 15\sin\omega t$, then the maximum average power that can be transferred to the load Z_L is ______.

(A) 5.32 W (B) 10.36 W
(C) 2.56 W (D) None of these

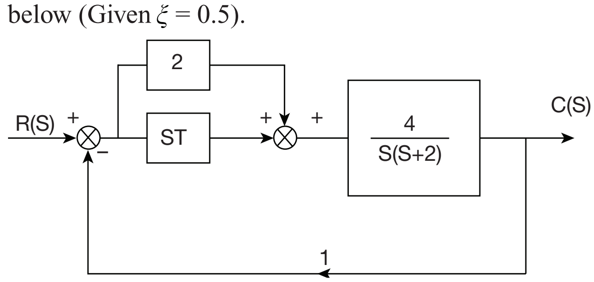
54. A JFET has drain current of 10 mA. If $I_{DSS} = 20$ mA and $V_P = 5$V. Then the value of V_{GS} is _______Volts.

55. A sample of *N*-type Germanium has a donor density of 10^{22} atoms/m^3. It is arranged in a Hall experiment having, magnetic field of 0.5 Wb/m^2 and the current density is 500 A/m^2. If d = 5 mm, the Hall voltage is ______ (volts).

(A) 0.5 mV (B) 0.32 V
(C) 0.8 V (D) 0.78 mV

56. Increase in collector-emitter voltage from 5V to 9V causes increase in collector current from 4 mA to 5.5 mA. Then the dynamic output resistance is ______ *k*Ω.

57. Consider the system with *PD* controller as shown in below (Given $\xi = 0.5$).



The value of *T* in sec ____.

58. A certain linear time invariant system has the state and output equations given below.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u; \quad y = \begin{bmatrix} 1 & 1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

If $x_1(0) = -1$, $x_2(0) = 0.5$ and $u(0) = 0$, then the value of $\frac{dy}{dt}$ at $t = 0$ is ______.

59. Consider the system with loop gain $G(s)H(s) = \frac{K}{s(0.5s+1)(2s+1)}$

If $s = -1+j1$ is on root locus, the value of gain K is……

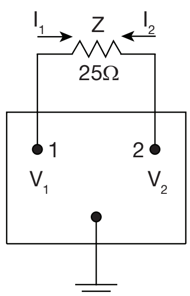
(A) 10
(B) 8

(C) 12.3
(D) it is **Not** on the root locus

60. A single transistor operates as an ideal class *B* amplifier. If d.c. current drawn from the supply is 25 mA, calculate the a.c. power delivered to load for load resistance of $2k\Omega$.
(A) 6 kW (B) 6W
(C) 4 kW (D) 4W

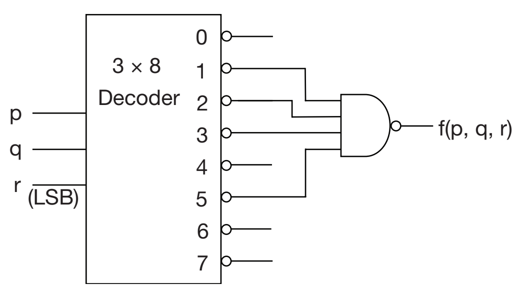
61. Given the following transistor measurements, made at I_C = 5 mA, V_{CE} = 10 Volt and at room temperature h_{fe} = 100, h_{ie} = 600Ω, A_i = 10 at 10MHz, C_e = 3*pF*. Then the unity gain frequency f_T is ______.
(A) 10 kHz (B) 100 MHz
(C) 100 kHz (D) 9950 MHz

62. Current gain, voltage gain of the given network are –20, –30 respectively. Find input resistance and output resistance.



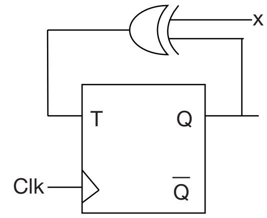
(A) 0.8Ω and 24.2Ω (B) 1Ω and 20Ω
(C) 361Ω and 18Ω (D) 775Ω and 24.2Ω

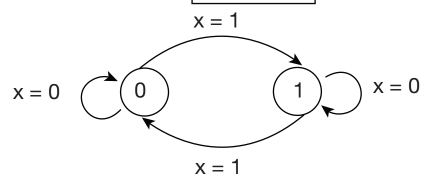
63. A 3 line to 8 line Decoder with active low outputs is used to implement a 3-variable Boolean function, as shown in the figure.
The simplified form of Boolean function *f*(*p*, *q*, *r*) implemented in "sum of Products" form will be?

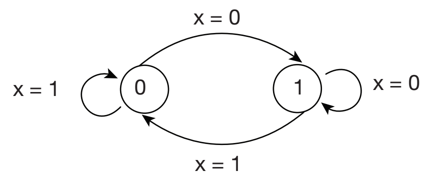


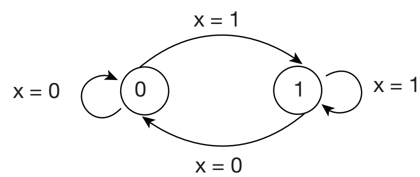
(A) $p^1q + pr^1$ (B) $pq + q^1r^1$
(C) $p^1q + q^1r + p^1r$ (D) $p^1q + q^1r$

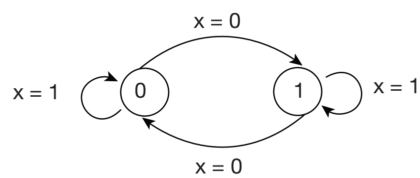
64. Find the state diagram for the given synchronous sequential circuit



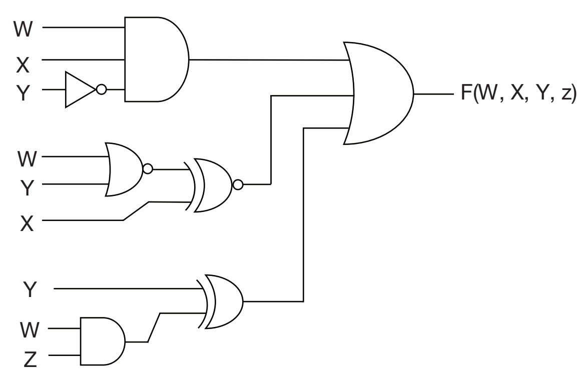
(A)


(B)


(C)


(D)


65.



The minimum POS form of *F*(*W*, *X*, *Y*, *Z*) is
(A) $(W + X + Y)(W^1 + X^1 + Y^1 + Z^1)$
(B) $(W^1 + X)(X^1 + Y)(W + Y^1)(Y + Z^1)$
(C) $(W^1 + Y)(X + Y^1)(W + X^1)(X^1 + Z^1)$
(D) $(W + X + Y + Z)(W^1 + X^1 + Y^1 + Z^1)$

Answer Keys

1. B	**2.** C	**3.** C	**4.** D	**5.** C	**6.** C	**7.** A	**8.** A	**9.** B
10. 6000	**11.** C	**12.** A	**13.** **0.5**	**14.** A	**15.** 0.075 to 0.085		**16.** A	**17.** C
18. 37 to 38		**19.** D	**20.** A	**21.** 3.9 to 4.1		**22.** C	**23.** 10 to 12	
24. 298 to 302		**25.** C	**26.** 6.7 to 6.9		**27.** C	**28.** B	**29.** C	**30.** 3.4 to 3.5

31. 0.35 to 0.4 **32.** B **33.** A **34.** D **35.** D **36.** B **37.** A **38.** 0.021 to 0.025
39. C **40.** B **41.** B **42.** A **43.** A **44.** C **45.** C **46.** B **47.** C **48.** A
49. B **50.** 1.3 to 1.4 **51.** 6.3 to 6.4 **52.** 1.24 to 1.26 **53.** A **54.** 1.4 to1.5
55. D **56.** 2.6 to 2.7 **57.** 0.2 to 0.21 **58.** 1.9 to 2.1 **59.** D **60.** B **61.** B
62. A **63.** D **64.** C **65.** A

Hints and Explanations

1. The synonym of risque is lascivious or vulgar. Queasy means sickening and pompous means overdone or affected and have little to do with the headword. Choice (B)

2. G O O G L E
+1 – 1 + 1 – 1 + 1 – 1
H N P F M D
Similarly,
A P P L E
+1 –1 + 1 – 1 + 1
B O Q K F Choice (C)

3. The numbers a, b, c, d, e are in geometric progression.

$\therefore \quad \frac{b}{a}=\frac{c}{b}=\frac{d}{c}=\frac{e}{d}$ let each of these be k.

(i) $\frac{b^2}{a^2}=\frac{c^2}{b^2}=\frac{d^2}{c^2}=\frac{e^2}{d^2}=k^2$

a^2, b^2, c^2, d^2, e^2 are in geometric progression.

(ii) The given terms need not be in geometric progression.

(iii) $\frac{3b}{3a}=\frac{3c}{3b}=\frac{3d}{3c}=\frac{3e}{3d}=k$

$3a, 3b, 3c, 3d, 3e$ are in geometric progression.
Only (i) and (iii) are in geometric progression. Choice (C)

4. Utopia is a place where everything is perfect. Synagogue is a place of worship for Jews. Choice (D)

5. The pair conjunction "neither . . . . nor" always takes a plural verb with the plural subject being placed second. So "have" is apt. Choice (C)

6. $f(x) = 3 - |x|$ where $-2 \le x \le 2$,
$|a| = a$ when $a \ge 0$,
$= -a$ when $a < 0$,
$|x|$ ranges from 0 to 2.
$f(x)$ has the minimum and the maximum values when x has the maximum and the minimum values respectively.
Min $(f(x)) = 3 - 2 = 1$.
Max $(f(x)) = 3 - 0 = 3$. Choice (C)

7. The noun "machinery" is correct and it cannot be used in the plural with an "*s*". So the entire structure accompanying it has to be in the singular. Thus "There is no machinery for . . . ." is apt Choice (A)

8. Statement (*B*) is not true. The passage only states that he was a dictator "at heart", not a crowned and dreaded despotic ruler. Towards the end of the passage we are told of his beliefs regarding war. He came to believe that the conquest of the self was the greatest conquest. This DOES NOT mean he believed that men would shun violence and live peacefully. So (*C*) too is ruled out. (*D*) is ruled out as it is out of the text. Choice (A) is correct as per the first line of the passage. ". . . one of the . . ." means not the only. Choice (A)

9.

Person	Designation
A	Head of R&D / Finance
B	Head of operations
C	Posted to work in all departments
D	Head of Finance / R&D
E	Head of Marketing

A valid assignment of heads to the domains can be.
A – Finance *B* – Operations *D* – *R&D* *E* – Marketing. Choice (B)

10. Total number of people using "Chuk–chuk for sure"

$= \frac{60}{360}(216000) = 36000$

Number of female customers of this company

$= \frac{1}{6}(36000) = 6000$ Ans: 6000

11. Given $f(x) = 5x^2 + \cos x$
The Taylor's series expansion of $f(x)$ about $x = a$ is

$$f(x) = f(a) + (x-a)f^1(a) + \frac{(x-a)^2}{2!}f^{11}(a) + ...\infty$$

$\therefore$ The third term is $\frac{(x-2)^2}{2!}f^{11}(a)$

Here $f(x) = 5x^2 + \cos x$ and $x = \pi$
$\Rightarrow$ $f^1(x) = 10 - \cos x$
$\therefore$ $f^1(a) = f^1(\pi) = 10 - \cos\pi = 11$
$\therefore$ The third term in the Taylor's series expansion of $f(x)$ about $x = \pi$ is $\frac{(x-\pi)^2}{2!}\times 11$

$= \frac{11}{2}(x-\pi)^2$ Choice (C)

12. Given, $AB = A$ $\rightarrow (1)$
and $BA = B$ $\rightarrow (2)$
From (1) $AB = A$
$\Rightarrow$ $(AB)A = A \times A$

$\Rightarrow$ $A(BA) = A^2$

$\Rightarrow$ $A(B) = A^2$ (From (2))

$\Rightarrow$ $A = A^2$ (from (1))

$\Rightarrow$ $A^2 = A \Rightarrow A$ is an idempotent matrix.

From (2), $BA = B$

$(BA)\,B = B \times B$

$\Rightarrow$ $B(AB) = B^2$

$\Rightarrow$ $B(A) = B^2$ (from (1))

$\Rightarrow$ $B = B^2$ (from (2))

$\Rightarrow$ $B^2 = B$

$\Rightarrow$ B is an idempotent matrix. Choice (A)

13. Given the $p.\,d.\,f$ of X is

$$F(x) = \begin{cases} ax(1-x) & 0 \le x \le 1 \\ 0 & otherwise \end{cases}$$

As $f(x)$ is a $p.\,d.\,f$ of X, we have

$$\int_{-\infty}^{\infty} (x)dx = 1$$

$$\Rightarrow \int_0^1 a\left(x - x^2\right)dx = 1$$

$$\Rightarrow a\left[\frac{x^2}{2} - \frac{x^3}{3}\right]_0^1 = 1$$

$$\Rightarrow a\left[\frac{1}{2} - \frac{1}{3}\right] = 1$$

$$\Rightarrow a\left(\frac{1}{6}\right) = 1$$

$\Rightarrow$ $a = 6$

$$\therefore\ f(x) = \begin{cases} 6x(1-x) & 0 \le x \le 1 \\ 0 & otherwise \end{cases}$$

The mean of X is

$$E(X) = \int_{-\infty}^{\infty} xf(x)dx = \int_0^1 x(6x(1-x))dx$$

$$= 6\int_0^1 (x^2 - x^3)dx$$

$$= 6\left[\frac{x^3}{3} - \frac{x^4}{4}\right]_0^1 = 6\left[\frac{1}{3} - \frac{1}{4}\right] = \frac{6}{12}$$

$\therefore$ $E(X) = \dfrac{1}{2}$ Ans: 0.5

14. Given $f(x, y, z) = 4xz^3 - 3x^2yz^2$

$\therefore$ $\nabla f = (4z^3 - 6xyz^2) - 3x^2z^2\overline{j} + (12xz^2 - 6x^2yz)\overline{k}$

$\nabla f_{at\,(2,\,-1,\,2)} = 80i - 48\overline{j} + 144\overline{k}$

$\therefore$ The directional derivative of f in the direction of x-axis

= The directional derivative of f in the direction of

$= \nabla f.i = (80i - 48\overline{j} + 144\overline{k}).i = 80$ Choice (A)

15. We have to find x such that x = $\dfrac{1}{8}$

$\Rightarrow$ $\dfrac{1}{x} = 8$; Let $f(x) = \dfrac{1}{x} - 8 = 0$

$\Rightarrow$ $f'(x) = \dfrac{-1}{x^2}$

And $x_0 = 0.2$

By Newton – Raphson method, the first approximate value x_1 is given by

$$x_1 = x_0 - \frac{f(x_0)}{f^1(x_0)} = x_0 - \frac{\left(\frac{1}{x_0} - 8\right)}{\left(\frac{-1}{x^2 0}\right)}$$

$\therefore$ $x_1 = 2x_0 - 8x^2{}_0$

$= 2 \times 0.2 - 8 \times (0.2)^2$

$= 0.4 - 0.32 = 0.08$ Ans: 0.075 to 0.085

16. Thermal noise is combined effect of random movements of a multitude of electrons. By the central limit theorem, that will be well modeled as Gaussian.

Choice (A)

17. $|H(f)| = \sqrt{(H(f))^2}$

So only amplitude will be square root Choice (C)

18. $m_p = 2$

$n = 7$

$L = 2^n = 128$

Singnal power, $S_i = \dfrac{1}{2}$

Noise power = $N_i = \dfrac{\Delta^2}{12} = \left(\dfrac{2mp}{L}\right)^2 \times \dfrac{1}{12}$

$10\log_{10}\left(\dfrac{S_i}{N_i}\right) = 37.88$ dB Ans: 37 to 38

19. $J = -\left(\dfrac{\partial}{\partial x}5e^{-y}\cos x\,\hat{a}x + \dfrac{\partial}{\partial y}5e^{-y}\cos x\hat{a}y\right) \times 10^4\,\dfrac{A}{m^2}$

$= -5 \times 10^5\left[-e^{-y}\sin x\,\hat{a}_x - e^{-y}\cos x\,\hat{a}_y\right]$

$= 5 \times 10^5\, e^{-y}\,(\sin x\,\hat{a}_x + \cos x\,\hat{a}_y)$

$\Rightarrow$ $I = \int \nabla.J.dV \rightarrow \iiint \nabla.Jd\,\vartheta$

$\nabla.J = 5 \times 10^5\left[\dfrac{\partial}{\partial x}\left(e^{-y}\sin x\,\hat{a}_x\right) + \dfrac{\partial}{\partial y}e^{-y}\cos x\right]$

$= 5 \times 10^5\,[e^{-y}\cos x - e^{-y}\cos x] = 0$ Choice (D)

20. $\oint \vec{H}.\vec{dl} = I_{enclose}$

$$\Rightarrow \int_0^{2\pi} k\rho\,\hat{a}_\varphi.\rho d\varphi\,\hat{a}_\varphi = 500A$$

[differential length along ϕ is $\rho d\phi\, \hat{a}_\varphi$]

$\Rightarrow \quad k \times (0.5 \times 10^{-2})^2 \times 2\,\pi = 500$

$\Rightarrow \quad k = 3.18 \times 10^6$ A/m^2 Choice (A)

21. $x(0^+) = \underset{S\to\infty}{Lim}\, s.X(s)$

$$= \underset{S\to\infty}{Lim}\frac{s.(4s+3)}{s^2+7s+21} = \underset{S\to\infty}{Lim}\frac{4s^2+3s}{s^2+7s+21}$$

$$\underset{S\to\infty}{Lim}\frac{4+\frac{3}{s}}{1+\frac{7}{s}+\frac{21}{s^2}} = 4$$

Ans: 3.9 to 4.1

22. **2 cos** $\left(0.2\pi t + \frac{\pi}{3}\right)$

Here $\omega t = 0.2\pi t$

$\omega = .2\pi$

$2\pi f_s = .2\pi$

$T_s = 10$ sec Choice (C)

23. We know from the reciprocity theorem $\frac{V_1}{I_1} = \frac{V_2}{I_2}$

Apply SPT to the figure (*b*)

If only 12 V source acting alone

Let $I = I^1$

$\frac{8}{4} = \frac{12}{I^1} \Rightarrow I^1 = \frac{12\times 4}{8} = 6A$ and

If only 20V source acting alone

Let $I = I^{11}$

$\therefore \frac{8}{2} = \frac{20}{I^{11}}$ and $I^{11} = 5A$

But $I = I^1 + I^{11}$

$I = 6 + 5$

$I = 11$A Ans: 10 to 12

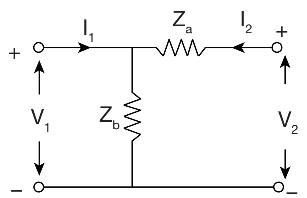
24. $I_{rms} = \sqrt{(5)^2 + \left(\frac{3}{\sqrt{2}}\right)^2 + \left(\frac{4}{\sqrt{2}}\right)^2}$

$= \sqrt{25+12.5} = \sqrt{37.5}$ A

$P = I_{rms}^2.R = 37.5 \times 8 = 300$W Ans: 298 to 302

25. From the given network

Remove the load Z_L and find the ABCD parameters.



We know $[T] = \begin{bmatrix} 1 & Z_a \\ \frac{1}{Z_b} & 1+\frac{Z_a}{Z_b} \end{bmatrix}$

$[T] = \begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix}$ Choice (C)

26. $|V_P| = \frac{q.N_D}{2\varepsilon_s}.a^2$

$q = 1.6 \times 10^{-19}$ C

$\varepsilon_s = 12\ \varepsilon_o = 12 \times 8.84 \times 10^{-14}$ F/cm

$$|V_P| = \frac{1.6\times 10^{-19}\times 10^{15}\times \left(3\times 10^{-4}\right)^2}{2\times 12\times 8.84\times 10^{-14}} = 0.0678\times 10^2$$

$= 6.78$ V Ans: 6.7 to 6.9

27. From the given data conductivity, $\sigma = 2(\Omega - \text{cm})^{-1}$

Charge density, $\rho = \frac{1}{R_H} = \frac{1}{8} = 0.125$ C/cm^3

We know $\rho = n.q$

$\therefore \quad n = \rho/q = \frac{0.125}{1.6} \times 10^{19} = 7.8125 \times 10^{17}$ atoms/cm^3

Choice (C)

28. Choice (B)

29. Given $T(s) = \frac{10(s+2)}{(s+20)(s^2+s+2)}$

By using dominant pole concept, the system response mostly depends on the dominant pole so neglect the $(S + 20)$ term.

$T(s) \approx \frac{10(s+2)}{(s^2+s+2)}$ Choice (C)

30. From the given plot $\omega_d = 2r$/sec

And $\xi = \cos\theta = \cos(90° - 30°) = \text{Cos } 60° = 0.5.$

$\omega_d = \omega_n\ .\ \sqrt{1-\xi^2}$

$2 = \omega_n\ .\ \sqrt{\frac{3}{4}}$

$\omega_n = \frac{4}{\sqrt{3}}$ rad/sec

$\xi\omega_n = \frac{2}{\sqrt{3}}$

2 % settling time $t_s = \frac{4}{\xi\omega_n}$

$t_s = 2\sqrt{3}$ sec = 3.46 sec. Ans: 3.4 to 3.5

31. $Gain|_{Twostage} = Gain|_{Stage\,1} \times Gain|_{Stage2} = 20 \times 40 = 800.$

Gain $= \frac{V_o}{V_i} = 800$

$V_i = \frac{V_0}{Gain} = \frac{300}{800}$

$V_i = \frac{3}{8}$Volts Ans: 0.35 to 0.4

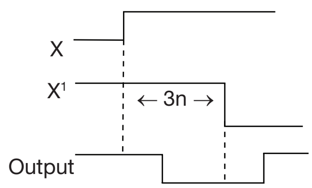
32. $f_{L_n} = \dfrac{f_L}{\sqrt{2^{\frac{1}{n}} - 1}} = \dfrac{30\ kHz}{\sqrt{2^{\frac{1}{5}} - 1}} = 77.8$ kHz Choice (B)

33. $Y = \overline{\left(\overline{\overline{AB}.\left(\overline{B+C}\right)} + C\right)} = (AB + B + C + C)^1$

$= (B + C)^1 = \overline{B}.\overline{C}$

To implement NOR gate (OR, NOT), we need 4 NAND gates. Choice (A)

34. Consider the delay of each NAND gate is 'n' seconds at t = 0, the logic LOW is switched to logic HIGH.
The wave forms will be like



X is input of NAND gate, other input will be X^1 which is complemented form of X, but delayed by $3n$. (n – delay of each NAND gate)
HIGH to LOW to HIGH Choice (D)

35. Applying KVL to the given circuit
$V - R.i - V_c = 0$

But $i = i_c = C.\dfrac{dV_c}{dt}$

$\dfrac{1}{RC}[V - V_c] = \dfrac{dV_c}{dt}$ → (i)

Compare equation (i) with given equation $\dfrac{1}{RC} = 2$ and

$\dfrac{V}{RC} = 3$

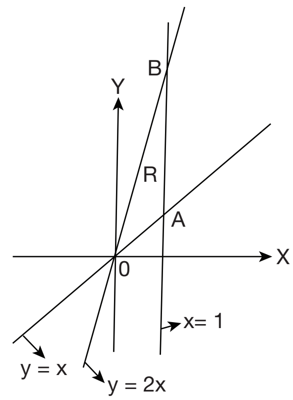
Let $R = 2\ \Omega$. $C = \dfrac{1}{4}F$

$V = 1.5$ Volts Choice (D)

36. Given, 1, 4 and 5 are the eigen values of A.
∴ The eigen values of $A^2 - 5A + 6I_3$ are $1^2 - 5 \times 1 + 6 = 2$, $4^2 - 5 \times 4 + 6 = 2$ and $5^2 - 5 \times 5 + 6 = 6$.
Hence, the eigen values of $A^2 - 5A + 6I_3$ are 2, 2 and 6
∴ $A^2 - 5A + 6I_3$ has two distinct eigen values. Choice (B)

37. We have to evaluate the double integral $\iint_R (4xy - y^2)dx\,dy$

where R is the triangular region OAB as shown in the figure.
In R, y varies form $y = x$ to $y = 2x$
and x varies form $x = 0$ to $x = 1$.



$$\therefore \iint_R \left[4xy - y^2\right]dxdy$$

$$= \int_{x=0}^{1}\left(\int_{y=x}^{2x}\left(4xy - y^2\right)dy\right)dx$$

$$= \int_{x=0}^{1}\left[2xy^2 - \frac{y^3}{3}\right]_{y=x}^{2x} dx$$

$$= \int_{x=0}^{1}\left[\left(2x(2x)^2 - \frac{(2x)^3}{3}\right) - \left(2x(x)^2 - \frac{x^3}{3}\right)\right]dx$$

$$= \int_{x=0}^{1}\left[\frac{11}{3}x^3\right]dx = \left.\frac{11}{3} \times \frac{x^4}{4}\right]_0^1$$

$$= \frac{11}{12}$$ Choice (A)

38. For the quadratic equation $ax^2 + bx + c = 0$, the roots are real and equal only if $b^2 - 4ac = 0$
⇒ $b^2 = 4ac$
When a die is rolled, the possible outcomes are 1, 2, 3 4, 5 and 6.
∴ a, b and c can take any of these values.
The total possible combinations of values for a, b and $c = 6 \times 6 \times 6 = 216$
$b^2 = 4ac \Rightarrow b^2$ must be a multiple of 4
⇒ b must be a multiple of 2
∴ The possible values that b can take are 2, 4 and 6.
For these values of b, the possible combinations of values of a and c for which $b^2 = 4ac$ are as given below.

b	a	c
2	1	1
4	1	4
4	4	1
4	2	2
6	3	3

∴ The number of combinations of favourable outcomes for $b^2 = 4ac$ are 5.

$\therefore$ Required probability = $\dfrac{5}{216}$

= 0.02315 Ans: 0.021 to 0.025

39. Given differential equation is

$$\frac{d^3y}{dx^3} - 5\frac{dy}{dx} = 3x^2 - 4 \qquad \text{———(1)}$$

Its particular integral is $y_p = \dfrac{1}{f(D)}X$

$$= \frac{1}{(D^3 - 5D)}(3x^2 - 4)$$

$$= \frac{1}{-5D\left(\frac{D^3}{-5D} + 1\right)}(3x^2 - 4)$$

$$= \frac{-1}{5D}\left(1 - \frac{D^2}{5}\right)^{-1}(3x^2 - 4)$$

$$= \frac{-1}{5D}\left[1 + \frac{D^2}{5}\right](3x^2 - 4)$$

$$= \frac{-1}{5D}\left[(3x^2 - 4) + \frac{1}{5}D^2(3x^2 - 4)\right]$$

$$= \frac{-1}{5D}\left[(3x^2 - 4) + \frac{1}{5}\frac{d^2}{dx^2}(3x^2 - 4)\right]$$

$$= \frac{-1}{5D}\left[(3x^2 - 4) + \frac{1}{5}\times 6\right]$$

$$= \frac{-1}{5D}\left[3x^2 - 4 + \frac{6}{5}\right] = \frac{-1}{5D}\left[3x^2 - \frac{14}{5}\right]$$

$$= \frac{-1}{5}\int\left(3x^2 - \frac{14}{5}\right)dx = \frac{-1}{5}\left[x^3 - \frac{14}{5}x\right]$$

$$\therefore \quad y_p = \frac{14x}{25} - \frac{x^3}{5}$$

Choice (C)

40. Given $f(z) = \dfrac{5}{(z-3)^2(z^2+1)}$

$z = 3$ is a pole of order 2 for $f(z)$

$$\operatorname*{Res}_{z=3}[f(z)] = \frac{1}{(2-1)!}$$

$$\operatorname*{Lt}_{z\to 3}\left[\frac{d^{2-1}}{dz^{2-1}}\left((z-3)^2\frac{5}{(z-3)^2(z^2+1)}\right)\right]$$

$$= \operatorname*{Lt}_{z\to 3}\left[\frac{d}{dz}\left(\frac{5}{z^2+1}\right)\right] = \operatorname*{Lt}_{z\to 3}\left[\frac{-10z}{(z^2+1)^2}\right]$$

$$= \frac{-10\times 3}{(3^2+1)^2} = -\frac{3}{10}$$

Choice (B)

41. $f_m = 10$ Hz

$f_s = 20$ Hz

The spectrum of the flat top sampled signal is given as

$$G(f) = f_s\sum_{n=-\infty}^{+\infty} X(f - nf_s)\,H(f)$$

value of $H(f)$ is expressed as

$H(f) = T\mathrm{Sin}C(fT)e^{-j\pi fT}$

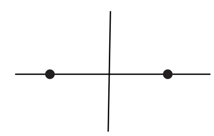
$H(f) = 0.2\mathrm{Sin}C(0.2f)e^{-j\pi f0.2}$

Now $G(f) = 20\displaystyle\sum_{n=-\infty}^{+\infty} X(f - n20)\,0.2\,\mathrm{Sin}\,C(0.2f)e^{-j\pi f\,0.2}$

$$= 4\sum_{n=-2}^{+2} X(f - 20n)\,\mathrm{Sin}\,C(0.02f)e^{-j0.05xf}$$

So 5 replicas will present. Choice (B)

42. As we know that $\dfrac{E}{N_0} = 10^{1.7} \approx 50.12$



So both the signals are independence to each other

$$P_e = Q\left(\frac{d}{\sqrt{2N_0}}\right)$$

And energy of $S_0(t) = \displaystyle\int_0^T S_o^{\,2}(t)\,dt = \frac{1}{3}A^2T$

$$S_1(t) = \frac{1}{3}A^2T$$

Distance between two points $BER = Q\left(\sqrt{\dfrac{E}{N_0}}\right)$

$= Q\left(\sqrt{50.12}\right) = Q(7.07)$ Choice (A)

43. Let $P\{x = 1\} = \dfrac{1}{4}$, $P\{x = 0\} = \dfrac{3}{4}$

For $H(Y)$ we should know $P(Y_0 = 0)$ and $P(Y_1 = 1)$

$P(Y_0) = P(Y_0/X_0) \,.\, P(X_0) + P(Y_0/X_1) \,.\, P(x_1)$

$$= \frac{1}{2}.\frac{1}{4} + \frac{1}{2}\times\frac{3}{4} = \frac{1}{2}$$

$$P(Y_1) = \frac{1}{2}$$

$$\Rightarrow \quad H(Y_1) = \frac{1}{2}\log_2 2 + \frac{1}{2}\log_2\frac{1}{2} = 1$$

Similarly, $P(Z_0) = \dfrac{1}{2}$

$PZ_1) = \dfrac{1}{2}$

$H(Z) = 1 \Rightarrow$ similarly, $H(W) = 1$

$H(Y) + H(Z) + H(W) = 3$bits. Choice (A)

44. $Z_i = Z_o\left[\dfrac{Z_L + jZ_o \tan\beta l}{Z_o + jZ_L \tan\beta l}\right]$

$\beta l = \dfrac{2\pi}{\lambda}\times \ell$

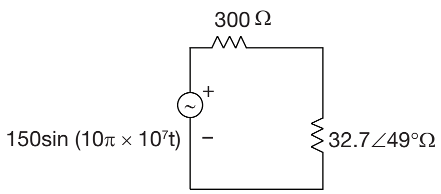
$\lambda = \dfrac{3\times10^8}{\dfrac{10\pi\times10^7}{2\pi}} = 6m$

$\beta l = \dfrac{2\pi}{6}\times5 = \dfrac{10\pi}{6} = 300^o$

$Z_{in} = 50\left[\dfrac{150 + j50\left(-\sqrt{3}\right)}{50 - j150\left(\sqrt{3}\right)}\right] = 50\left[\dfrac{3 - j\sqrt{3}}{1 - j3\sqrt{3}}\right]$

$= 50\dfrac{3.46\angle -30^o}{5.29\angle -79}$

$Z_{in} = 32.70 \angle 49^o\ \Omega$



$\Rightarrow\ P_L = V_L I_L$

$V_L = \dfrac{150\times32.7\angle49^o}{300 + 32.7\angle49^o} = \dfrac{150\times32.7\angle49^o}{321.53 + j24.67}$

$= \dfrac{150\times32.7\angle49^o}{322.47\angle4.38} = 15.2 \angle 44.62^o$

$I_L = \dfrac{150}{322.47\angle4.38} = 0.465\angle -4.38$

$P_L = 15.2 \angle 44.62 \times 0.465 \angle -4.38$

$= 7.068 \angle 40.24^o$W Choice (C)

45. $E_{rms} = \dfrac{120\pi h_e I_{rms}}{\lambda r}$

$= \dfrac{120\pi\times50\times150}{250\times100\times10^3} = 113$ mV/m Choice (C)

46. Cutoff wave length of dominant mode is

$\lambda_C = 2a = 5$cm

$\Rightarrow f_c = \dfrac{C}{\lambda_C} = \dfrac{3\times10^{10}}{\sqrt{2.89}\times5cm}$

$= \dfrac{30}{5\times1.7}GHz = 3.53$ GHz Choice (B)

47. $\Gamma = \dfrac{Z_L - Z_O}{Z_L + Z_O}$

$= \dfrac{125 + j75 - 75}{200 + j75} = \dfrac{50 + j75}{200 + j75} = \dfrac{90.138\angle56.30}{213.6\angle20.55}$

$= 0.42 \angle 35.75^o$

$\phi = 35.75^o = \dfrac{\pi}{5}$

$f = 450 \times 10^6$ Hz

$\lambda = \dfrac{C}{f} = \dfrac{300}{450} = \dfrac{2}{3}m \Rightarrow \beta = \dfrac{2\pi}{\lambda} = 3\pi$

Position of voltage minimum nearest of load $= \dfrac{\varphi + \pi}{2\beta}$

$= \dfrac{\dfrac{\pi}{5} + \pi}{2\times2\pi}\times\lambda$

$= \dfrac{3}{10}\times\dfrac{2}{3} = \dfrac{1}{5} = 0.2m$ from load Choice (C)

48. By accumulation property $y[n] = \sum_{m=-\infty}^{n} x[m]$

$Y(z) = \dfrac{X(z)}{1 - z^{-1}} = \dfrac{z\,X(z)}{(z-1)} = \dfrac{4}{z(z-1)^2}$

$\Rightarrow\ z\,X(z) = \dfrac{4}{z(z-1)}$

$\Rightarrow\ X(z) = \dfrac{4z^{-3}}{\left(1 - z^{-1}\right)}$

$x[n] = (1)^{n-3}\, u[n-3]$

$x[2] = 0$ Choice (A)

49. $x[n] \longleftrightarrow a_k;\ N_0$

$y[n] = x[2n]; \longleftrightarrow b_k = 2a_k;\ N_0^{\ 1} = \dfrac{N_0}{2}$

DTFS for $x[n]$

$X[n] = \sin\left[\dfrac{2\pi n}{12}\right]$

$X[n] = \dfrac{e^{\frac{j2\pi n}{12}} - e^{\frac{-j2\pi n}{12}}}{2j}$

$a_1 = \dfrac{1}{2j},\ a_{-1} = \dfrac{-1}{2j}$

DTFS for $y[n]$

$b_1 = \dfrac{1}{j},\ b_{-1} = \dfrac{-1}{j}$

$N_0^1 = \dfrac{N_0}{2} = \dfrac{12}{2} = 6$

$N_0^1 = 6$ Choice (B)

50. $\boldsymbol{fs_1 = 2f_{m1} = 2 \times 200 = 400}$ Hz

$fs_2 = 2f_{m2} = 300$ Hz

$\dfrac{fs_1}{fs_2} = \dfrac{4}{3} = 1.33$ Ans: 1.3 to 1.4

51. From the given data $X_L = 500\Omega$ and $R = 10\Omega$

$$Q = \frac{X_L}{R} = 50$$

$C = 1\mu F$

At resonance $X_L = X_C$

$$\therefore \quad X_C = \frac{1}{\omega c} = 500\Omega$$

$$\omega_0 = \frac{10^6}{500} = 2 \times 10^3 \text{ rad/sec}$$

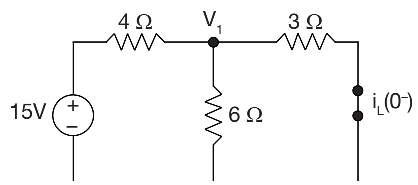
$$f_0 = 318.3\text{Hz}$$

$$\therefore \quad \text{Band width } \frac{f_0}{Q} = 6.36 \text{ Hz}$$

Ans: 6.3 to 6.4

52. For $t < 0$:

at $t = 0^-$, switch was connected at Position 1.



$$\frac{V_1 - 15}{4} + \frac{V_1}{6} + \frac{V_1}{3} = 0$$

$3V_1 - 45 + 2V_1 + 4V_1 = 0$

$9V_1 = 45$

$V_1 = 5$ volts

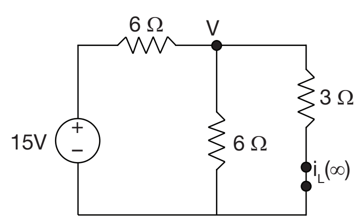
$$i_L(0^-) = \frac{5}{3} \text{ Amp}$$

for t > 0:

at $t = 0^+$, switch was connected at position 2.

$$i_L(0^-) = i_L(0^+) = \frac{5}{3} A$$

If $t \to \infty$; circuit is in steady state



$$\frac{V_2 - 15}{6} + \frac{V_2}{6} + \frac{V_2}{3} = 0$$

$V_2 - 15 + V_2 + 2V_2 = 0$

$4V_2 = 15$

$$V_2 = \frac{15}{4} \text{V}$$

$$i_L(\infty) = \frac{5}{4} \text{ Amp}$$

$$i(t) = \frac{5}{4} + \left\{\frac{5}{3} - \frac{5}{4}\right\} . e^{\frac{-t}{\tau}}$$

$\tau = L/Req$

$R_{eq} = (6 \,||\, 6) + 3 = 6\ \Omega$

$$\tau = \frac{2}{6} = \frac{1}{3} \text{sec}$$

$$i(t) = \frac{5}{4} + \frac{5}{12} . e^{-3t}$$

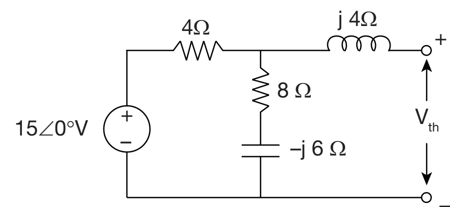
$i(2.5) = 1.25$ Amp Ans: 1.24 to 1.26

53. Find the thevenin's equivalent circuit across load terminals.

$Z_{th} = j4 + \{4 \,||\, (8 - j6)\}$

$= j4 + 2.933 - 0.533j$

$Z_{th} = (2.933 + j3.466)\ \Omega$ and



$$V_{th} = \frac{(8 - j6) \times 15\angle 0^o}{12 - j6}$$

$V_{th} = 15 \times \{0.733 - j0.133\}$

$V_{th} = (11 - j2)$volts

$= 11.18\ \angle -10.30^o$ volts

We know, the max power transferred, only when

$Z_L = Z_{th}^*$

$$P_{max} = \frac{1}{2} |I|^2 . R_L$$

$$\therefore \quad P_{max} = \frac{|V_{th}|^2}{8\,R_{th}}$$

$$= \frac{(11.18)^2}{8 \times 2.933} = 5.32 \text{ W}$$

Choice (A)

54. We know $I_D = I_{DSS}\left[1 - \frac{V_{GS}}{V_P}\right]^2$

$$\sqrt{\frac{I_D}{I_{DSS}}} = 1 - \frac{V_{GS}}{V_P}$$

$$V_{GS} = V_P\left[1 - \sqrt{\frac{I_D}{I_{DSS}}}\right] \text{volts}$$

$$= 5\left[1 - \sqrt{\frac{10}{20}}\right] = 1.4644 \text{ volts}$$

Ans: 1.4 to 1.5

55. From the given data

$N_D = 10^{22}$ atoms/m^3

$B = 0.5$ Tesla
$J = 500$ A/m^2
$d = 5 \times 10^{-3}$ m

$$V_H = \frac{B.I}{\rho.W} = \frac{B.J.W.d}{n.q.w}$$

$$\therefore V_H = \frac{B.J.d}{n.q} = \frac{0.5 \times 500 \times 5 \times 10^{-3}}{10^{22} \times 1.6 \times 10^{-19}}$$

$V_H = 7.8125 \times 10^{-4}$ V
$\therefore \quad V_H = 0.78$ mV Choice (D)

56. $\Delta V_{CE} = 9 - 5 = 4$ V
$\Delta I_C = 5.5 - 4 = 1.5$ mA

$$r_{out} = \frac{\Delta V_{CE}}{\Delta I_C} = \frac{4}{1.5} k\Omega \ = 2.66\ k\ \Omega$$

Answer: 2.6 to 2.7

57. We known C.E is
$1 + G.H = 0$

$$1 + \frac{(2+s.T)(4)}{s(s+2)} = 0$$

$s^2 + 2s + 8 + 4sT = 0$
$s^2 + (2 + 4T)\ S + 8 = 0$
$\omega_n = \sqrt{8} \ = 2.828$ rad/ sec
$2\ \xi\ \omega_n = 2\ (1 + 2T)$
$\omega_n = 2 + 4T$
$T = 0.207$ sec Ans 0.2 to 0.21

58. $\dfrac{dx_1}{dt} = x_2$ and $\dfrac{dx_2}{dt} = x_2 - x_1$

$\dot{x}_1(0) = x_2(0) = 0.5$

$\dot{x}_2\ (0) = x_2\ (0) - x_1\ (0) = 1.5$

$y = x_1 + x_2$

$$\frac{dy}{dt} = \dot{x}_1 + \dot{x}_2$$

At $t = 0$

$$\frac{dy}{dt} = \dot{x}_1(0) + \dot{x}_2(0) \ = 0.5 + 1.5 = 2$$

Ans 1.9 to 2.1

59. Check s = –1 + j1 is on RL or Not.
If it is on RL $\angle G(s).\ H(s)$ at s = –1 + j1 = odd multiple of 180° = $(2n + 1)\ \pi$

$$\angle G(s)H(S) = \frac{K}{\angle -1 + j1.\ \angle 0.5 + j0.5. \angle -1 + j2}$$

$= 0° - \{180° - 45°\} - Tan^{-1}\ 1 - \{180° - Tan^{-1}\ 2\ \}$
$= -180° + 45° - 45° - 116.565 = 296.56°$
It is not odd multiples of 180° so it is not on the RL.
Choice (D)

60. A single transistor operates as class B, hence I_{dc} is average of i_c which is half wave rectified waveform as it operates for 180°

$$I_{dc} = \frac{I_m}{\pi}$$

$I_m = 78.5$ mA
$P_{ac} = I^2_{rms}\ R_L$

$$= \left(\frac{I_m}{\sqrt{2}}\right)^2 R_L^{\ 1} \text{ but } R_L^{\ 1} = R_L = 2k\Omega$$

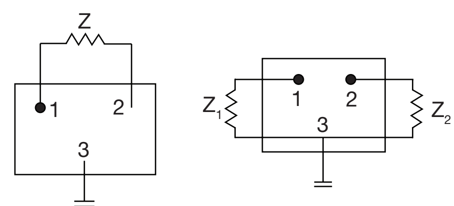
$P_{ac} = 6.16$ W Choice (B)

61. $$|A_i| = \frac{h_{fe}}{\sqrt{1 + \left({}^{f}/_{f_\beta}\right)^2}}$$

$$\Rightarrow \quad 10 = \frac{100}{\sqrt{1 + \left(\dfrac{10M}{f\beta}\right)^2}}$$

$\Rightarrow \quad f_\beta = 1$MHz
$f_T = h_{fe} f_\beta$
$= 100 \times 1$ MHz
$= 100$ MHz Choice (B)

62.



$$Z_1 = \frac{z}{1 - A_v} = \frac{25}{1+30} = 0.8\Omega$$

$$Z_2 = \frac{Z}{1 - \dfrac{1}{A_v}} = \frac{25}{1 + \dfrac{1}{30}} = 24.2\Omega$$

Choice (A)

63. The output of Decoder are active low outputs so
$f(p, q, r) = \overline{\bar{Y}_1 . \bar{Y}_2 . \bar{Y}_3 . \bar{Y}_5} = Y_1 + Y_2 + Y_3 + Y_5$
$= \Sigma_m(1, 2, 3, 5)$
$= p^1\ q + q^1\ r$ Choice (D)

64. The characteristic equation of T flip flop $Q_{n+1} = T \sum Q_n$
Here $T = Q_n \sum x$
So $Q_{n+1} = Q_n \sum x \sum Q_n$
$Q_{n+1} = x$, next state is same as input applied
Choice (C)

65. $F = W\,X\,Y^1 + \{(W + Y)^1 \odot X\} + \{Y \sum WZ\}$
$F = W\,X\,Y^1 + X(W + Y)^1 + X^1(W + Y) + Y^1(WZ) + Y(WZ)^1$
$= W\,X\,Y^1 + XW^1Y^1 + X^1W + X^1\,Y + WY^1Z + YW^1 + YZ^1$

wx \ yz	00	01	11	10
00	0	0	1	1
01	1	1	1	1
11	1	1	0	1
10	1	1	1	1

$= (W + X + Y)(W^1 + X^1 + Y^1 + Z^1)$ Choice (A)