Mock Test I

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

Direction for question 1: Fill in the blank with the suitable word/phrase:

1. There are _________candidates opting for Home Science today as a course of study at the college level.
(A) smaller (B) less
(C) fewer (D) lesser

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

2. The average weight of a class increases by 1 kg, when A joins the class. Later when B also joins, the average weight further increases by 1/2 kg. If the number of students now in the class is 14, the difference in the weights of A and B ___________.

3. Every Saturday evening from 6pm to 7pm a game known as "FAMILY FORTUNES" is telecast on 'XTV' channel. The mode of the game is as follows.
A table containing prices of different articles is present on the monitor. The anchor asks questions regarding the prices of different articles. If you are able to answer these questions correctly, the corresponding article is yours.
Be the lucky winner by answering the questions that follow the table given below:

2500	3000	1500	3500
2750	1750	3200	2800
2400	3600	4000	2200
1800	1200	1600	2250
3800	3400	3100	2000

A discount of 10% is offered on 'Ultra Microwave Oven' and in the above price table, the list price and the sale price of the above said article are adjacent to each other, not necessarily in the same order. What is its sale price?
(A) ₹4000 (B) ₹3600
(C) ₹1800 (D) ₹2000

Direction for question 4: Select the statement in which the underlined word is used correctly:

4. (A) These insects **adapted** themselves very easily to new environments.
(B) That woman has **adapted** a child from an orphanage.
(C) That Telugu family **immigrated** to Australia last year.
(D) People who have **emigrated** to the U.S have had to deal with tougher labour laws.

Directions for question 5: Select the correct alternative from the given choices.

5. In a certain code language, if REPTILE is coded as 49 and CROCODILE is coded as 81, then how is ALLIGATOR coded in that language?
(A) 95 (B) 100
(C) 49 (D) 81

Questions 6 to 10 carry Two Marks each.

Direction for question 6: Out of the following four sentences, select the most suitable sentence with respect to grammar and usage:

6. (A) We took a month and a few days to get acclimated to our new teacher, who is from Baroda.
(B) We will take month and few days to get acclimated to our new teacher, who is from Baroda.
(C) We have taken month and a fewer days to get acclimated to our new teacher, who is from Baroda.
(D) We took a month few days to get acclimated to our new teacher, who is from Baroda.

Directions for question 7: Select the correct alternative from the given choices.

7. If $|x| < 1$ and $1 + 3x + 5x^2 + 7x^3 + 9x^4 + \ldots\infty = 3$, find x.
(A) 1/2 (B) 1/3
(C) 1/4 (D) 1/5

Direction for question 8: In the following question, the first and the last sentences of a passage are in order and numbered 1 and 6. The rest of the passage is split into 4 parts and numbered as 2, 3, 4 and 5. These 4 parts are not arranged in the proper order. Read the sentences and arrange them in a logical sequence to make a passage and choose the correct sequence from the given order:

8. (1) A classic example of how the "get what you want by helping others get what they want" approach works is the result that a major automaker got when it came out with a new design.
(2) After all, the person turning the wrench knows more about the way it really works on the assembly line than the engineers who designed the wrench.
(3) Before making these changes, the management asked the employees who would actually be building the new vehicles whether they had any ideas for making the assembly lines more effective.

(4) The workers had dozens of marvelous ideas.
(5) This design necessitated the construction of new plants and the retooling of existing ones.
(6) First, the employees explained that when they had to go down the steps into the pit to work on the underside of a car, they sometimes slipped and fell, injuring themselves.

(A) 5, 3, 4, 2 (B) 3, 4, 2, 5
(C) 2, 5, 4, 3 (D) 4, 3, 2, 5

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

9. In a parking lot six buses are parked in front of bus number 25 and fifteen buses are parked behind bus number 45. If six buses are parked between bus numbers 25 and 45, then how many buses are there in the parking lot?
(A) 29
(B) 26
(C) 15
(D) Cannot be determined

10. Jane Davis, founder of Get Into Reading, which has helped Clare Ross so much, discovered the healing power of books by accident. An English lecturer at Liverpool University, England, she also taught literature courses in her community. In the process she discovered that people derived consolation from great writers and the support network the group provided. So she set up Get Into Reading, which now has more than 135 groups.
Which of the statement(s) below is/are logically valid and can be inferred from the above statements?
(i) Reading gives multiple benefits, both unexpected and wholesome.
(ii) Reading helps everyone to set up an association like Get Into Reading.
(iii) Reading is just a waste of time which makes one hope for an unattainable goal.
(iv) Reading gives not only help from great writers but also support from other sources.

(A) (i) and (iii) (B) (i) and (iv)
(C) (ii) and (iii) (D) (ii) and (iv)

ELECTRONICS AND COMMUNICATION ENGINEERING

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

11. One of the eigenvectors of the matrix

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix} \text{ is } \_\_\_\_$$

(A) $\begin{bmatrix} 4 \\ 3 \\ -2 \end{bmatrix}$ (B) $\begin{bmatrix} 2 \\ 2 \\ -2 \end{bmatrix}$

(C) $\begin{bmatrix} 3 \\ 4 \\ -2 \end{bmatrix}$ (D) $\begin{bmatrix} -3 \\ -3 \\ -3 \end{bmatrix}$

12. The value of the improper integral $\int_0^\infty 3x^{14} e^{-x^3} dx$ is ____

13. Which of the following is NOT a valid identity for any three arbitrary events A, B and C of a sample space?
(A) $P(\frac{\overline{A}}{B}) = 1 - P(A/B)$
(B) $P(A \cap B) = P(A)\, P(B/A)$
(C) $P((A \cup B)/C) = P(A/C) + P(B/C) - P((A \cap B)/C)$
(D) None of these

14. The unit outward drawn normal to the surface $z = x^2 + y^2 - 25$ at the point P (4, 2, –5) is ____

(A) $\frac{1}{3}\left(4i + 3\overline{j} - \overline{k}\right)$ (B) $\frac{1}{6}\left(8i + 4\overline{j} - 2\overline{k}\right)$

(C) $\frac{1}{9}\left(8i + 4\overline{j} - 2\overline{k}\right)$ (D) $\frac{1}{9}\left(8i + \overline{j} + 4\overline{k}\right)$

15. The value of $\underset{x \to 2}{Lim} \dfrac{(x^3 - 2x^2 - 9x + 18)}{(x^4 - 5x^2 + 4)}$ is ____

16. The spectral density of a real valued random process has
(A) an odd symmetry (B) an even symmetry
(C) a conjugate symmetry (D) No symmetry

17. For the demodulation of differential PSK
(A) A PLL can be used
(B) costas loop can be used
(C) A modified costas loop can be used
(D) None of these

18. The transfer function of a system is given as

$$H(s) = \frac{s+2}{(s+3)(s-1)};\ ROC - 3 < R_e(s) < 1.$$

The given system is
(A) causal only (B) stable only
(C) causal and Stable (D) None of these

19. If x[n] is an absolutely summable discrete – time signal. Its z-transform is a rational function with one pole and one zero. The pole is at $z = +3$. True statement for signal $x[n]$ is ____
(A) It is a periodic signal
(B) It is a causal signal
(C) It is a Non-causal signal
(D) It is a finite duration signal

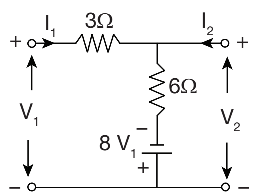
20. At t = 0, the $\dfrac{\sin t}{t}$ signal is ____

(A) maximum (B) minimum
(C) discontinuous (D) Zero

21. Inner and Outer radius of co-axial capacitor respectively are 3 mm and 9 mm. Capacitance of this cable is 135 pF/m. If the ratio of inner radius to outer radius is 0.25, then capacitance is
(A) 106.98 pF
(B) 170.35 pF
(C) 135.28 pF
(D) 150.34 pF

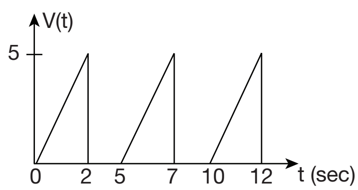
22. Isolation and Directivity of a directional coupler respectively are 35 dB and 20 dB. The coupling factor of directional coupler is _______ dB.

23. Consider the network show in below



The h-parameters are
(A) Symmetrical and non reciprocal
(B) Asymmetrical and reciprocal
(C) Both symmetrical and reciprocal
(D) Asymmetrical and non reciprocal

24. The R.M.S value of the voltage waveform is _______ volts.

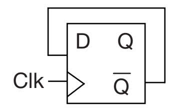


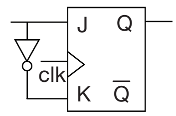
25. The dark current (I_o) due to in a semiconductor photo diode is _________
(A) the transient current
(B) the forward bias current
(C) the reverse saturation current
(D) All the above

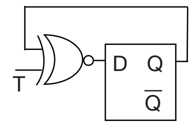
26. Find the diffusion coefficient of electrons of a Si crystal at 27°C. If the mobilities of electrons and holes are 0.17 and 0.025 m^2/V-s, respectively at 27°C.
(A) 43.96 cm^2/sec
(B) 4.4 m^2/sec
(C) 2.32×10^{-4} m^2/sec
(D) 3.8 cm^2/sec

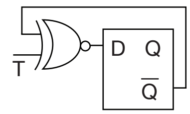
27. Find the minimum POS form of the following expression $f(a, b, c, d) = (a^1 + c^1 + d)(a^1 + b + d)(a^1 + b + c)(a + b + d)(b + c^1 + d)$.
(A) $(a^1 + c^1 + d)(a + b)(b + c^1 + d)$
(B) $(b + d)(a^1 + c^1 + d)(a^1 + b + c)$
(C) $(a^1 + c^1)(a + b + d)(b + c^1 + d^1)$
(D) $(a^1 + b)(a + b + d)(b^1 + c + d)$

28. Which of the following circuit diagram perform like a T-flipflop.

(A) 

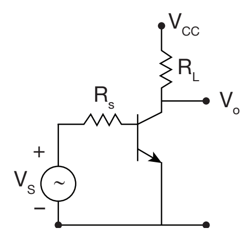
(B) 

(C) 

(D) 

29. In Halfwave Rectifier V_m sin ω t is supplied at primary winding of Transformer. The *RMS* voltage across the secondary winding of Transformer is
(A) V_m
(B) $\frac{V_m}{\sqrt{2}}$
(C) $\frac{V_m}{2}$
(D) $\frac{V_m}{\pi}$

30. Determine output impedance (R_0), for the given circuit as shown in figure.



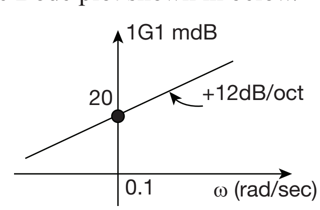
(A) 0
(B) ∞
(C) R_L
(D) $R_L \| R_S$

31. Which of the following relations are correct in high frequency model
(1) $g_m = I_c/V_T$
(2) $f_\beta = \beta f_T$
(3) $g_m = I_{CO}/V_T$
(4) $f_\alpha = \alpha . f_T$
(A) 3 and 4 only
(B) 1 and 4 only
(C) 2 and 3 only
(D) 1 and 2 only

32. The open loop zero effects the stability of
(A) open loop system
(B) closed loop system
(C) both A and B
(D) None of these

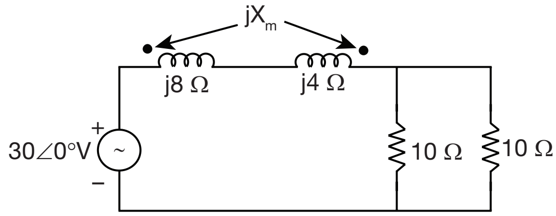
33. A second order system is described by the equation $\frac{d^2c}{dt^2} + 3\frac{dc}{dt} + 4c = 5r$. The resonant peak and resonant frequency (r/s) respectively would be
(A) $M_r = 1$ and $\omega_r = 0$
(B) $M_r = 1$ and $\omega_r = 0.3$
(C) $M_r = 0$ and $\omega_r = 1$
(D) $M_r = 0$ and $\omega_r = 1$

34. Consider the Bode plot shown in below.



The value of gain K is _________.

35. Power absorbed by the network excited by a 30∠0°V sinusoidal source is 150W.



The value of mutual inductive reactance x_m (In Ω) should be ______.

36. If the system of linear equations

$2x - 4y + 3z = 4$

$2x - 5y + 7z = 5$

$4x + 3y + az = b$

has a unique solution, then

(A) 'a' can't be any real number other than +38
(B) 'a' can't be any real number other than +3
(C) 'a' can be any real number other than '–38'
(D) 'a' can be any real number other than '–3'

37. The particular integral of the differential equation $\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = 4\cosh 2t$ is ______

(A) $\frac{-1}{8}e^{2t} + t^2 e^{-2t}$ (B) $-t^2 e^{2t} + \frac{1}{8}e^{-2t}$

(C) $t^2 e^{2t} + \frac{1}{8}e^{-2t}$ (D) $\frac{1}{8}e^{2t} + t^2 e^{-2t}$

38. A stationary value of a function $f(x)$ is a value of x, where $f'(x) = 0$. The number of distinct stationary values of $f(x) = 8x^5 - 15x^4 + 10x^2$, where $f(x)$ has neither maximum nor minimum is ____

39. The mean of a continuous random variable X with its probability density function $f(x)$ given by

$f(x) = k(3 + 2x)$; $2 \le x \le 4$; 0; otherwise

Is _____

(A) 83/27 (B) 88/27
(C) 91/27 (D) 94/27

40. If the imaginary part of an analytic function $f(z) = u(x, y) + iv(x, y)$ is $v(x, y) = x^3 - 3xy^2 + 2y$, then $f(z)$ is ____ (Here c is a constant)

(A) $-3z + iz^2 + c$ (B) $3z - iz^2 + c$
(C) $z^3 - i2z + c$ (D) $2z + iz^3 + c$

41. The PDF of a Gaussian random variable X is given by $P_x(x) = \frac{1}{3\sqrt{2\pi}}\exp\frac{-(x-8)^2}{12}$. The probability of the event $\{X = 3\}$ is ________

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$

(C) $\frac{1}{3}$ (D) 0

42. We have QPSK, where each signal carries 2 bits, the signals are ________

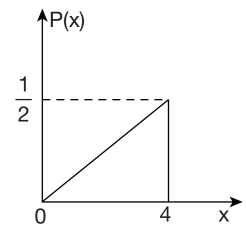
$$Si(t) = \begin{cases} A\sin\left(2\pi f_o t - \frac{2\pi i}{m}\right); & 0 \le t \le T \\ 0 & ; else \end{cases}$$

Where for $i = 1, 2, 3, 4$ with $f_o t = 1$ and $m = 4$ phase angles are $\pm\frac{\pi}{4}$, $\pm\frac{3\pi}{4}$.

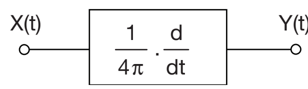
To increase data rate by 50% each signal has to carry 3 – bits, using 8 – PSK. The increment in amplitude A, to maintain the same symbol error probability.

(A) 0.54 (B) 2.85
(C) 1.85 (D) Zero

43. An output of communication channel is a random variable x with the probability density function as shown in figure. The standard deviation of x is ______



44. A deterministic signal $x(t) = \sin 2\pi t$ is passed through a differentiator as shown in figure



The auto correlation function $R_{YY}(\tau)$ is

(A) $\frac{\sin 2\pi\tau}{4}$ (B) $\pi\sin(2\pi\tau)$

(C) $2\pi\sin(2\pi\tau)$ (D) $\frac{\sin 2\pi\tau}{\pi}$

45. For a continuous time signal which is a linear combination of unit impulse functions given as

$x(t) = [\delta(t - 2) + \delta(t + 2) + \delta(t - 1) + \delta(+ 1)]$.

The fourier transform of $x(t)$ is ______

(A) $2\cos 2\omega + 2\sin 2\omega$ (B) $2\cos 2\omega + 2\cos\omega$
(C) $\cos\omega + \cos 2\omega$ (D) $2\cos 2\omega + \sin 2\omega$

46. If $x_o[n]$ and $x_e[n]$ are the odd and even parts of a signal $x[n]$ which of the following relation must be true?

(A) $\sum_{n=-\infty}^{+\infty} x_e[n] + \sum_{n=-\infty}^{+\infty} x_o[n] = 0$

(B) $\sum_{n=-\infty}^{+\infty} x[n] + 2\sum_{n=-\infty}^{+\infty} x_e[n] = 0$

(C) $\sum_{n=-\infty}^{+\infty} x_e[n]x_o[n] = 0$

(D) $\sum_{n=-\infty}^{+\infty} x_e[n]x_o[n] = \sum_{n=-\infty}^{+\infty} x^2[n]$

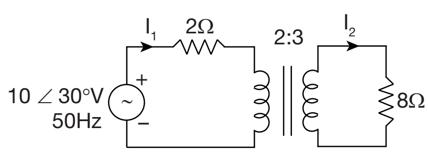
47. $x[n]$ is right sided signal and its Z-transform $X(z)$ has a single pole. If $x(0) = 5$ and $x(2) = \frac{1}{5}$, then the value of $x[3]$ is ______

48. A transmission line has conductance of 0.5 μS/km, capacitance of 0.001 μF/km, resistance of 5 Ω/km and inductance of 1.5 mH/km. Then find attenuation constant at 4 kHz frequency.
(A) 2.355×10^{-3} Np/km
(B) 0.03 Np/m
(C) 5.32×10^{-3} Np/km
(D) 32.4×10^{-3} Np/m

49. In H-plane Tee junction, 40 mW power source is connected at port 3 which is perfectly matched to the junction. Loads of 80 Ω and 90 Ω are connected to port (1) and port (2) respectively the tee has 50 Ω characteristic impedance. Then find power delivered to 80Ω.
(A) 20 mW (B) 18.9 mW
(C) 0.20 mW (D) 40 mW

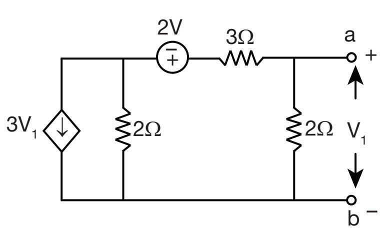
50. An antenna is transmitted $2W$ of power with 30dB of directive gain. Distance between receiving and transmitting antenna is 250 λ and gain of the receiving antenna is 2.2 dB. Then calculate power received by receiving antenna?
(A) 0.133 mW (B) 4.458 mW
(C) 32.11 mW (D) 26.7 mW

51. Consider the following circuit



The current I_2 is.
(A) $1.2\cos(100\pi t + 30^\circ)$A
(B) $1.2\sin(100\pi t - 30^\circ)$A
(C) $1.5\cos(100\pi t + 30^\circ)$A
(D) $1.5\sin(200\pi t - 30^\circ)$A

52. Consider the circuit shown in below

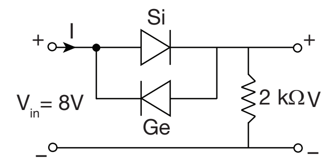


The norton's equivalent resistance across the terminals 'a' and 'b' is _______ Ω.

53. An LC tank circuit consists of an ideal capacitor C connected in parallel with a coil of Inductance L having an Internal resistance R. If $L = 4H$, $C = 1F$ and $R = 0.5$ Ω, then the resonant frequency of the tank circuit is _____ rad/sec.

54. In an N-type silicon sample, the donor concentration is 1 atom per 2.5×10^3 silicon atoms. If the effective mass of an electron is equal to the true mass. The value of the absolute temperature at which the Fermi level coincides with the edge of the conduction band is ________. (Concentration of silicon atoms = 5×10^{22} atoms/cm³).
(A) 0.2°K
(B) 0.0258°K
(C) 2.5°K
(D) 300°K

55. Consider the circuit shown in below



(consider $V\gamma = 0.7$ V for Si, $V\gamma = 0.2$ V for Ge)
The value of I (in mA) is __________.

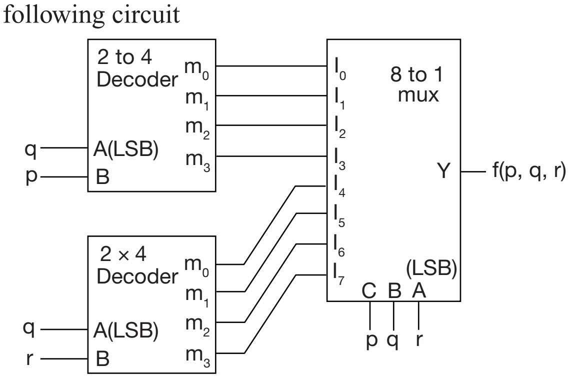
56. A zener diode has an impedance of 50 Ω in the range for $I_Z = 2.5$ mA to 8 mA. The voltage corresponding to I_Z of 2.5 mA is 10V. The maximum zener voltage can be expected if the diode is used in an application where the zener current varies from 3 mA to 6 mA is ______ volts.

57. What is the output at PORT1 when the following instructions are executed?

```
MVI A, 82H
ADI 7FH
JC DSPLAY
OUT PORT1
HLT
DSPLAY : SUB A
OUT PORT1
HLT
```

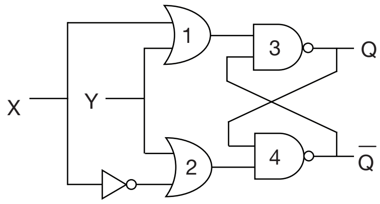
(A) 82 H (B) 7FH
(C) 01H (D) 00H

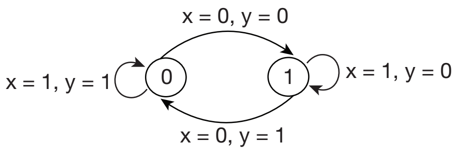
58. Find the min terms of the function implemented by the following circuit

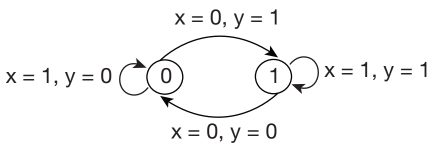


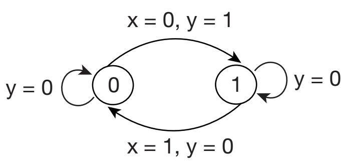
(A) $\sum m(0, 7)$
(B) $\sum m(3, 4)$
(C) $\sum m(0, 4, 7)$
(D) $\sum m(2, 3, 5)$

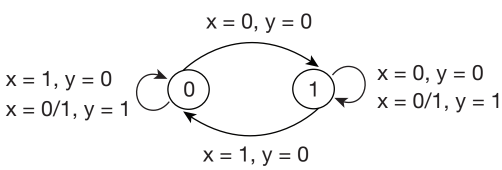
59. What is the state diagram of the following latch circuit?



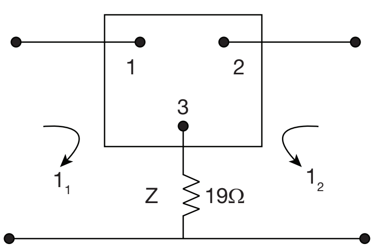
(A) 

(B) 

(C) 

(D) 

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



(A) $\frac{19}{29}\Omega, \frac{570}{29}\Omega$ (B) 1Ω, 20Ω

(C) 380Ω, 20Ω (D) 551Ω, 18.37Ω

61. Given that $h_{fe} = 50$, $h_{oe} = 24\mu\ A/V$. Find out g_m and $g_{b'e}$ at $I_C = 1.3$ mA and room temperature(27°C).

(A) 1℧ and 2.5 ℧ (B) 0.05 ℧ and 10^{-3} ℧

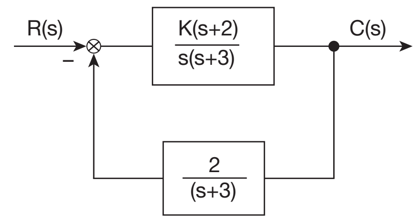
(C) 0.01℧ and 25℧ (D) 1℧ and 1℧

62. Three identical non-interacting amplifier stages are in cascade, have an overall gain of 1 dB down at 30 Hz compared to midband. Calculate the lower cut-off frequency of the individual stages.

(A) 7.8 kHz (B) 8.8 kHz

(C) 7.8 Hz (D) 8.8 Hz

63. Consider the closed loop control system shown in below.



The value of K so that there is 20% error in the steady state is ______.

64. Given the system represented in state space by equations.

$$\frac{dx}{dt} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \mu$$

$$y = \begin{bmatrix} 1 & 2 \end{bmatrix} x;$$

The unit impulse response of the system y(t) is ______.

(A) $(2.e^{-3t} - e^{-t}).u(t)$ (B) $(e^{-2t} - 2.e^{-t}).u(t)$

(C) $(3.e^{-2t} - e^{-t}).u(t)$ (D) None of these

65. The open loop transfer function of a feedback control system is given by $G(s).H(s) = \dfrac{K(s+1)}{s(1+\tau s)(1+3s)}$.

Determine the region in which the closed loop system is stable.

(A) $\tau < \frac{2}{3}$ and $0 < K < \frac{2+\tau}{3\tau - 2}$

(B) $\tau > 1.5$ and $0 < K < \frac{3+\tau}{2\tau - 3}$

(C) $0 < \tau < \frac{3}{2}$

(D) $\tau > \frac{3}{2}$ and $K > 2$.

Answer Keys

1. C **2.** 5 **3.** B **4.** A **5.** D **6.** A **7.** B **8.** A **9.** A **10.** B
11. B **12.** 24 **13.** D **14.** C **15.** –0.44 to –0.39 **16.** B **17.** C **18.** B **19.** C
20. A **21.** A **22.** 14.5 to 15.5 **23.** D **24.** 1.8 to 1.9 **25.** C **26.** A **27.** B
28. D **29.** B **30.** A **31.** D **32.** B **33.** A **34.** 995 to 1005 **35.** 4.8 to 4.9
36. C **37.** D **38.** 0.9 to 1.1 **39.** A **40.** D **41.** D **42.** C **43.** 0.9 to 1
44. A **45.** B **46.** C **47.** 0.03 to 0.05 **48.** A **49.** B **50.** C **51.** A
52. 0.52 to 0.53 **53.** 0.45 to 0.5 **54.** B **55.** 3.6 to 3.7 **56.** 10.1 to 10.2 **57.** D
58. C **59.** D **60.** C **61.** B **62.** C **63.** 3.7 to 3.8 **64.** C **65.** B

HINTS AND EXPLANATIONS

1. The grammatically correct choice is (*C*) "fewer". The reason is "fewer" is used when the noun is countable; "Less" is used for uncountable things, as illustrated in "there's less dust on the furniture today; there was less noise in the class, there is less milk in the fridge." "Smaller" and "lesser" are irrelevant. Choice (C)

2. Let the weight of *A* be a kg and that of *B* be *b* kg.
After *A* and *B* join, total number of students in the class is 14.
∴ Before *A* and *B* joined, the strength of the class was 12. If we assume that the average weight of the 12 students is *n*, then after *A* joins, it is $\frac{12n+a}{13}$

$\frac{12n+a}{13} = n + 1,$

⇒ $12n + a = 13n + 13$ —— (1)
⇒ $a = n + 13$
After *B* joined, the average increases by 1/2.
∴ $\frac{12n+a+b}{14} = n + 1 + \frac{1}{2},$
⇒ $12n + a + b = 14n + 14 + 7$ —— (2)
(2) – (1) gives $b = n + 8$ and $a = n + 13$
∴ $a - b = 5.$ Ans: 5

3. Since 90% of 4000 = 3600 and both 3600 and 4000 are adjacent to each other the sale price of the article should be = ₹3600. Choice (B)

4. Sentences (*B*) to (*D*) are all wrong for several reasons. The grammatically correct sentence is (*A*). The verb "adapt" is rightly used and therefore it is syntactically correct. In sentence (*B*) the correct word is "adopt", not "adapt". Childless women or couples adopt others' child or children. In sentence (*C*) the appropriate word is "emigrated", not "immigrated". In sentence (*D*) the wrong word is "emigrated". The correct word is "immigrated". Choice (A)

5. The Number of letters in the word REPTILE is 7 and $7^2 = 49$. Similarly the number of letters in the word CROCODILE is 9 and $9^2 = 81$.
The number of letters in the word ALLIGATOR is 9 and $9^2 = 81$.
∴ 81 is the code for the word ALLIGATOR.
Choice (D)

6. The correct sentence with respect to grammar and usage is sentence (*A*). In sentences (*B*), (*C*) and (*D*) the article "*a*" is omitted before 'few' and that is what makes them wrong and unacceptable. Choice (A)

7. $S = 1 + 3x + 5x^2 + 7x^3 + 9x^4 + \ldots$ → (1)
$Sx = x + 3x^2 + 5x^3 + 7x^4 + \ldots$ → (2)
----
(1) – (2) $S \Rightarrow (1 - x) = 1 + 2x + 2x^2 + 2x^3 \ldots\ldots\infty$
$= 1 + 2x\,(1 + x + x^2 + \ldots\infty)$

$= 1 + \frac{2x}{1-x}$

$S(1 - x) = \frac{1+x}{1-x}$

$S = \frac{1+x}{(1-x)^2} = 3$

$3x^2 - 7x + 2 = 0$

$(3x - 1)(x - 2) = 0 \Rightarrow x = \frac{1}{3}$ (or) $x = 2$

But $|x| < 1 \Rightarrow x = \frac{1}{3}$ Choice (B)

8. Sentences (1) and (6) remain constant and unchanged while the following and preceding four sentences will be shuffled and rearranged in their proper and logical sequence. Sentence (1) says the passage illustrates how an approach was adopted by an automaker to arrive at a new design for an automobile. The new design entailed constructing new plants (5). In the second sentence (3) the management invited the employees' ideas. In the third sentence (4) the employees were forthcoming with their ideas. In the fourth sentence (2) the author agrees that the workers know better if the wrench works well or not. The logical sequence of the sentences is (*A*) 5, 3, 4, 2. Choice (A)

9. According to the given information the possible arrangement is as follows.
6 bus25 6 bus45 15
∴ The total number of buses in the parking lot is 29.
Choice (A)

10. The above short passage is exclusively about the varied and unforeseen benefits of reading. Though the benefits can be denied or disputed by some, they are nonetheless real and verifiable. The passage says reading provided healing power by accident to some people. Not only that, reading affords consolation and support to those who are sincerely devoted to reading. Belittling it is of no consequence. The answer choices are (i) and (iv), that is (*B*). Choice (B)

11. Given matrix is $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$

The characteristic equation of *A* is $|A - \lambda I| = 0$ i.e.,

$$\begin{vmatrix} 1-\lambda & 0 & 0 \\ 0 & 2-\lambda & 1 \\ 2 & 0 & 3-\lambda \end{vmatrix} = 0$$

⇒ $(1 - \lambda)(2 - \lambda)(3 - \lambda) = 0$
⇒ $\lambda = 1, 2, 3$
∴ The eigenvalues of *A* are 1, 2 and 3

If X is an eigenvector of A, corresponding to an eigenvalue λ, then $AX = \lambda X \rightarrow (1)$ for exactly one of $\lambda = 1, 2$ and 3.
Among the vectors given in the options, the vector $X = \begin{bmatrix} 2 \\ 2 \\ -2 \end{bmatrix}$ given in option (B) will satisfy the condition $AX = \lambda X$ for $\lambda = 1$

The vector $\begin{bmatrix} 2 \\ 2 \\ -2 \end{bmatrix}$ is an eigenvector of A

Choice (B)

12. Let $I = \int_0^\infty 3x^{14} e^{-x^3} dx \quad \rightarrow (1)$

Let $x^3 = t \Rightarrow 3x^2 dx = dt$
At $x = 0$; $t = 0$ and at $x = \infty$; $t = \infty$
$\therefore$ (1) becomes,

$$I = \int_0^\infty 3x^{14} e^{-x^3} dx = \int_0^\infty x^{12} e^{-x^3} (3x^2) dx$$

$$= \int_0^\infty (x^3)^4 e^{-x^3} (3x^2) dx = \int_0^\infty t^4 e^{-t} dt$$

$$= \int_0^\infty e^{-t} t^{5-1} dt = \Gamma(5) = 4! = 24$$

[Answer 24]

13. Standard Results Choice (D)

14. Given surface is $z = x^2 + y^2 - 25$
i.e., $x^2 + y^2 - z - 25 = 0$
Let $f(x, y, z) = x^2 + y^2 - z - 25 = 0$
The normal to the surface $f(x, y, z) = 0$ is $\nabla f = \text{grad } f$

$$= \frac{\partial f}{\partial x}\bar{i} + \frac{\partial f}{\partial y}\bar{j} + \frac{\partial f}{\partial z}\bar{k} = 2x\bar{i} + 2y\bar{j} - \bar{k}$$

$\therefore$ The normal to the surface $f(x, y, z) = 0$ at $P(4, 2, -5)$ is
∇f at $P(4, 2, -5) = (8\bar{i} + 4\bar{j} - \bar{k})$

$\therefore$ The unit outward drawn normal to the surface is

$$\frac{\nabla f}{|\nabla f|} = \frac{8\bar{i} + 4\bar{j} - \bar{k}}{\sqrt{8^2 + 4^2 + (-1)^2}} = \frac{1}{9}(8\bar{i} + 4\bar{j} - \bar{k})$$

Choice (C)

15. We have $\lim_{x \to 2} \frac{(x^3 - 2x^2 - 9x + 18)}{(x^4 - 5x^2 + 4)}$

$$= \lim_{x \to 2} \frac{(3x^2 - 4x - 9)}{(4x^3 - 10x)} \text{ (By } L \text{ Hospital's Rule)}$$

$$= \frac{-5}{12} = -0.4167$$

Ans: –0.44 to –0.39

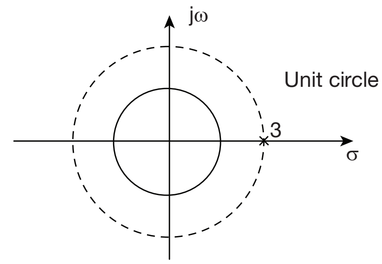
16. Choice (B)

17. More precisely, a modified costas loop can be used for this purpose. Choice (C)

18. $H(s) = \dfrac{S+2}{(S+3)(S-1)}$

Zeros are at s = –2
Poles are a s = –3 and 1
One pole at R.H.S of s-plane so non causal.
For Stability:
ROC of the system will be $-3 < R_e(s) < 1$
So ROC includes jω axis so stable. Choice (B)

19. Since $x[n]$ is absolutely summable thus its ROC must include unit circle

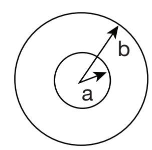


Thus ROC must be inside the circle radius 3 $x[n]$ must be non causal signal. Choice (C)

20. At $t = 0$, $\dfrac{\sin t}{t} = 1$ and $-1 \le \sin t \le 1$, So at $t = 0$

$\dfrac{\sin t}{t}$ is maximum Choice (A)

21. Co-axial cable capacitor $C = \dfrac{2\varepsilon\pi l}{\ln\left(\dfrac{b}{a}\right)}$



Given that $\dfrac{a}{b} = 0.25$

$\Rightarrow \dfrac{b}{a} = 4$

$$C_1 \ln\left(\frac{b_1}{a_1}\right) = C_2 \ln\left(\frac{b_2}{a_2}\right)$$

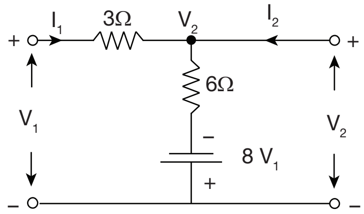
$$\Rightarrow \frac{135 \times In\left(\frac{9}{3}\right)}{In(4)} = C_2 = 106.98 \text{ pF}$$

Choice (A)

22. Isolation (dB) = coupling (dB) + directivity (dB)
$\Rightarrow$ Coupling = I – D
= (35 – 20)dB = 15dB Ans: 14.5 to 15.5

23. We know h-parameters are defined in terms of
$V_1 = h_{11} I_1 + h_{12} V_2$

$I_2 = h_{21} I_1 + h_{22} V_2$



$\frac{V_2 + 8V_1}{6} - I_1 - I_2 = 0$

$V_2 + 8V_1 = 6I_1 + 6I_2$

$\frac{V_1 - V_2}{3} = I_1$

$V_1 = 3I_1 + V_2$ $\rightarrow$ (i)

$6I_2 = -6I_1 + V_2 + 8V_1$

$6I_2 = -6I_1 + V_2 + 8\{3I_1 + V_2\}$

$6I_2 = -6I_1 + V_2 + 24I_1 + 8V_2$

$6I_2 = 18I_1 + 9V_2$

$I_2 = 3I_1 + 1.5V_2$ $\rightarrow$ (ii)

From (i) and (ii) $[h] = \begin{bmatrix} 3 & 1 \\ 3 & 1.5 \end{bmatrix}$

$h_{12} \neq -h_{21}$ and $|h| \neq 1$

So It is asymmetrical and Non-reciprocal Choice (D)

24. $V_{rms} = \sqrt{\frac{1}{T}\int_0^T V^2(t)\,dt}$

From the wave from $T = 5$ sec

$0 \le t \le 2$:-

$A(0, 0)$, $B(2, 5)$

$y - y_1 = m(x - x_1)$

$V(t) - 0 = \frac{5}{2}(t - 0)$

$V(t) = \frac{5}{2} t$ volts and

$2 \le t \le 5$:-

$V(t) = 0$

$\therefore V_{rms}^2 = \frac{1}{5}\left[\int_0^2 \left(\frac{5}{2}t\right)^2 .dt + \int_2^5 0.dt\right]$

$= \frac{1}{5}\left[\frac{25}{12}.\left[t^3\right]_0^2 + 0\right]$

$V_{rms} = \sqrt{\frac{1}{5} \times \frac{25}{12} \times 8}$

$V_{rms} = 1.825$ volts Ans: 1.8 to 1.9

25. Dark current nothing but it is a reverse saturation current. Choice (C)

26. From the given data

$\mu_n = 1700$ cm^2/V-s

$\mu_p = 250$ cm^2/V-s

$T = 300^o$k

From the Einstein relation

$\frac{D_n}{\mu_n} = \frac{D_p}{\mu_p} = V_T = \frac{T}{11600}$

$D_n = \frac{\mu_n . T}{11600} = \frac{1700 \times 300}{11600}$

$= 43.96$ cm^2/sec Choice (A)

27. Given

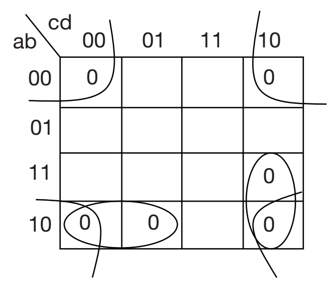
$F(a, b, c, d) = (a^1 + c^1 + d)(a^1 + b + d)(a^1 + b + c)(a + b + d)$
$(b + c^1 + d)$

$= (a^1 + c^1 + d)(a^1 + b + c)(a^1.a + b + d)(b + c^1 + d)$

$= (a^1 + c^1 + d)(a^1 + b + c)(b + d)$

(or)

By using K-map



$f = (a^1 + c^1 + d)(a^1 + b + c)(b + d)$ Choice (B)

28. The characteristic of D flip flop is $Q_{n+1} = D$

Choice (A) $Q_{n+1} = D = \overline{Q_n}$ (toggle switch)

Choice (B) $Q_{n+1} = \text{J}\,\overline{Q_n} + \overline{K}\,Q_n = \text{T}\,\overline{Q_n} + \overline{\overline{T}}Q_n = T$

Choice (C) $Q_{n+1} = D = Q_n \odot T$

Choice (D) $Q_{n+1} = D = \overline{Q}_n \odot T = Q_n \sum T$ (T flip flop)

Choice (D)

29. Choice (B)

30. $Ro = \frac{1}{y_o} = \frac{v_o}{i_o}\Big|_{\text{Vs} = 0} = 0$ Choice (A)

31. $g_m = \frac{I_c}{V_T} : f_\beta = \beta . f_T$ *and* $f_\alpha = (1 + \beta).f_T$ Choice (D)

32. The OL Zeros not effecting the OL stability but it effects the closed loop system stability. Choice (B)

33. $\frac{C}{R} = \frac{5}{s^2 + 3s + 4}$

$\omega_n = 2$

$2\,\zeta\,\omega_n = 3$

$\zeta = \frac{3}{4} = 0.75$

$\zeta > \frac{1}{\sqrt{2}}$

$M_r = \frac{1}{2\zeta\sqrt{1 - \zeta^2}}$ for $\zeta < \frac{1}{\sqrt{2}}$ and

$M_r = 1$ for $\zeta > \frac{1}{\sqrt{2}}$

$\omega_r = \omega_n . \sqrt{1-2\zeta^2}$

if $\zeta > \frac{1}{\sqrt{2}}$

$\omega_r = 0.$ Choice (A)

34. We know from the given data

Slope $\Rightarrow$ + 12dB/0ct or + 40dB/dec

So G. $H = KS^2$

$\therefore$ 20 = 20 log K + 40 log

Sub $\omega = 0.1$

20 log K = 60

$K = 10^3 = 1000.$

35. From the given data

$P = 150$ W

$P = I^2.R$

$R = (10||10) = 5\ \Omega$

$I = \frac{30}{\sqrt{25+X^2}}$

$I^2 = \frac{900}{25+X^2}$

$I^2.(5) = 150$

$I^2 = 30$

$30(25 + X^2) = 900$

$30X^2 = 150$

$X^2 = 5$

$X = 2.236$

Total reactance $j8 + j4 - 2\,jX_m = j2.236$

$12 - 2.236 = 2\,X_m$

$X_m = 4.88\ \Omega$ Ans: 4.8 to 4.9

36. Given system of linear equations is

$$\left.\begin{array}{l} 2x-4y+3z=4 \\ 2x-5y+7z=5 \\ 4x+3y+az=b \end{array}\right\} \rightarrow (1)$$

It can be written in matrix form as $AX = B$

Where $A = \begin{bmatrix} 2 & -4 & 3 \\ 2 & -5 & 7 \\ 4 & 3 & a \end{bmatrix}$; $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and $B = \begin{bmatrix} 4 \\ 5 \\ b \end{bmatrix}$

Consider the augmented matrix

$$[A/B] = \begin{bmatrix} 2 & -4 & 3 & 4 \\ 2 & -5 & 7 & 5 \\ 4 & 3 & a & b \end{bmatrix}$$

$R_2 \rightarrow R_2 - R_1$ and $R_3 \rightarrow R_3 - 2R_1$

$$\sim \begin{bmatrix} 2 & -4 & 3 & 4 \\ 0 & -1 & 4 & 1 \\ 0 & 11 & a-6 & b-8 \end{bmatrix}$$

$R_3 \rightarrow R_3 + 11\,R_2$

$$[A/B] \sim \begin{bmatrix} 2 & -4 & 3 & 4 \\ 0 & -1 & 4 & 1 \\ 0 & 0 & a+38 & b+3 \end{bmatrix}$$

The system of equations (1) has a unique solution,

If $p(A) = p([A/B]) = 3$ (= The number of unknowns)

This is possible only when a + 38 ≠ 0 and for any value of b

$\Rightarrow$ $a \neq -38$ Choice (C)

37. Given differential equation is

$$\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = 4\cos h2t \rightarrow (1)$$

Particular integral $= y_p = \frac{1}{f(D)}X$

$= \frac{1}{(D^2+4D+4)} 4\cos h2t$

$= \frac{1}{(D^2+4D+4)} 4\left(\frac{e^{2t}+e^{-2t}}{2}\right)$

$= \frac{1}{(D^2+4D+4)} 2e^{2t} + \left(\frac{1}{(D^2+4D+4)}\right) 2e^{-2t}$

$= \frac{1}{2^2+4\times2+4} 2e^{2t} + t\frac{1}{(2D+4)} 2e^{-2t}$

$= \frac{1}{8} e^{2t} + t^2 \frac{1}{2} 2e^{-2t}$

$\therefore$ $y_p = \frac{1}{8} e^{2t} + t^2 e^{-2t}$ Choice (D)

38. Given $f(x) = 8x^5 - 15x^4 + 10x^2$

$f'(x) = 40x^4 - 60x^3 + 20x$

$f'(x) = 0 \Rightarrow 40x^4 - 60x^3 + 20x = 0$

$\Rightarrow$ $x(x-1)^2(2x+1) = 0$

$\Rightarrow$ $x = 0$; $x = 1$, 1 and $x = \frac{-1}{2}$

$\therefore$ The stationary values of $f(x)$ are 0, 1 and $\frac{-1}{2}$

$f''(x) = 160x^3 - 180x^2 + 20$

At $x = 0$; $f''(x) = 20 > 0$

$\therefore$ $f(x)$ has a minimum at $x = 0$

At $x = \frac{-1}{2}$, $f''(x) = -45 < 0$

$\therefore$ $f(x)$ has a maximum at $x = \frac{-1}{2}$

At $x = 1$; $f''(x) = 0$

$f'''(x) = 480x^2 - 360x$

At $x = 1$; $f''(x) = 120 \neq 0$

$\therefore$ $f(x)$ has neither maximum nor minimum at $x = 1$

$\therefore$ The number of stationary values where $f(x)$ has neither maximum nor minimum = 1 Ans: 1

39. Given the probability density function of a random variable

X is $f(x) = \begin{cases} k(3+2x)\text{d} & ;2 \le x \le 4 \\ 0 & ;\ otherwise \end{cases}$

For any pdf $f(x)$, we know that

$$\int_{-\infty}^{\infty} f(x)dx = 1 \Rightarrow \int_{2}^{4} k(3+2x)dx = 1$$

$$\Rightarrow \quad k(3x+x^2)\Big]_2^4 = 1$$

$$\Rightarrow \quad k = \frac{1}{18}$$

$$\therefore \quad f(x) = \begin{cases} \frac{1}{18}(3+2x) & ;\ 2 \le x \le 4 \\ 0 & ;\ \text{otherwise} \end{cases}$$

$$\text{Mean of } X = E(X) = \int_{-\infty}^{\infty} xf(x)dx$$

$$= \int_{2}^{4} x\left(\frac{1}{18}(3+2x)\right) dx$$

$$= \frac{1}{18}\int_{2}^{4}(3x+2x^2)\ dx$$

$$= \frac{1}{18}\left(\frac{3}{2}x^2 + \frac{2}{3}x^3\right)_2^4$$

$\therefore \quad E(X) = \dfrac{83}{27}$ Choice (A)

40. Given that $f(z) = u(x, y) + i\ v(x, y)$ is analytic
Where $v(x, y) = x^3 - 3xy^2 + 2y$

$$\therefore \quad f^1(z) = \frac{\sigma u}{\sigma x} + i\frac{\sigma v}{\sigma x}$$

$$= \frac{\sigma v}{\sigma y} + i\frac{\sigma v}{\sigma x} \quad \text{(By } C-R \text{ equations)}$$

$\therefore \quad f^1(z) = (-6xy + 2) + i(3x^2 - 3y^2)$ $\rightarrow (1)$

Put $x = z$ and $y = 0$ in (1), then

$f^1(z) = (-6z \times 0 + 2) + i\ (3z^2 - 3 \times 0^2)$

$\therefore \quad f^1(z) = 2 + i3z^2$

Integrating w.r.t z on both sides, we get

$f(z) = 2z + i\ z^3 + c$ Choice (D)

41. The probability of Gaussian random variable 'X' is not defined at a single point so $Pe\ (x = 3) = 0$ Choice (D)

42. Let P_e, 4 is BER for QPSK
And P_e 8, is BER for 8.PSK
So, P_e, 4 = P_e, 8

$$2Q\left(\frac{d_4}{\sqrt{2N_0}}\right) = 2Q\left(\frac{d_8}{\sqrt{2N_0}}\right)$$

Where $d4$ & $d8$ are the minimum distance for $QPSK$ & 8 – PSk respectively.

$$\text{So } d_4 = 2\sqrt{E_4 \text{Sin}\left(\frac{\pi}{4}\right)}$$

$$D_8 = 2\sqrt{E_8 \text{Sin}(\pi/8)}$$

Where E_4 & E_8 are the signal energies for $QPSK$ & 8 – PSK respectively.

$$\frac{E_8}{E_4} = \left[\frac{\text{Sin}\left(\frac{\pi}{4}\right)}{\text{Sin}\left(\frac{\pi}{8}\right)}\right]^2$$

Now as we know that signal energy is $E = A2T_b$

$$\text{So } \frac{A_8}{A_4} = \sqrt{\frac{E_8}{E_4}} = \frac{\text{Sin}\left(\frac{\pi}{4}\right)}{\text{Sin}\left(\frac{\pi}{4}\right)} = 1.85$$

A must be increased by a factor of 1.85 Choice (C)

43. Mean $= E[x] = \int_0^4 x.P(x)dx$

$$= \int_0^4 x.\frac{1}{8}x\,dx = \frac{1}{8}\left[\frac{x^3}{3}\right]_0^4 = \frac{(4)^3}{8\times 3} = \frac{8}{3}$$

Mean square value $E[x^2] = \int_0^4 x^2.P(x).dx$

$$= \int_0^4 x^2.\frac{1}{8}x\,.dx = \frac{1}{8}.\left[\frac{x^4}{4}\right]_0^4$$

$$= \frac{1}{8}.\frac{1}{4}[4\times 4\times 4\times 4] = 8$$

Now variance $\sigma^2_x = E[x^2] - [E[x]]^2$

$$= 8 - \frac{64}{9} = \frac{8}{9}$$

Now standard deviation $\sigma_x = \sqrt{\dfrac{8}{9}} = 0.942$

44. We know that auto correlation is expressed as
$Rxx(\tau) = E[X(t + \tau)\ .\ X(t)]$

$$= \frac{1}{\tau}\int_{\frac{-\tau}{2}}^{\frac{+\tau}{2}} \sin 2\pi(y+\tau)\sin 2\pi t\,dt$$

$$= \frac{1}{2\tau}\int_{\frac{-\tau}{2}}^{\frac{+\tau}{2}} [\cos 2\pi\tau - \cos 2\pi(2t+\tau)]dt$$

$$= \frac{1}{2\tau}\left[[\cos 2\pi\tau.t] - \left[\frac{\sin 2\pi(2t+\tau)}{4\pi}\right]\right]_{\frac{-\tau}{2}}^{\frac{+\tau}{2}} = \frac{\cos 2\pi\tau}{2}$$

Now $R_{YY}(\tau) = \frac{1}{4\pi}\frac{d}{dt}.R_{xx}(\tau)$

$= \frac{1}{4\pi}\frac{\text{Sin}\,2\pi\tau}{2}.2\pi = \frac{\text{Sin}\,2\pi\tau}{4}$ Choice (A)

45. $X(\omega) = [e^{-2j\omega} + e^{+j2\omega} + e^{+j\omega} + e^{-j\omega}]$
$= 2\cos 2\omega + 2\cos\omega$ Choice (B)

46. As we know that

$x_e[n] = \frac{x[n]+x[-n]}{2}$

$x_o[n] = \frac{x[n]-x[-n]}{2}$

for option C

$\sum_{n=-\infty}^{+\infty}\left(\left(\frac{x[n]+x[-n]}{2}\right)\left(\frac{x(n)-x(-n)}{2}\right)\right)$

$\sum_{n=-\infty}^{+\infty}\frac{x^2(n)}{4}-\frac{x^2[-n]}{4}$

Whether the signal is even or odd $x^2[n]$ and $x^2[-n]$ will be $x^2[n]$ only.
So (C) must be true

For option A

$\sum_{n=\infty}^{+\infty}x_0[n] = \sum_{n=\infty}^{+\infty}x_e[n]$

As we know that any signal can be written as even and odd part.
$x[n] = x_e[n] + x_o(n)$

for option B

same

for option D

Proceed in option (C) Choice (C)

47. Since $x[n]$ is right sided signal so $x[n]$ is a causal signal.

Now $X(z) = \frac{a}{1-az^{-1}}$ 1 $ROC\ |z| > |\alpha|$

So $x[n] = a\,\alpha^n\,u[n]$
Now $x[0] = 5 = a\alpha^o\,u[n]$
So $a = 5$

Now $x[2] = \frac{1}{5} = a.\,\alpha^2.1$

$\therefore\quad 5\,\alpha^2 = \frac{1}{5}$

$\alpha = \frac{1}{5}$

So $x[n] = 5.\left(\frac{1}{5}\right)^n u[n]$

$X(n) = \left(\frac{1}{5}\right)^{n-1} u[n]$

$X(3) = \frac{1}{25}$ Ans: 0.03 to 0.05

48. $\gamma = \alpha + j\beta = \sqrt{(R+j\omega L)(G+j\omega C)}$
$X_L = \omega L = 2\pi \times 4 \times 10^3 \times 1.5 \times 10^{-3} = 12\pi$
$X_C = \omega c = 2\pi \times 4 \times 10^3 \times 10^{-9} = 8\pi \times 10^{-6}$
$\gamma = \alpha + j\beta = \sqrt{(5+j12\pi)(0.5+j8\pi)\times 10^{-6}}$

$=10^{-3}\left(38.03\angle 82.4\times 25.137\angle 88.86\right)^{\frac{1}{2}}$
$= 30.91 \times 10^{-3}\angle 85.63$
$= 2.355 \times 10^{-3} + j\,0.030$
$\alpha = 2.355 \times 10^{-3}$ Np/km Choice (A)

49. Scattering parameter of H-plane junction

$$[S]=\begin{bmatrix}\frac{1}{2} & \frac{1}{2} & \frac{1}{\sqrt{2}}\\ \frac{-1}{2} & \frac{1}{2} & \frac{1}{\sqrt{2}}\\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0\end{bmatrix}$$

Power reflected to port 1 is $\frac{1}{2}40mW\left[1-|\Gamma_1|^2\right]$

$\Gamma_1 = \frac{80-50}{80+50} = \frac{3}{13}$

Power deliveries to 80Ω is 18.9 mW Choice (B)

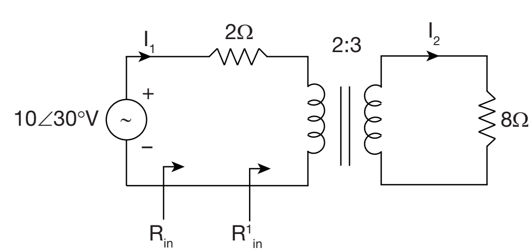
50. 30 dB = 10 $\log_{10} G_t$
$\Rightarrow\quad G_t = 10^3$
Similarly $G_r = 10^{2.2} = 158.48$
$r = 250\,\lambda$
$P_t = 2$W

$\Rightarrow\quad P_r = P_t\,G_t\,G_r\left[\frac{\lambda}{4\pi r}\right]^2$

$= 2 \times 10^3 \times 158.49\left[\frac{\lambda}{4\pi\times 250\lambda}\right]^2$

$= 32.11$ mW Choice (C)

51. We know $\frac{V_2}{I_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2}$



$R_{in}^1 = Z_L\left\{\frac{N_1}{N_2}\right\}^2 = 8\left\{\frac{2}{3}\right\}^2\ \Omega$

$R_{in} = 2 + R_{in}^1 = 2 + 3.55 = 5.55\ \Omega$

$I_1 = \frac{10\angle 30^o}{5.55} = 1.8\angle 30^o$ A

$i_1(t) = 1.8 \cos(100\,\pi t + 30^o)$A

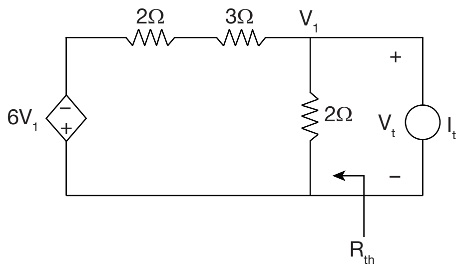
$\frac{I_1}{I_2} = \frac{3}{2} \Rightarrow I_2 = \frac{2}{3} \times 1.8125 \angle 30^o$ A $= 1.2 \angle 30^o$A

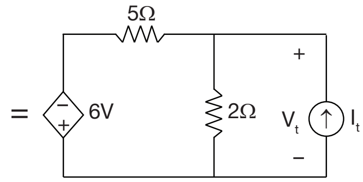
$i_2(t) = 1.2 \cos(100\,\pi t + 30^o)$A Choice (A)

52. We know $R_N = R_{th} = \frac{V_{th}}{I_{SC}}$

Or connect one test source and find the equivalent resistance

The equivalent circuit becomes





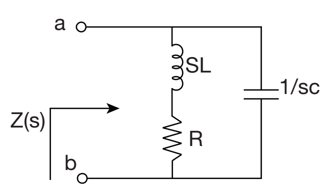
But $V_1 = V_t - I_t + \frac{V_t}{2} + \frac{V_t + 6V_t}{5} = 0$

$10I_t = 5\,V_t + 14V_t$

$19V_t = 10\,I_t$

$\frac{V_t}{I_t} = \frac{10}{19}\Omega = 0.52\ \Omega$ Ans: 0.52 to 0.53

53.



$Z(s) = (R + sL) \,||\left(\frac{1}{sC}\right)$; $L = 4$H, $C = 1F$

$Z(s) = \frac{R + sL}{LCs^2 + RCs + 1}$ $R = 0.5\Omega$

$Z(j\omega) = \frac{R + j\omega L}{(1 - \omega^2 LC) + j\omega RC}$

at resonance $I_{mag}\,\{Z(s)\} = 0$

$\therefore$ $-j\,\omega R^2 C + j\,\omega L\,(1 - \omega^2 LC) = 0$

$\therefore$ $\omega_o = \frac{1}{\sqrt{LC}} \cdot \sqrt{1 - \frac{R^2 C}{L}}$

Sub R, L, C values

$\omega_o = \frac{1}{\sqrt{4}} \cdot \sqrt{1 - \frac{1}{16}}$

$\omega_o = 0.4841$ rad/sec Ans: 0.45 to 0.5

54. We know $n \approx N_c . e^{\frac{-(E_C - E_F)}{kT}}$

at $E_C = E_F$

$n = N_C$

$n = N_C \approx N_D$

$N_D = 5 \times 10^{22} \times \frac{1}{2.5 \times 10^3} = 2 \times 10^{19}$ atoms/cm^3

$= 2 \times 10^{19}$ atoms/m^3

$N_C = 4.82 \times 10^{21} \left(\frac{m_e}{m}\right)^{\frac{3}{2}} . T^{3/2}$

$2 \times 10^{19} = 4.82 \times 10^{21} \times (T)^{3/2}$

$(0.0041)^{2/3} = T$

$T = 0.0258^o$ K Choice (B)

55. From the given circuit the diodes Si is in forward biased and Ge is in R.B.

So $V_{out} = V_{in} - 0.7 = 8 - 0.7 = 7.3$V

$\therefore$ $I = \frac{V_{out}}{2k} = 3.65$ mA Answer: 3.6 to 3.7

56. Voltage change between $I_Z = 2.5$ mA and $I_Z = 3$ mA

$\therefore$ $\Delta V_Z = \Delta I_Z . r_Z = 0.5 \times 50$ mV $= 25$ mV

$\therefore$ minimum zener voltage, $V_{Zmin} = V + \Delta V_Z$

$= 10 + 0.025 = 10.025$ V

The voltage change between $I_Z = 3$ mA to 6mA

$\therefore$ $\Delta V_Z = \Delta I_Z . r_Z = 3 \times 10^{-3} \times 50 = 0.15$V

So maximum zener voltage $V_{Zmax} = V_{Zmin} + \Delta V_Z$

$= 10.025 + 0.15$

$= 10.175$ volts Ans: 10.1 to10.2

57. MVI A, 82 H $\rightarrow$ $A = 82$ H

ADI 7FH $\rightarrow$ Add 7FH to A, and store result in A

$A = 82 = 1000\ 0010$

$7F = 7F\ 0111\ 1111$

(1) 0000 0001

So carry flag = 1. A = 01H

JC DSPLAY, – If there is carry in previous instruction, jump to DSPLAY. As there is CY present in previous addition, execution will go to location DSPLAY

SUB A $\rightarrow$ subtract A from A, so A = 00H

OUT Port 1 $\rightarrow$ display contents of Accumulator = 00H. at Port 1. HLT – Stop Choice (D)

58. The output of first decoder

$m_o = \bar{p}\,\bar{q}$, $m_1 = \bar{p}\,q$, $m_2 = \mathrm{p}\,\bar{q}$, $m_3 = pq$

the output of second decoder

$m_o = \bar{r}\,\bar{q}$, $m_1 = \bar{r}\,q$, $m_2 = \mathrm{r}\,\bar{q}$, $m_3 = rq$

output of multiplexer

$= I_0\,\overline{S_2}\,\overline{S_1}\,\overline{S_0} + I_1\,\overline{S_2}\,\overline{S_1}\,S_0 + I_2\,\overline{S_2}\,S_1\,\overline{S_0}$ ……$+ I_7 S_2 S_1 S_0$

$f(p, q, r) = \bar{p}\,\bar{q}\,.\,\bar{p}\,\bar{q}\,\bar{r} + \bar{p}\,q\,.\,\bar{p}\,\bar{q}\,r + p\,\bar{q}\,.\,\bar{p}\,q\,\bar{r} +$

$pq\,.\,\bar{p}\,qr + \bar{r}\,\bar{q}\,.\,p\,\bar{q}\,\bar{r} + \bar{r}\,q.p\,\bar{q}\,r + r\,\bar{q}\,.pq\,\bar{r} + rq\,pqr$

$f(p, q, r) = \bar{p}\,\bar{q}\,\bar{r} + p\,\bar{q}\,\bar{r} + pqr$

$= \Sigma m(0, 4, 7)$ Choice (C)

59. When $y = 1$, the output of or gate is 1, so NAND gate outputs will be $\overline{1.\overline{Q}} = Q, \overline{1.Q} = \overline{Q}$ i.e., output Q, $\overline{Q}$ remains in same state as long as $Y = 1$, irrespective of X input.

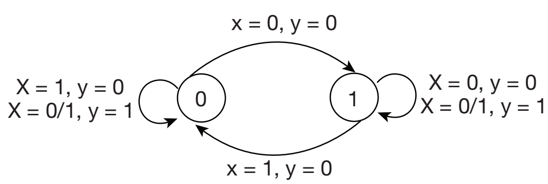
When $Y = 0$, the circuit works as follows

Y	X	Output OR gate 1	Output OR gate 2	Output (Q) NAND gates	Output NAND gates $(\overline{Q})$
0	0	0	1	1	0
0	1	1	0	0	1

So when $y = 0$, next state depends on X value.

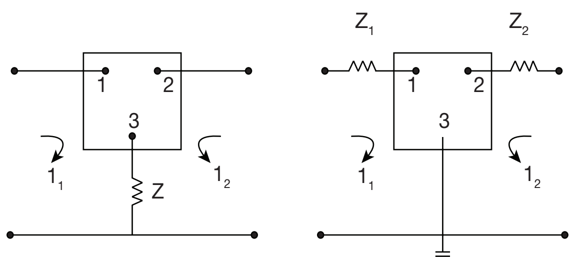
If $x = 0$, next state = 1

if $x = 1$, next state = 0



Choice (D)

60.



$Z_1 = Z(1 - A_I), Z_2 = Z(1 - \frac{1}{A_I})$

$= 19 \times 20 = 19 \times (1 + 1/20)$

$= 380\Omega = 20\Omega$ Choice (C)

61. $g_m = \frac{I_C}{V_T}$ & $V_T = \frac{T}{11600}$

$g_m = 0.05$

$g_{b^1e} = \frac{g_m}{h_{fe}} = \frac{0.05}{50} = 10^{-3}$ mho. Choice (B)

62. $\left|\frac{A_L}{A_{mid}}\right| = -1\text{dB}, \ f = 30$ Hz

$$\left|\frac{A_L}{A_{mid}}\right| = \frac{1}{\left[1 + \left(\frac{f_{Ln}}{f}\right)^2\right]^{\frac{1}{2}}}$$

$$20 \log \left[\frac{1}{\sqrt{1 + \left(\frac{f_{Ln}}{f}\right)^2}}\right] = -1$$

$$\frac{1}{\sqrt{1 + \left(\frac{f_{L^n}}{f}\right)^2}} = 0.89$$

$$\frac{f_{Ln}}{f} = 0.5$$

$f_{Ln} = 15.265\ H_Z.$

$$f_{Ln} = \frac{f_L}{\sqrt{2^{\frac{1}{n}} - 1}}$$

$f_L = 7.782$ Hz Choice (C)

63. $G.H = \frac{2K(s+2)}{s(s+1)(s+3)}$

It is type-1 system so $e_{ss} = \frac{1}{K_v} = 0.2$

$K_v = 5.$

$K_v = \underset{s\to 0}{\text{Lt}}\, s.G(s).H(s) = \frac{2K(2)}{3}$

$\frac{4K}{3} = 5$

$K = \frac{15}{4}$ Ans: 3.7 to 3.8

64. From the given data $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

$C = [1, 2], D = 0$

We know the overall transfer function of the system

$$\frac{y(s)}{\mu(s)} = c\,.\,(SI - A)^{-1}\,.B + D$$

$$(sI - A) = \begin{bmatrix} s & -1 \\ 2 & s+3 \end{bmatrix}$$

$$(sI - A)^{-1} = \frac{adj[SI - A]}{|SI - A|} = \frac{1}{s(s+3)+2}\begin{bmatrix} s+3 & 1 \\ -2 & s \end{bmatrix}$$

$$\frac{Y(s)}{\mu(s)} = \begin{bmatrix} 1 & 2 \end{bmatrix}\begin{bmatrix} s+3 & 1 \\ -2 & s \end{bmatrix}\begin{bmatrix} 0 \\ 1 \end{bmatrix} \times \frac{1}{(s+1)(s+2)}$$

$$= \begin{bmatrix} 1 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ s \end{bmatrix} \times \frac{1}{(s+1)(s+2)}$$

$$\frac{y(s)}{\mu(s)} = \frac{1+2s}{(s+1)(s+2)}$$

Given $\mu(s) = 1$

$y(t) = \text{ILTF } \{y(s)\}$

$$y(t) = \frac{A}{s+1} + \frac{B}{s+2}$$

$$A = \frac{(2s+1)}{s+2} \text{ at } s = -1$$

$A = -1$ and

$$B = \frac{(2s+1)}{s+1} \text{ at } s = -2$$

$$B = \frac{-4+1}{-2+1} = 3$$

$$\therefore \quad y(s) = \frac{3}{s+2} - \frac{1}{s+1}$$

$y(t) = \{3.e^{-2t} - e^{-t}\}.u(t)$ Choice (C)

65. Characteristic equation $1 + G.H = 0$.

$$1 + \frac{K(s+1)}{s(1+\tau s)(1+3s)} = 0$$

$s[1 + 3s + \tau s + 3\tau s^2] + Ks + K = 0.$

$3\tau s^3 + (3 + \tau)\, s^2 + (K + 1)\, s + K = 0.$

The Routh's array is

S^3 3τ $K + 1$

S^2 $3+\tau$ K

S^1 $(K+1) - \dfrac{3\tau K}{3+\tau}$

S° K

For stable system

$K > 0$, $\tau > 0$ and $3 + \tau > 0$.

$$(K+1) - \frac{3\tau K}{3+\tau} > 0$$

$$(K+1) > \frac{3\tau K}{3+\tau}$$

$$1 + \frac{1}{K} > \frac{3\tau}{3+\tau} \text{ gives}$$

$$K < \frac{3+\tau}{2\tau - 3}; \text{ and } k > 0$$

$$\therefore \quad \tau > \frac{3}{2}$$

Choice (B)