Mock Test 5

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 most appropriate word from the options given below to complete the following sentence:

1. If I ___________ you I would not have taken the help of an outsider to solve my personal problems.
   (A) was (B) were
   (C) am (D) will be

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

2. Ram and Shyam started simultaneously from two different stations towards each other with speeds of x kmph and y kmph respectively. To cross each other, Ram travelled y times the distance travelled by Shyam. If the speed of Ram is 4 kmph, then the speed (in kmph) of Shyam is _______.

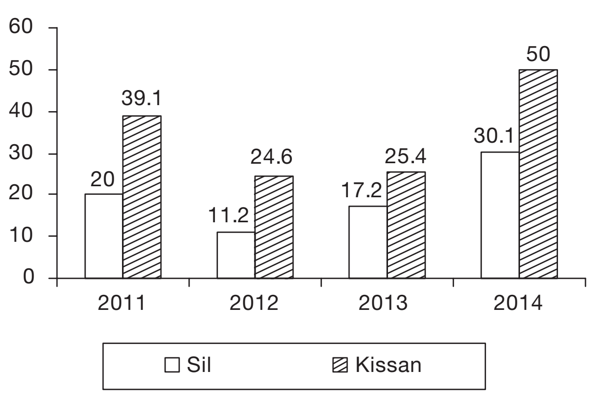
3. How is Khadar's wife's daughter's mother's daughter-in-law's husband's father related to Khadar?
   (A) Grand-father (B) Father
   (C) Father-in-law (D) Himself

***Directions for question* 4**: Which one of the following combinations is incorrect?

4. (A) Beatific – Mundane
   (B) Empirical – Experiential
   (C) Gaunt – Emaciated
   (D) Momentous – Critical

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

5. The sales (in crores of ₹) of Kissan and Sil Mixed Fruit jams in Khaogali in each of the years from 2011 to 2014 are shown in the following bar chart.



The ratio of sales of Kissan to that of Sil is the highest in _______.
   (A) 2012 (B) 2011
   (C) 2013 (D) None of these

Questions 6 to 10 carry Two Marks each.

***Directions for question* 6:** Select the alternative meaning of the underlined part of the sentence:

6. The government officials have promised the moon on the issue of regulation for industrial relations and so, have decided not to sign any new ventures.
   (A) passed the buck
   (B) broadened their horizons
   (C) stood their ground
   (D) heard something on the grapevine

***Directions for question* 7:** The given statement is followed by some course of action. Assuming the statement to be true, decide the correct option:

7. Healthcare workers often reuse syringes or needles for multiple uses which increases the chance of infection and transmission of ailments, thus exposing people to a host of diseases from clinics, nursing homes and hospitals.
   (i) Hospitals must encourage staff to incorporate smart disposal techniques.
   (ii) Healthcare workers and patients must be made aware of WHO policy guidelines on safe injection practices.
   (iii) Patients acquiring diseases from hospitals and nursing homes must be treated free of cost.
   (iv) The government of India must make it mandatory for hospitals to switch from disposable syringes to Auto Disposable (AD) syringes.
   (A) (i) and (iii) (B) (ii) and (iii)
   (C) (i) and (ii) (D) (ii) and (iv)

Directions for questions 8 and 9: Select the correct alternative form the given choices.

8. Evaluate $\sqrt{5+\sqrt{5-\sqrt{5+\sqrt{5.....}}}}$.
   (A) $\dfrac{\sqrt{13}-1}{2}$ (B) $\dfrac{\sqrt{17}-1}{2}$
   (C) $\dfrac{\sqrt{17}+1}{2}$ (D) $\sqrt{17}$

9. America had entered the world war since Japan had attacked Pearl Harbour.
   Which one of the statements below is logically valid and can be inferred from the above sentence?
   (A) Japan was feeling restless.
   (B) America would not have entered the world war, if Japan would not have attacked Pearl Harbour.

(C) Japan and America are enemies.
(D) None of these

***Directions for question* 10:** Out of the four sentences, select the most suitable sentence with respect to grammar and usage:

10. (A) Today's tip would have been sufficient to buy a full meal three years ago.
(B) Todays tip would pay for a full meal three years ago.
(C) Today's tip would be sufficient for a three-years-ago meal.
(D) A tip today would costed one a meal three years back.

ELECTRONICS AND COMMUNICATION ENGINEERING

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

11. The value of the contour integral $\oint_C \frac{z^2+6z+10}{z^2+9}dz$ where C is the circle $|z - i| = 1$ traversed in a counter-clockwise direction is ______.

12. The value of the definite integral $\int_0^{\pi} \sin^8 x\,dx$ is______.

(A) $\frac{7^2.5^2.3^2.1^2}{8!}\pi$ (B) $\frac{8^2.6^2.4^2.2^2}{7!}\pi$

(C) $\frac{7^2.5^2.3^2.1^2}{8!}.\frac{\pi}{2}$ (D) $\frac{8^2.6^2.4^2.2^2}{7!}.\frac{\pi}{2}$

13. If X is a normal random variable, then which of the following is always true?
(A) Mean of X = Variance of X
(B) Mean of X = Standard Deviation of X
(C) Mean, median and mode of X is the same
(D) Variance of X = (Mean of X)^2

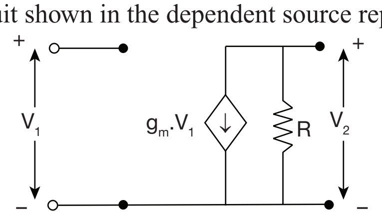
14. A particular integral of $\frac{d^2x}{dt^2} + 9x = 6\cos 3t$ is _____.

(A) $t \sin 3t$ (B) x sin $3t$

(C) $\frac{3}{2}t\cos 3t$ (D) $\frac{3}{2}x\cos 3t$

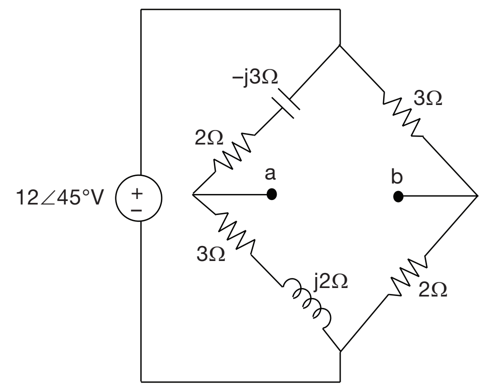
15. If $U(x, y, z) = F(x - y, y - z, z - x)$, then the value of $\frac{\partial U}{\partial x} + \frac{\partial U}{\partial y} + \frac{\partial U}{\partial z}$ is ______.

16. The circuit shown in the dependent source represents a



(A) voltage controlled voltage source
(B) voltage controlled current source
(C) current controlled current source
(D) current controlled voltage source

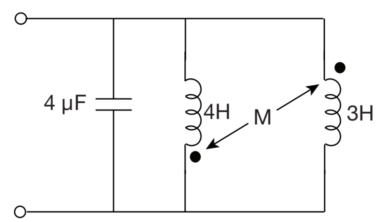
17. Consider the network shown in figure



The Thevenin equivalent impedance at terminals '*a*' and '*b*' is _____________.

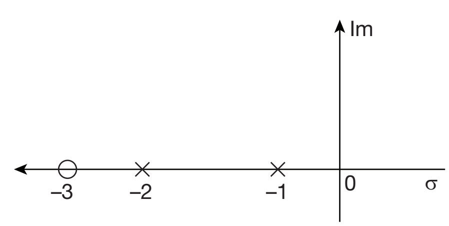
(A) $(2.5 + j0.5)\ \Omega$ (B) $(-1.3 + j0.5)\ \Omega$
(C) $(3.7 - j0.5)\ \Omega$ (D) $(3.7 + j0.5)\ \Omega$

18. Consider the network shown in below



if the mutual inductance of the circuit is 1.5 H, the resonant frequency (in Hz) of the circuit is ______.

19. The pole – zero pattern of a open loop system is shown below.



At break – in point the value of gain 'k' is ________.

20. Only Steady – state accuracy of a system can be improved by using

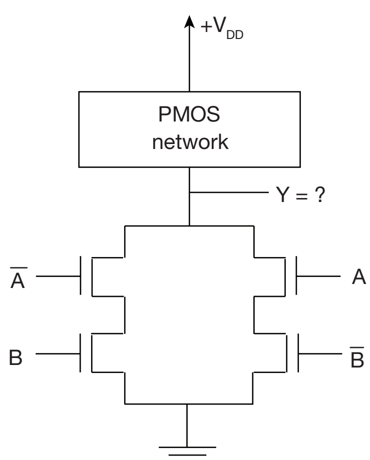
(A) Lead compensator (B) lag compensator
(C) lag – lead compensator (D) differentiator

21. Which of the following are the effects of additions of zeros?
(1) The system becomes less oscillatory
(2) settling time decreases
(3) damping frequency increases
(4) rise time and peak time increases.
(A) 1 and 2 only (B) 2, 3 and 4 only
(C) 1, 2 and 3 only (D) 1, 2 and 4 only

22. The light emitting diode emits light of a particular colour because
(A) transition between energy level of the carriers take place while crossing the p-n junction.
(B) It is a indirect band gap semiconductor.
(C) It is fabricated from a fluorescent material.
(D) E_g of the semiconductor material used in the fabrication of the diode is equal to the energy (hν) of the light photon.

23. Which of the following are the effects of increasing the reverse bias voltage across a p-n junction?
(1) Increase reverse saturation current.
(2) Decrease in junction capacitance of the diode.
(3) Increase carrier recombination in the depletion layer.
(4) Increase depletion width.
Select the correct answer using the codes given below:
(A) 1 and 3 only (B) 1, 2 and 3 only
(C) 1, 2 and 4 only (D) 2 and 4 only

24. In the following CMOS circuit find the logic implemented by Y?



(A) $\overline{A}B+A\overline{B}$ (B) $(A+\overline{B})(\overline{A}+B)$
(C) $\overline{A}\,\overline{B}+\overline{A}B$ (D) $(A+B)(\overline{A}+\overline{B})$

25. In a 5 bit binary weighted resistor digital to analog converter, the resistor value corresponding to LSB is 16kΩ, then the resistor value corresponding to the MSB will be?
(A) 500 Ω (B) 1 kΩ
(C) 128 kΩ (D) 256 kΩ

26. Higher cutoff frequency of 5 stage amplifier when higher cutoff frequency of single stage amplifier is 30 kHz is _____.
(A) 11.568 kHz (B) 77.8 kHz
(C) 5.388 kHz (D) 167 kHz

27. In multi stage amplifier, overall Bandwidth of the amplifier _____.
(A) increases (B) decreases
(C) no changes (D) None of the above

28. $E(z, t) = 10\cos(2.5\pi \times 10^8 t - \pi z)$ traveling in a medium (ε_r). What is the value of ε_r.
(A) 1.2 (B) 0.83
(C) 0.69 (D) 1.44

29. Given that $\vec{H} = a\sin(10^8\pi t - \beta y)\,\hat{a}_x$ A/m and $\vec{E} = 50\pi\sin(10^8\pi t - \beta y)\,\hat{a}_z$ and average power density is 140 W/m^2, then the phase constant is _______ rad/sec

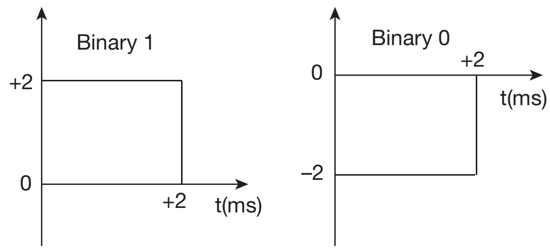
30. The inverse Fourier transform of $X(j\omega) = \dfrac{8}{\omega^2+16}$ will be _____
(A) $e^{-4t}u(t) + e^{4t}u(-t)$
(B) $e^{-4t}u(-t) + e^{4t}u(t)$
(C) $e^{4t}u(-t) + e^{-4t}u(t)$
(D) None of the above

31. If $x[n] = \begin{cases} 2, & 0 \le n \le 5 \\ 0, & 6 \le n \le 9 \end{cases}$, with period $N = 10$ and $y[n] = x[n] - x[n-2]$.
Then the fundamental period of $y[n]$ is
(A) 2 (B) 10
(C) 12 (D) None of these

32. A system is described by a differential equation as follows $\dfrac{dy(t)}{dt} + 3y(t) = u(t)$.
Assume initial conditions are zero, then $y(t)$ will be _____
(A) $\frac{1}{3}[e^{-3t} - 1]$ (B) $\frac{1}{3}[1 - e^{-3t}]$
(C) $\frac{1}{3}[1 + e^{-3t}]$ (D) $\frac{1}{3}[1 + e^{+3t}]$

33. Four independent voice signals have bandwidth of 100Hz, 200Hz, 400Hz, 100Hz respectively. Each is sampled at Nyquist rate, and converted into binary PCM signal using 256quantization levels.
The bit transmission rate for the time division multiplexed signal will be
(A) 64 kbps (B) 12.8 kbps
(C) 256 kbps (D) 512 kbps

34. A source produces binary data at a rate of 20 kbps. The binary symbols are represented as shown



If the symbols are transmitted using two modulation schemes BPSK and QPSK. Then the bandwidth requirement B_1 and B_2 will be __________ and __________ respectively.

(A) 20 kHz and 20 kHz (B) 20 kHz and 40 kHz
(C) 40 kHz and 40 kHz (D) 40 kHz and 20 kHz

35. An audio $X(t)$ is to be transmitted over a radio frequency (RF) channel with additive white noise. If it is required that output SNR be greater than 20dB.

PSD of white noise $\frac{\eta}{2} = 10^{-9}$ W/Hz and

B = 20kHz

Required average power for DSB modulation is ________

(A) 3×10^{-4}W (B) 4×10^{-4}W
(C) 4×10^{-3}W (D) 2×10^{-3}W

36. If the system of linear equations

$2x_1 + 3x_2 + 5x_3 + 7x_4 = 0$
$-2x_2 + ax_3 = 0$
$3x_3 + 2x_4 = 0$
$6x_2 + bx_4 = 0$

Has a non-trivial solution, then 'a' and 'b' are related by _____.

(A) $a + 2b = 0$ (B) $a - 2b = 0$
(C) $2a + b = 0$ (D) $2a - b = 0$

37. The coefficient of x^3 in the Maclaurin's series expansion of $(1-x)^{\frac{5}{2}}$ is ______

38. A fair die is rolled twice. Let X denote the number on the die in the first roll and let Y denote the number on the die in the second roll. Then the value of $P\left(\frac{X+Y=6}{X-Y=2}\right)$ is ______.

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$
(C) $\frac{1}{8}$ (D) $\frac{1}{16}$

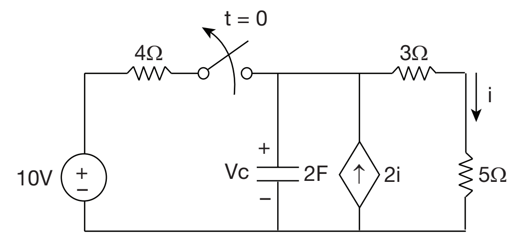
39. The directional derivative of $f = 3xy^2 + yz^3$ at (2, –1, 1) in the direction of the vector $4\bar{i} + 3\bar{k}$ is ______.

(A) $\frac{3}{5}$ (B) $\frac{6}{5}$
(C) $\frac{9}{5}$ (D) $\frac{12}{5}$

40. The value of Δy to be added to y_0 to get the value of y_1 at x_1 = 0.2 in the process of solving the differential equation $\frac{dy}{dx} = x + 2y$ with $y_0 = y(0) = 1$ by Runge Kutta method of the fourth order is ______.

(A) 0.3254 (B) 0.5147
(C) 0.7315 (D) 0.9164

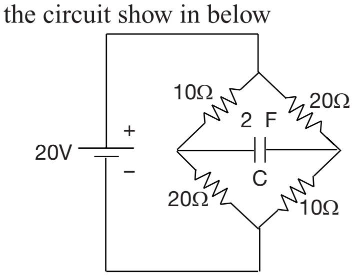
41. Consider the network shown in below



The value of V_c at t = –4 sec is ______.

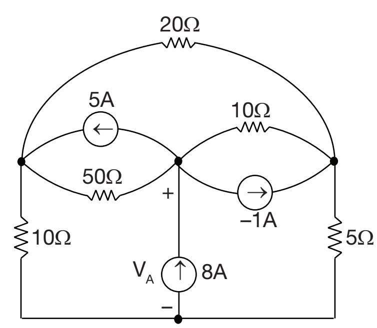
(A) 15.58 V (B) 12 V
(C) 8 V (D) None

42. Consider the circuit show in below



The energy stored by the capacitor is _______ μJ.

43. Consider the circuit shown below



The value of voltage V_A(in volt) is ______.

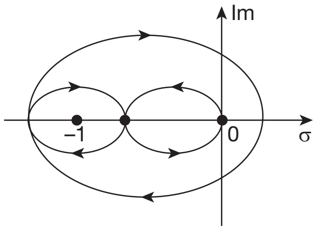
44. Consider the particular system state equations

$\dot{x}_1 = -x_1 + u$; $\dot{x}_2 = x_1 + 0.5x_2 + 2u$, and output equation $y = x_1 + x_2$.

The system is

(A) Controllable but not observable
(B) Observable but not controllable
(C) Neither observable nor controllable
(D) Both controllable and observable

45. The Nyquist plot for the open loop transfer function $G(S)$ of s unity negative feed back system is shown in the figure, if $G(s)$ has 1 pole in the RHS of s-plane, the closed loop system is



(A) unstable, 3 poles in *RHS* of s-plane
(B) unstable, 2 poles in *RHS* of s-plane
(C) stable
(D) unstable, 1 pole in *RHS* of s-plane.

46. The transfer function of a linear control system is given by $G(s) = \dfrac{50(0.05s+1)}{s(0.2s+1)(s+4)}$. In its Bode diagram, the value of gain for = 0.1rad/sec is ________ dB.

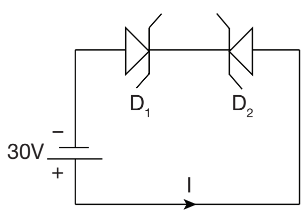
47. A Ge P^+n junction has a donor doping of 5×10^{16} cm^{-3} on the n-side and a cross-sectional area of 10^{-3} cm^2. If $n_i = 1.5 \times 10^{10}$ cm^{-3}, $\tau_p = 1$ µs and $D_p = 10$ cm^2/s. Calculate the current with a forward bias of 0.5V at 300°*K* (consider $\eta V_T = 26$ mV).

(A) 0.51 µA
(B) 0.34 µA
(C) 0.72 µA
(D) 0.24 µA

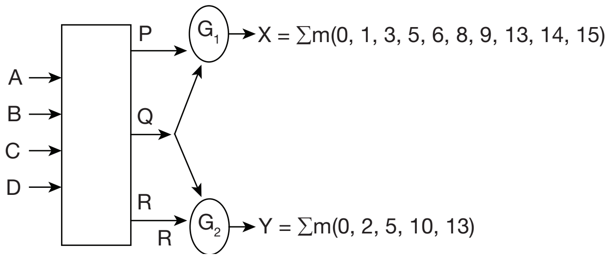
48. An abrupt Si pn junction has $N_a = 10^{18}$ cm^{-3} on one side and $N_d = 2.5 \times 10^{15}$ cm^{-3} on the other side. It has a circular cross-section with a diameter of 8 µm and depletion width of 0.46 µm. At room temperature calculate the value of charge (Q_+) on *p* side is ______.

(A) 2.3×10^{-16} *C*
(B) 4.8×10^{-15} *C*
(C) 2.82×10^{-10} *C*
(D) 9.2×10^{-15} *C*

49. In the circuit given below the Zener diode D_1 has reverse bias breakdown voltage of 50V and reverse saturation current of 20 µA. The corresponding values for D_2 are 80V and 3 0 µA. The current in the circuit is _______ µ*A*.



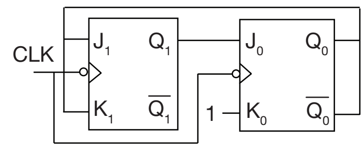
50. Given Combinational network with four inputs *A*, *B*, *C*, *D* and three intermediate outputs *P*, *Q*, *R* and two outputs *X* and *Y* as shown in figure.



Assuming that G_1 is *NAND* gate, and G_2 is *AND* gate find the smallest function '*Q*'. (with minimum number of min terms) which makes it possible to produce *X* and *Y*?

(A) $\bar{A}\bar{C}D + A\bar{C}\bar{D} + \bar{A}B + B\bar{C}\bar{D}$
(B) $\bar{A}\bar{B} + \bar{A}C\bar{D} + \bar{A}C\bar{D} + \bar{B}C\bar{D}$
(C) $\bar{A}\bar{B} + \bar{A}C + B\bar{C}$
(D) $\bar{A}\bar{B}\bar{D} + \bar{A}BD + A\bar{B}C + B\bar{C}$

51. Consider the following synchronous counter with *JK* flip flops, with initial state at reset.



If the *JK* flip flops have to be replaced by *D* flip flops for the same sequence, then the *D* flip flop inputs D_1, D_0 are (corresponding to Q_1, Q_0 flip flops)

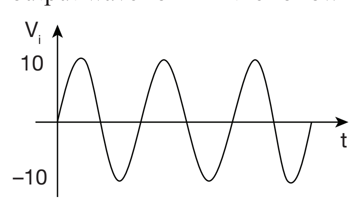
(A) $D_1 = Q_1 \oplus Q_0$, $D_0 = Q_1\bar{Q}_0$
(B) $D_1 = Q_1 \odot Q_0$, $D_0 = Q_1\bar{Q}_0$
(C) $D_1 = Q_1 + Q_0$, $D_0 = Q_1 \oplus Q_0$
(D) $D_1 = Q_1 \odot Q_0$, $D_0 = Q_1 + \bar{Q}_0$

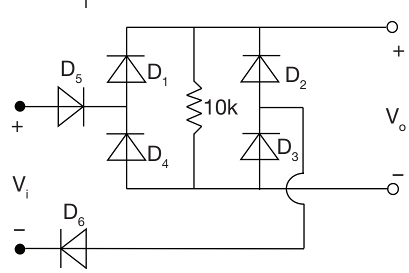
52. The following 8085 microprocessor program reads one data byte at a time from *I*/*O*, which of the following data byte, will transfer the program to location ACCEPT?

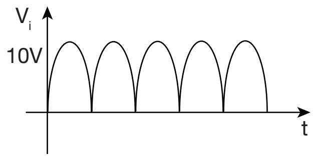
```
IN PORT1
MVI B, 40H
CMP B
JC REJECT
JM REJECT
STA 2016H
JMP ACCEPT
REJECT: JMP INVALID
```

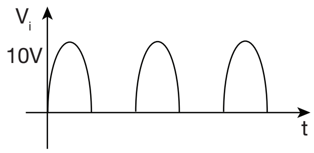
(A) 39*H*
(B) *F*2*H*
(C) 8*FH*
(D) *D*8*H*

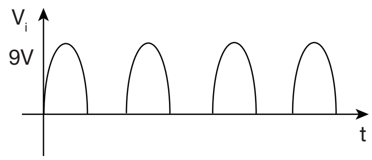
53. FOUR diodes (D_1, D_2, D_3, D_4 Ideal) and TWO diodes (D_5, $V\gamma = 0.7$, D_6, $V\gamma = 0.3$) are used in the circuit. 10 Sin ω*t* signal is excited to a given circuit shown in figure. The output wave form in the following is.





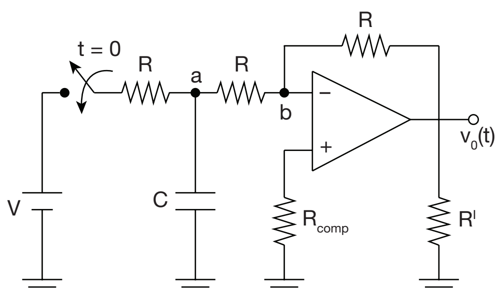
(A) 

(B) 

(C) 

(D) None of these

54. In the circuit shown below, the initial charge on the capacitor is zero. The switch is closed at time $t = 0$. The output voltage $V_0(t)$, for $t > 0$ is _______



(A) $\frac{V}{2}\left[1-e^{\frac{-2t}{RC}}\right]$ (B) $V\left[1-e^{-\frac{t}{2RC}}\right]$

(C) $\frac{V}{2}\left[1-e^{\frac{-t}{2RC}}\right]$ (D) $\frac{V}{2}\left[e^{\frac{-2t}{RC}}-1\right]$

55. A transistor supplies 0.85 W to a 4 $k\Omega$ load. The zero signal D.C. collector current is 31 mA and the D.C. collector current with signal is 34mA. Determine the second harmonic distortion.

(A) 14% (B) 10%

(C) 11% (D) 14.7%

56. Given the following transistor measurements made at I_C = 5mA, V_{CE} = 10 volt and at room temperature h_{fe} = 100, h_{ie} = 600Ω, A_{ie}= 10 at 10 MHz, C_μ = 3pF. Then the value of C_e is ______.

(A) 301pF (B) 304 μF

(C) 30.4pF (D) 30.4 μF

57. It is desired to reduce the reflection at an air by using $\frac{\lambda}{4}$ porcelain plate (ε_r = 8). Thickness of the porcelain plate required at 9 GHz is

(A) 1.17 cm

(B) 0.6 cm

(C) 0.3 cm

(D) 2.34 cm

58. A wave is travelling from free space ($z \le 0$) to dielectric medium ($z \ge 0$, $\varepsilon_r = 4$) and the plane wave is $H_i = 5\cos(2\times10^8 t - \beta z)\,\hat{a}_y$ mA/m then find reflected component of electric field.

(A) $1.885\cos(2\times10^8 t + \frac{4}{3}z)$

(B) $-0.628\cos(2\times10^8 t - \frac{4}{3}z)$

(C) $1.885\cos(2\times10^8 t - \frac{2}{3}z)$

(D) $-0.628\cos(2\times10^8 t + \frac{2}{3}z)$

59. When a wave is travelling from free space to medium. Conductivity of medium is 12 μmhos/m and relative permittivity is 8 at a frequency of 1 GHz. Then find reflection co-efficient.

(A) –0.47 (B) 0.477

(C) 0.74 (D) –0.74

60. If DTFT of a signal $x[n]$ is given as $X[e^{j\omega}] = \sin\left(\frac{10\pi\omega}{31}\right)$

Then the signal $x[n]$ is

(A) $2j\,[\delta(n+5) - \delta(n-5)]$

(B) $\frac{1}{2j}[\delta(n+5) - \delta(n-5)]$

(C) $2j\,[\delta(n+5) + \delta(n-5)]$

(D) $\frac{1}{2j}[\delta[n+5) + \delta(n-5)]$

61. If $X(z)$ has poles at $z = \frac{1}{2}$ and z = -1. If $x(2) = \frac{1}{2}$ and $x(-2)$ = -1 and ROC includes the point $\frac{3}{4}$. The time signal $x[n]$ is ____

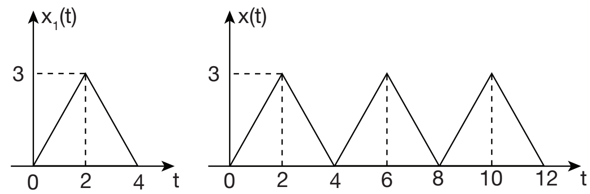
(A) $\frac{1}{2^n}u[n] - (-1)^n u[-n-1]$

(B) $\frac{1}{2^{n-1}}u[n] + u[-n+1]$

(C) $\frac{1}{2^{n-1}}u[n] - (-1)^n u[-n-1]$

(D) None of these

62. The triangular pulses and triangular wave are given in figure.



The mathematical function for wave form $x(t)$ is

(A) $x(t) = \sum_{k=0}^{+\infty} x_1(t-2k)$ (B) $x(t) = \sum_{k=-\infty}^{+\infty} x_1(t-4k)$

(C) $x(t) = \sum_{k=-\infty}^{+\infty} x_1(t-2k)$ (D) $x(t) = \sum_{k=0}^{\infty} x_1(t-4k)$

63. For a given random process
$x(t) = A\cos(2\omega^c t + \theta)$
Where θ is random variable uniformly distributed over $[-\pi, \pi]$.
The PSD and mean square value of the random process is

(A) $\frac{A^2}{2}\left[\delta(f+f_c)+\delta(f-f_c)\right]$ and $\frac{A^2}{2}$

(B) $\frac{A^2}{4}\left[\delta(f+f_c)+\delta(f-f_c)\right]$ and $\frac{A^2}{4}$

(C) $\frac{A^2}{2}\left[\delta(f+2f_c)-\delta(f-2f_c)\right]$ and $\frac{A^2}{4}$

(D) $\frac{A^2}{4}\left[\delta(f+2f_c)-\delta(f-2f_c)\right]$ and $\frac{A^2}{2}$

64. A PM signal having frequency deviation 70 kHz and modulating signal bandwidth of 4 kHz is applied to the square law device. The bandwidth of output signal is ____ kHz.

65. If energy 0 per bit signal is 10^{-7}watt – sec and power spectral density of white noise is $\frac{N_0}{2} = 0.5 \times 10^{-9}$, then the output SNR of the matched filter is ________

(A) 10 dB (B) 20 dB
(C) 30 dB (D) None of these

Answer Keys

1. B	**2.** 2	**3.** D	**4.** A	**5.** A	**6.** C	**7.** D	**8.** C	**9.** B	**10.** A
11. 0	**12.** A	**13.** C	**14.** A	**15.** 0	**16.** B	**17.** C	**18.** 80 to 81		
19. 5.5 to 6		**20.** B	**21.** D	**22.** D	**23.** D	**24.** B	**25.** B	**26.** A	**27.** B
28. D	**29.** 4.3 to 4.6		**30.** A	**31.** B	**32.** B	**33.** B	**34.** D	**35.** C	**36.** D
37. –0.32 to –0.31		**38.** B	**39.** A	**40.** B	**41.** A	**42.** 98 to 102		**43.** 55 to 57	
44. D	**45.** A	**46.** 41 to 43		**47.** A	**48.** D	**49.** 19 to 21		**50.** D	**51.** B
52. C	**53.** C	**54.** D	**55.** D	**56.** A	**57.** C	**58.** D	**59.** A	**60.** B	**61.** C
62. D	**63.** D	**64.** 285 to 290		**65.** B					

Hints and Explanations

1. The given statement is a hypothetical one. An unreal situation is presented here so the verb "were" is apt.
Choice (B)

2. Let t hours be the time taken to cross each other.
Then, distance covered by Ram, to meet the other
$= xt$ km → (1)
The distance covered by Shyam, to meet the other
$= yt$ km → (2)
But, as per data, (1) is y times (2).
Hence, $xt = (y)(yt)$;
$\Rightarrow x = y^2$.
It is given that $x = 4$; hence $y = 2$. Ans: 2

3. Khadar's wife's daughter is Khadar's daughter whose mother is Khadar's wife. Khadar's wife's daughter-in-law is Khadar's daughter-in-law. Her husband's father is Khadar himself. Choice (D)

4. Except (*A*) all the other combinations have a synonymous relationship. "Empirical" is that which can be practically proved while "emaciated" is lean and weak. Momentous means significant. In (*A*) both the words are antonyms. Beatific means sublime while mundane is common or coarse. Choice (A)

5. The ratio of sales of Kissan to Sil is the highest in the year 2012 and this highest ratio equals 2.19.
Choice (A)

6. The right idiom to fit the bill is "stood their ground", which means to stick to one's stand on one's decision. To "pass the buck" is to shrug off responsibility, "broaden one's horizons" is to enlarge one's range of activities and world and "to hear something on the grapevine" is to get to know something via rumours. To "promise somebody the moon" is to promise somebody something that is impossible to deliver.
Choice (C)

7. Statement (i) is about disposal techniques which is not the point of discussion or the source of the problem. Similarly (iii) is not the point of discussion which actually finds a solution to the problem. The possible solutions are offered in (ii) and (iv). It is necessary to create awareness among public and staff to incorporate safe injection practices and make extensive use of AD syringes. Choice (D)

8. Let $x = \sqrt{5+\sqrt{5-\sqrt{5+\sqrt{5------}}}}$

We can see that $x > \sqrt{5}$ ($\sqrt{5} \approx 2.25$)

Choice (1): $\dfrac{\sqrt{13}-1}{2} \approx \dfrac{3.6-1}{2} \approx 1.3$

Choice (2): $\dfrac{\sqrt{17}-1}{7} \approx \dfrac{4.2-1}{2} \approx 1.6$

$\therefore \quad (x^2-5)^2 = 5 - x$ --- (1)

Now consider $x = \dfrac{\sqrt{17}+1}{2}$ ----(2)

$\therefore \quad 5 - x = \dfrac{9-\sqrt{17}}{2}$

$(2) \Rightarrow x^2 = \dfrac{18+2\sqrt{17}}{4} = \dfrac{9+\sqrt{17}}{2}$

$\therefore \quad x^2 - 5 = \dfrac{\sqrt{17}-1}{2}$

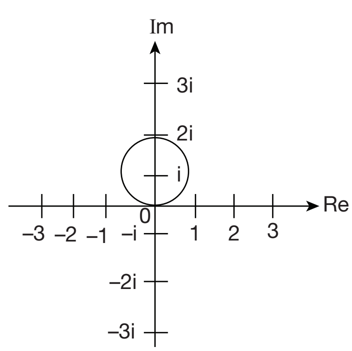
$\therefore \quad (x^2-5)^2 = \dfrac{18-2\sqrt{17}}{4} = \dfrac{9-\sqrt{17}}{2}$

$\therefore \quad x = \dfrac{\sqrt{17}+1}{2}$ satisfies (1) Choice (C)

9. The sentence which is logically valid and can be inferred from the given sentence is:
America would not have entered the world war if Japan would not have attacked the Pearl Harbour.
Japan's attack on pearl Harbour is cited as the reason for the America entering. Choice (B)

10. Statement (*A*) is grammatically correct and clearly brings out the intended meaning that a tip today would be enough to buy a meal three years ago. Choice (B) is ungrammatical as "today's" does not use an apostrophe. In (*C*) "three-years-ago meal" distorts the meaning. (*D*) uses "would costed" which is ungrammatical. Choice (A)

11.



We have to evaluate $\oint_C \dfrac{z^2+6z+10}{z^2+9}dz$

Where *C* is the circle $|z - i| = 1$

Let $f(z) = \dfrac{z^2+6z+10}{z^2+9}$

$z = \pm 3i$ are the singularities of $f(z)$ and $z = \pm 3i$ lie outside the circle $|z - i| = 1$

By Cauchy's integral theorem

$$\oint_C \frac{z^2+6z+10}{z^2+9}dz = \oint_C f(z)dz = 0.$$ Ans: 0

12. We have $\int_0^{\pi} \sin^8 x dx = 2\int_0^{\frac{\pi}{2}} \sin^8 x dx$

$$\left(\because \int_0^{2a} f(x)dx = 2\int_0^{a} f(x)dx; if \quad f(2a-x) = f(a)\right)$$

$$= 2\left[\frac{8-1}{8}\cdot\frac{8-3}{8-2}\cdot\frac{8-5}{8-4}\cdot\frac{1}{2}\cdot\frac{\pi}{2}\right]$$

$$\left(\because \int_0^{\frac{\pi}{2}} \sin^n x dx = \frac{n-1}{n}\cdot\frac{n-3}{n-2}\cdot\frac{n-5}{n-4}\cdots\frac{3}{4}\cdot\frac{1}{2}\cdot\frac{\pi}{2} \text{ if } n \text{ is even}\right)$$

$$= 2\left[\frac{7}{8} : \frac{5}{6}\cdot\frac{3}{4}\cdot\frac{1}{2}\cdot\frac{\pi}{2}\right]$$

$$= \frac{7^2}{8.7}\cdot\frac{5^2}{6.5}\cdot\frac{3^2}{4.3}\cdot\frac{1^2}{2.1}\pi = \frac{7^2.5^2.3^2.1^2}{8!}\pi.$$ Choice (A)

13. Standard result. Choice (C)

14. Given differential equation is $\dfrac{d^2x}{dt^2} + 9x = 6\cos 3t$

-------- (1)

Particular integral (P.I) $= x_p = \dfrac{1}{f(D)}X$

$$= \frac{1}{(D^2+9)} 6\cos 3t = t\,\frac{1}{2D}\, 6\cos 3t$$

$$= t\int 3\cos 3t dt = t\,\frac{3\sin 3t}{3}$$

$\therefore \quad x_p = t \sin 3t.$ Choice (A)

15. Given $U(x, y, z) = F(x - y, y - z, z - x)$
Let $r = x - y$, $s = y - z$ and $t = z - x$
$\therefore \quad U = F(r, s, t)$

$$\therefore \quad \frac{\partial u}{\partial x} = \frac{\partial F}{\partial r}\cdot\frac{\partial r}{\partial x} + \frac{\partial F}{\partial s}\cdot\frac{\partial s}{\partial x} + \frac{\partial F}{\partial t}\cdot\frac{\partial t}{\partial x} = \frac{\partial F}{\partial r} - \frac{\partial F}{\partial t}$$

$$\frac{\partial U}{\partial y} = \frac{\partial F}{\partial r}\cdot\frac{\partial r}{\partial y} + \frac{\partial F}{\partial s}\cdot\frac{\partial s}{\partial y} + \frac{\partial F}{\partial t}\cdot\frac{\partial t}{\partial y} = -\frac{\partial F}{\partial r} + \frac{\partial F}{\partial s}$$ and $$\frac{\partial U}{\partial z} = \frac{\partial F}{\partial r}\cdot\frac{\partial r}{\partial z} + \frac{\partial F}{\partial s}\cdot\frac{\partial s}{\partial z} + \frac{\partial F}{\partial t}\cdot\frac{\partial t}{\partial z} = -\frac{\partial F}{\partial s} + \frac{\partial F}{\partial t}$$

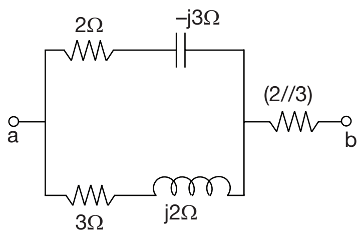
$$\therefore \quad \frac{\partial U}{\partial x} + \frac{\partial U}{\partial y} + \frac{\partial U}{\partial z} = \left(\frac{\partial F}{\partial r} - \frac{\partial F}{\partial t}\right) + \left(-\frac{\partial F}{\partial r} + \frac{\partial F}{\partial s}\right)$$

$$+\left(-\frac{\partial F}{\partial s} + \frac{\partial F}{\partial t}\right) = 0.$$ Ans: 0

16. Dependent source indicating current source, it depends on the voltage V_1 value

$\therefore$ It is a VCCS Choice (B)

17. Deactivate the independent source and find the equivalent Z_{ab}.



$$Z_{ab} = 1.2 + \frac{(2-j3)(3+j2)}{2-j3+3+j2}$$

$= 1.2 + 2.5 – 0.5j$

$= (3.7 – j0.5)\ \Omega$ Choice (C)

18. $f_o = \dfrac{1}{2\pi\sqrt{L_{eq}.C}}$

$L_{eq} = \dfrac{L_1 L_2 - M^2}{L_1 + L_2 + 2M}$ (parallel opposition)

$= \dfrac{4\times3-2.25}{4+3+3} = 0.975\,H$

$\therefore f_o = \dfrac{1}{2\pi.\sqrt{0.975\times4}}$ kHz

f_o = 80.59 Hz Answer range 80 to 81 Hz

19. From the given data

$G(s) = \dfrac{K(s+3)}{(s+1)(s+2)}$

$1 + G(s) . H(s) = 0$

$(s+1)(s+2)+K(s+3) = 0$

$K = -\dfrac{(s+1)(s+2)}{(s+3)}$

At Break point $\dfrac{dk}{ds} = 0.$

$(s + 3)[2s + 3] = (s^2 + 3s + 2)\ 1$

$2s^2 + 3s + 6s + 9 = s^2 + 3s + 2$

$s^2 + 6s + 7 = 0$

$s = –1.58, –4.41.$

But from given P-Z locations B.I point at $s = –4.41$.

Sub $S = –4.41$ in characteristic equation we get $K = 5.828$

20. Lag compensator means pole adding system it improves the steady state response, so error decreases.

Lead compensator means zero adding system, it improves the system stability.

Lag lead

$\Rightarrow$ It improves both ss response and stability of the system. Choice (B).

21. $\xi \Rightarrow \omega_d \downarrow$ Choice (D).

22. $E_g = h\upsilon = \dfrac{hc}{\lambda}$ Choice (D)

23. $W \alpha \dfrac{\sqrt{V_j}}{2}$ and $C_T \alpha \dfrac{1}{W}$ Choice (D)

24. NMOS transistor connected in series (AND)

So $\bar{A}B, A\bar{B}$

When connected in parallel (OR) $\bar{A}B + A\bar{B}$

So output $Y = \overline{\bar{A}B + A\bar{B}} = AB + \bar{A}\bar{B}$

$= (A+\bar{B})(\bar{A}+B)$ Choice (B)

25. Ratio of resistors $\dfrac{MSB}{LSB}$ =

$MSB = \dfrac{1}{2^{n-1}} \times LSB$

$= \times\ 16\ k\Omega = 1k\Omega$ Choice (B)

26. $f_{Hn} = f_H\sqrt{2^{\frac{1}{n}} - 1}$

$= 30\sqrt{2^{\frac{1}{5}} - 1}$ KHz = 11.568 KHz. Choice (A)

27. Choice (B)

28. $\beta = \pi$

$\omega = 2.5\pi \times 10^8$

$\beta = \omega\sqrt{\mu_o\,\varepsilon_o\,\varepsilon_r}$

$\Rightarrow \sqrt{\varepsilon_r} = \dfrac{\beta}{\omega\sqrt{\mu_o\varepsilon_o}}$

$= \dfrac{\pi\times3\times10^8}{2.5\pi\times10^8}$

$\sqrt{\varepsilon_r} = \dfrac{6}{5} \Rightarrow \varepsilon_r = 1.44$ Choice (D)

29. $P_{an} = \left|\dfrac{E^2}{2\eta}\right|$

$140 = \dfrac{(50\pi)^2}{2\times\eta}$

$\Rightarrow \quad \eta = 88 = \dfrac{120\pi}{\sqrt{\varepsilon_r}}$

$$\Rightarrow \sqrt{\varepsilon_r} = \frac{120\pi}{88} = 4.28$$

$$\beta = \omega\sqrt{\mu_o\varepsilon_o\varepsilon_r}$$

$$\beta = \frac{10^8\pi\times 4.28}{3\times 10^8}$$

= 4.48 rad/m Ans: 4.3 to 4.6

30. $X(j\omega) = \dfrac{8}{(4-j\omega)(4+j\omega)}$

$$= \frac{A}{(4-j\omega)} + \frac{B}{(4+j\omega)}$$

$$= \frac{1}{4-j\omega} + \frac{1}{4+j\omega}$$

$x(t) = e^{-4t}\,u(t) + e^{4t}\,u(-t)$ Choice (A)

31. $y[n]$ will always periodic with period $N = 10$.

Choice (B)

32. By taking laplace transform

$$SY(s) + 3\,Y(s) = \frac{1}{s}$$

$$Y(s)\,[s+3] = \frac{1}{s}$$

$$Y(s) = \frac{1}{s(s+3)} = \frac{1}{3}\left[\frac{1}{s} - \frac{1}{s+3}\right]$$

$Y(s) = \dfrac{1}{3}\left[1 - e^{-3t}\right]u(t)$ Choice (B)

33. So the sample rate will be

200 + 400 + 800 + 200 = 1600Hz

Now can sample is encoded into $\log_2 256$ = 8bits

So, the bit transmission rate

= 1600 × 8b/s = 12.8kbps Choice (B)

34. R_b = 20 kHz

$B_1 = (B.W)\,BPSK = \dfrac{2}{T_b} = 2R_b$ = 40 kHz

$B_2 = (B.\,W)\,QPSK = \dfrac{2}{T_s} = \dfrac{2}{2T_b} = \dfrac{1}{T_b}$

$= R_b$ = 20 KHz

Ans 40 kHz & 20 kHz Choice (D)

35. Noise power $N = PSD \times BW$

$= 10^{-9} \times 20 \times 10^3$

$= 2 \times 10^{-5}$

$SNR = 100$

$$\frac{S}{N} = 100$$

$\Rightarrow$ $S = 100 \times 2 \times 10^{-5} = 2 \times 10^{-3}$W

For DSB modulation (USB & LSB)

Avg power = 4×10^{-3}W Choice (C)

36. Given system of linear equations is

$$\left.\begin{aligned} 2x_1 + 3x_2 + 5x_3 + 7x_4 &= 0 \\ -2x_2 + ax_3 &= 0 \\ 3x_3 + 2x_4 &= 0 \\ 6x_2 + bx_4 &= 0 \end{aligned}\right\} \text{------------ (1)}$$

(1) can be written in matrix form as

$AX = O$

Where $A = \begin{bmatrix} 2 & 3 & 5 & 7 \\ 0 & -2 & a & 0 \\ 0 & 0 & 3 & 2 \\ 0 & 6 & 0 & b \end{bmatrix}$; $X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$ and $O = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$

Given that (1) has a non-trivial solution

$\Rightarrow$ Det $(A) = 0$

$$\Rightarrow \begin{vmatrix} 2 & 3 & 5 & 7 \\ 0 & -2 & a & 0 \\ 0 & 0 & 3 & 2 \\ 0 & 6 & 0 & b \end{vmatrix} = 0$$

$$\Rightarrow 2\begin{vmatrix} -2 & a & 0 \\ 0 & 3 & 2 \\ 6 & 0 & b \end{vmatrix} = 0$$

$$\Rightarrow 2\left(-2\begin{vmatrix} 3 & 2 \\ 0 & b \end{vmatrix} + 6\begin{vmatrix} a & 0 \\ 3 & 2 \end{vmatrix}\right) = 0$$

$\Rightarrow$ $2(-6b + 12a) = 0$

$\Rightarrow$ $2a - b = 0.$ Choice (D)

37. Let $f(x) = (1-x)^{\frac{5}{2}}$

The coefficient of x^3 in the Maclaurin's series expansion of $f(x) = \dfrac{f^{111}(0)}{3!}$

$$f(x) = (1-x)^{\frac{5}{2}}$$

$$\Rightarrow f^1(x) = \frac{-5}{2}\,(1-x)^{\frac{3}{2}}$$

$$\Rightarrow f^{11}(x) = \frac{5}{2} \times \frac{3}{2}\,(1-x)^{\frac{1}{2}} \text{ and}$$

$$f^{111}(x) = \frac{-5}{2} \times \frac{3}{2} \times \frac{1}{2}\,(1-x)^{\frac{-1}{2}}$$

$$\therefore f^{111}(0) = \frac{-15}{8}$$

The coefficient of x^3 in the Maclaurin's series expansion of $(1-x)^{\frac{5}{2}} = \dfrac{\left(\frac{-15}{8}\right)}{3!}$

$= \dfrac{-5}{16} = -0.3125$ Ans: –0.32 to –0.31

38. Given that X and Y denote the numbers shown up on the die in the first roll and the second roll respectively

$$\therefore \quad P(X+Y=6/X-Y=2) = \frac{P[(X+Y=6)\cap(X-Y=2)]}{P(X-Y=2)}$$

$$= \frac{P(X=4, Y=2)}{P\begin{bmatrix}(X=3,Y=1)\cup(X=4,Y=2)\cup\\(X=5,Y=3)\cup(X=6,Y=4)\end{bmatrix}}$$

$$= \frac{P(X=4,Y=2)}{p(X=3,Y=1)+p(X=4,Y=2)+p(X=5,Y=3)+p(X=6,Y=4)}$$

$$= \frac{P(X=4)P(Y=2)}{P(X=3)\ P(Y=1)+P(X=4)\ P(Y=2)+P(X=5)P(Y=3)+P(X=6)P(Y=4)}$$

($\because X$ and Y are independent random variables)

$$\frac{\frac{1}{6}\times\frac{1}{6}}{\frac{1}{6}\times\frac{1}{6}+\frac{1}{6}\times\frac{1}{6}+\frac{1}{6}\times\frac{1}{6}+\frac{1}{6}\times\frac{1}{6}} = \frac{1}{4}.$$

Choice (B)

39. Given $f = 3xy^2 + yz^3$

$$\Rightarrow \quad \nabla f = \frac{\partial f}{\partial x}\bar{i} + \frac{\partial f}{\partial y}\bar{j} + \frac{\partial f}{\partial z}\bar{k}$$

$$= 3y^2\,\bar{i} + (6xy + z^3)\,\bar{j} + 3yz^2\,\bar{k}$$

$$\nabla f_{at(2,-1,1)} = 3\bar{i} - 11\bar{j} - 3\bar{k}$$

Let $\bar{a} = 4\bar{i} + 3\bar{k}$

Unit vector along $\bar{a} = \hat{n} = \frac{\bar{a}}{|\bar{a}|} = \frac{4\bar{i}+3\bar{k}}{\sqrt{4^2+3^2}} = \frac{4}{5}\bar{i} + \frac{3}{5}\bar{k}$

The directional derivative of f in the direction of $\bar{a}$ is $\nabla f.\hat{n} = (3\bar{i}-11\bar{j}-3\bar{k}).\left(\frac{4}{5}\bar{i}+\frac{3}{5}\bar{k}\right)\sqrt{2}$

$$= \frac{12}{5} - \frac{9}{5} = \frac{3}{5}.$$

Choice (A)

40. Given differential equation is $\frac{dy}{dx} = x + 2y$ ------ (1)

with $y(0) = y_0 = 1$

$\therefore \quad x_0 = 0$ and $x_1 = 0.2$

$\Rightarrow \quad h = 0.2$

Here $f(x, y) = x + 2y$

$\therefore \quad \Delta y$ to be added to y_0 to get the value of y_1 by $R - K$ method of fourth order is

$$\Delta y = \frac{1}{6}[k_1 + 2k_2 + 2k_3 + k_4] \quad \text{----- (2)}$$

where $k_1 = h\,f(x_0, y_0) = h(x_0 + 2y_0)$

$= (0.2)[0 + 2 \times 1] = 0.4$

$$k_2 = h\,f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right) = (0.2)$$

$$\left[\left(x_0 + \frac{h}{2}\right) + 2\left(y_0 + \frac{k_1}{2}\right)\right]$$

$$= (0.2)\left[\left(0 + \frac{0.2}{2}\right) + 2\left(1 + \frac{0.4}{2}\right)\right] = 0.5$$

$$K_3 = h\,f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right) =$$

$$= (0.2)\left[\left(0 + \frac{0.2}{2}\right) + 2\left(1 + \frac{0.5}{2}\right)\right] = 0.52$$

and $k_4 = h\,f(x_0 + h, y_0 + k_3) = h[(x_0 + h) + 2\,(y_0 + k_3)]$

$= (0.2)\ (0+0.2) + 2(1 + 0.52)] = 0.648$

Substituting these in (2), we get

$$\Delta y = \frac{1}{6}\ [0.4 + 2 \times 0.5 + 2 \times 0.52 + 0.648)$$

$= 0.5147.$

Choice (B)

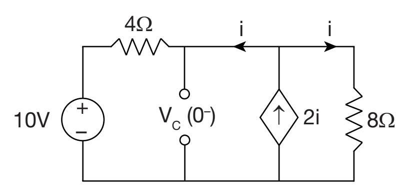
41. **For $t < 0$:-**

At $t = 0^-$, the switch was closed, and the circuit is in steady state

In S. S.

Capacitor $\rightarrow$ open circuit

Inductor $\rightarrow$ short circuit



$$i = \frac{V_C(0^-) - 10}{4}$$

but $V_C(0^-) = 8\,i$

$V_C(0^-) = 2V_C(0^-) - 20$

$V_C(0^-) = 20V$

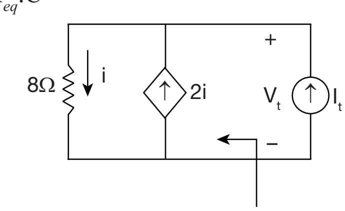
For $t > 0$:-

at $t = 0^+$, switch was opened and $V_C(0^-) = V_C(0^+) = 20V$

as $t \rightarrow \infty$. $V_C(\infty) = 0V$

$\Rightarrow \quad V_C(t) = 0 + \{20 - 0\}.e^{-t/\tau}$

$\tau = R_{eq}.C$



$I_t + 2i = i$

$I_t + i = 0$

$$I_t + \frac{V_t}{8} = 0$$

$$\frac{V_t}{I_t} = -8\ \Omega$$

$\tau = -8 \times 2 = -16\text{sec}$

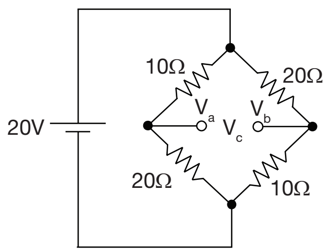
$V_C(-4) = 20.e^{-4/16}$

$= 20.e^{-1/4}$ V = 15.58 V Choice (A)

42. We know

$$W_c = \frac{1}{2}CV_c^2$$

find the V_C value



$V_C = V_a - V_b$

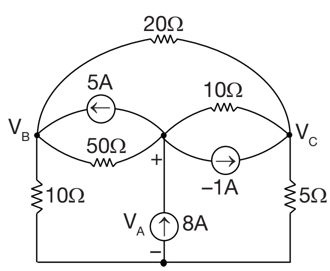
$$V_a = \frac{20\times 20}{20+10} = \frac{40}{3}\text{V}$$

$$V_b = \frac{10\times 20}{30} = \frac{10}{3}\text{V}$$

$V_c = V_a - V_b = 10\text{V}$

$\therefore \quad W_c = \frac{1}{2}\ (2 \times 10^{-6}) \times (10)^2 = 100\ \mu J$

43.



Applying nodal analysis

$$\frac{V_A - V_B}{50} + 5 - 8 + \frac{V_A - V_C}{10} - 1 = 0$$

$V_A - V_B - 3 \times 850 + 5\ (V_A - V_C) - 50 = 0$

$6V_A - V_B - 5V_C = 200$ → (i)

$$\frac{V_B}{10} + \frac{V_B - V_C}{20} + \frac{V_B - V_A}{50} - 5 = 0$$

$10V_B + 5V_B - 5V_C + 2V_B - 2V_A = 500$

$-2V_A + 17\ V_B - 5\ V_C = 500$ → (ii)

and $\frac{V_C - V_A}{10} + 1 + \frac{V_C}{5} + \frac{V_C - V_B}{20} = 0$

$(V_C - V_A) \times 10 + 100 + 20\ V_C + 5(V_C - V_B) = 0$

$-10V_A + 10V_C + 100 + 20V_C + 5V_C - 5V_B = 0$

$10\ V_A + 5\ V_B - 35V_C = 100$ → (iii)

From equation (i), (ii) and (iii)

We get $V_A = 56.25$ V

$V_B = 41.66$ V

$V_C = 19.16$V Ans: 55 to 57

44. From the given system

$$A = \begin{bmatrix} -1 & 0 \\ 1 & 0.5 \end{bmatrix}$$

$B = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$, $C = [1\ 1]$ and $D = 0$

Controllability test

$Q_C = [B\ AB]$

$$AB = \begin{bmatrix} -1 & \bar{0} \\ 1 & 0.5 \end{bmatrix}\begin{bmatrix} 1 \\ 2 \end{bmatrix}\downarrow$$

$$AB = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$$

$$Q_C = \begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix}$$

$|Q_C| = 2 + 2$

$\therefore \quad |Q_C| \neq 0$

The system is controllable.

Observability test :

$$Q_O = \begin{bmatrix} C \\ CA \end{bmatrix}$$

$$CA = \begin{bmatrix} 1 & 1 \end{bmatrix}\begin{bmatrix} -1 & 0 \\ 1 & 0.5 \end{bmatrix}$$

$$CA = \begin{bmatrix} 0 & 0.5 \end{bmatrix}$$

$$Q_O = \begin{bmatrix} 1 & 1 \\ 0 & 0.5 \end{bmatrix}$$

$Q_O = 0.5 \neq 0$

$|Q_0| \neq 0$

It is observable

So the given system is controllable and observable.

Choice (D)

45. $N = P - Z$

Given P = 1

The encirclement of critical point $-1 + j.0$ in clock wise direction is twice

$N = -2$.Clock wise direction

$-2 = 1 - Z$

$Z = 3$

The system is unstable with 3 poles in RHS of s. plane.

Choice (A)

46. $$G\ (s) = \frac{50\ \times 0.05(s+20)}{0.2\,s(s+5)(s+4)}$$

$$G\ (j\omega) = \frac{12.5(20+j\omega)}{j\omega.(5+j\omega)\ (4+j\omega)}$$

At $\omega = 0.1$ rad/sec

$$\therefore \quad |G(j\omega)| \approx \frac{12.5\times 20}{0.1\times 5\times 4} = 125$$

$$G = 20 \text{ Log } 125 \text{ dB}$$
$$= 41.938 \text{ dB}$$ Ans: 41 to 43

47. For a forward bias $p^+ n$ diode

$$I \approx \frac{q.A.D_p}{L_p}.P_n.e^{qV_D/kT} = \frac{qAD_pP_n}{Lp}.e^{V_D/\eta V_T}$$

$$n_n.p_n = n_i^2 \text{ and } L_p = \sqrt{D.\tau}$$

$$P_n = \frac{n_i^2}{N_D} = \frac{(1.5\times 10^{10})^2}{5\times 10^{16}} = \frac{2.25\times 10^{20}}{5\times 10^{16}} = 0.45\times 10^4\ cm^{-3}$$

$$I = \frac{1.6\times 10^{-19}\times 10^{-3}\times 10\times 0.45\times 10^4}{3.16\times 10^{-3}}.e^{\{0.5/0.026\}}$$

$= 2.278 \times 10^{-15}.e^{19.23}$
$= 5.121 \times 10^{-7}$ Amp $= 0.51\ \mu A$ Choice (A)

48. $Q_+ = q.A.\ W_n.N_D$
$A = \pi r^2 = \pi (4 \times 10^{-4})^2 = 5.02 \times 10^{-7}\ \text{cm}^2$
Given $W = 0.46\ \mu\text{m}$
$w_n.N_d = w_p.N_A$
$w = w_n + w_p$

$$\therefore W_n = \frac{W}{1+\frac{N_d}{N_A}} = \frac{0.46}{1+\frac{2.5\times 10^{15}}{10^{18}}} = \frac{0.46}{1+2.5\times 10^{-3}}$$

$= 0.458\ \mu m \approx W$
$\because \quad Q_+ = 1.6 \times 10^{-19} \times 5.02 \times 10^{-7} \times 0.458 \times 10^{-4} \times 2.5 \times 10^{15} = 9.2 \times 10^{-15}\ C$ Choice (D)

49. From the given data D_2 is in ON state and D_1 will be in Reverse bias.
So it allows only Reverse saturation current of D_1.
$\therefore \quad I = 20\ \mu A$ Ans: 19 to 21

50. $X = \overline{P.Q} = (G_1$ is NAND gate)
$= \sum m\ (0, 1, 3, 5, 6, 8, 9, 13, 14, 15)$
$P.Q = \sum m(2, 4, 7, 10, 11, 12)$
$Y = Q.R = \sum m(0, 2, 5, 10, 13)$ (G_2 is AND gate)
from above two equations
$Q = \sum m(0, 2, 4, 5, 7, 10, 11, 12, 13)$

AB \ CD	00	01	11	10
00	1			1
01	1	1	1	
11	1	1		
10			1	1

$\overline{A}\overline{B}\overline{D} + \overline{A}BD + A\overline{B}C + B\overline{C}$ Choice (D)

51. Here $J_1 = K_1 = \overline{Q}_0$, $J_0 = Q_1$, $K_0 = 1$
If JK flipflop has to be replaced with D flip flop then
$D = J\,K$ characteristic equation $= J\ \overline{Q} + \overline{K}Q$

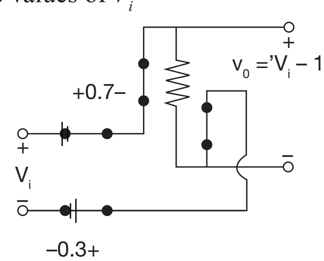
So, $D_1 = J_1\overline{Q}_1 + \overline{K}_1 Q_1$
But here $J_1 = \overline{Q}_0, K_1 = \overline{Q}_0$ (as per connections given)

$$D_1 = \overline{Q}_0.\overline{Q}_1 + \overline{\overline{Q}}_0\ Q_1 = \overline{Q}_0\ \overline{Q}_1 + Q_0\ Q_1 = Q_0 \odot Q_1$$

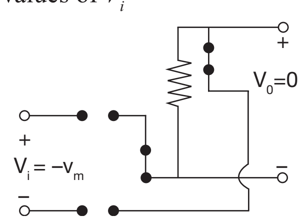
Similarly $D_0 = J_0\ \overline{Q}_0 + 0.Q_0$
$J_0 = Q_1, K_0 = 1$
So $D_0 = Q_1.\overline{Q}_0 + 0.Q_0$
$D_0 = Q_1\ \overline{Q}_0$
(or) Find the sequence of given counter, and design the same sequence counter with D-flip flops. Choice (B)

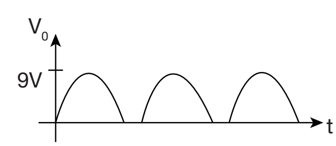
52. IN PORT1 will take input byte from I/O to Accumulator
MVI B, 40$H \rightarrow$ Copy $B = 40\ H$
CMP $B \rightarrow$ Compare B with A, it will perform $(A - B)$ Subtraction
JC REJECT, JM REJECT $\rightarrow$ in the above operation if there is a carry $(A < B)$ or sign flag $= 1(A - B \geq 80)$ then sequence will go to REJECT.
Otherwise STA 2016H $\rightarrow$ store Accumulator in 2016H,
JMP ACCEPT – jump to Accept
So it will jump to Accept if $A > B$ (40 H) and $A <$ C0H
Choice (C)

53. For positive values of V_i



For negative values of V_i





Choice (C)

54. $$\frac{V_C - V}{R} + \frac{V_c - 0}{R} + C\frac{dV_c}{dt} = 0$$

$$\frac{dV_c}{dt} + \frac{2V_c}{RC} = \frac{V}{RC}$$

$\Rightarrow$ 1st order linear differential equation

Solution

$$V_c\, e^{\frac{2}{RC}t} = \int \frac{V}{RC}.e^{\frac{2t}{Rc}}.dt + K$$

$$=\frac{V}{RC.\frac{2}{RC}}e^{\frac{2}{RC}t}+K$$

$$V_c=\frac{V}{2}+K.e^{\frac{-2t}{RC}}$$

$t = 0$, $V_C(0) = 0$

$K = -V/2$

$$V(t)=\frac{V}{2}\left[1-e^{\frac{-2t}{RC}}\right]$$

Apply nodal analysis at node b

$$\frac{0-V_c(t)}{R}+\frac{0-V_0}{R}=0$$

$\therefore \quad V_0 = -V_c(t)$

$$\therefore \quad V_0=\frac{V}{2}\left[e^{-\frac{2t}{RC}}-1\right]$$ Choice (D)

55. $R_L = 4\text{k}\Omega$, $(P_{ac})_D = 0.85$ W

The current without signal is $I_{CQ} = 31$ mA

The current with signal is $I_{CQ} + B_0 = 34$ mA

The increase is due to harmonic content P_n the signal.

$B_0 = 34 - 31 = 3$ mA

$B_2 = B_o = 3$ mA

$(P_{ac})_D = P_{ac}[1 + D^2]$

$$(P_{ac})_D = ½\ B_1^2\ R_L\left[1+\frac{B_2^2}{B_1^2}\right]$$

$$(P_{ac})_D = ½\ B_1^2 R_L + \frac{1}{2}B_2^2 R_L = 0.85$$

$$0.85 = ½\ B_1^2\times4\times10^3+\frac{1}{2}\times(3\times10^{-2})^2\times4\times10^3$$

$B_1 = 20.396$ mA

$$D_2=\left|\frac{B_2}{B_1}\right|\times100 = 14.7\%.$$ Choice (D)

56. $$C=\frac{g_m}{2\pi f_T}=\frac{|I_C|}{V_T}\frac{1}{2\pi f_T}$$

$$|Ai|=\frac{h_{fe}}{\sqrt{1+\left({}^{f}/f_\beta\right)^2}},\ f_T=h_{fe}f_\beta$$

$$C=\frac{5}{26}\ \frac{1}{2\times\pi\times100\times10^6}$$

$C = 304$pF

But $C = C\mu + C\pi$

$C\pi = C_e = 301$ pF Choice (A)

57. $$\lambda=\frac{C}{f}$$

$$=\frac{3\times10^{10}}{\sqrt{\varepsilon_r}\times9\times10^9}$$

$$=\frac{30}{\sqrt{8}\times9}=1.17\text{cm}$$

Thickness required is

$$=\frac{\lambda}{4}=\frac{1.17}{4} = 0.3\text{cm}$$ Choice (C)

58. $\eta_1 = 120\ \pi$

$$\eta_2=\sqrt{\frac{\mu}{\varepsilon}}=60\pi$$

$$\beta=\frac{\omega}{C}=\frac{2\times10^8}{3\times10^8}=\frac{2}{3}$$

$$\frac{E_{ro}}{E_{io}}=\Gamma=\frac{\eta_2-\eta_1}{\eta_2+\eta_1}$$

$E_{io} = H_{io}\ \eta_1$

$= 120\ \pi \times 5\cos(2\times10^8 t - \beta z)\ \hat{a}_x\ \ 10^{-3}$ A/m

$= 1.885\cos(2\times10^8 t - \times\ \beta z)\ \hat{a}_x$

$$\frac{E_{ro}}{E_{io}}=\frac{60\pi-120\pi}{60\pi+120\pi}=\frac{-1}{3}$$

$$E_{ro} = -0.628\cos(2\times10^8 t - \frac{2}{3}(-z))$$

$$\therefore \quad E_{ro} = -0.628\cos(2\times10^8 t + \frac{2}{3}z)$$ Choice (D)

59. $$\eta_2=\sqrt{\frac{j\omega\mu_o}{\sigma+j\omega\varepsilon_o\varepsilon_r}} = 133.958 \simeq 134\ \Omega$$

$\eta_1 = 377\ \Omega$

$$\gamma=\frac{\eta_2-\eta_1}{\eta_2+\eta_1}=\frac{134-377}{134+377} = -0.47$$

2[nd] method

$$\gamma=\frac{\sqrt{\varepsilon_{r_1}}-\sqrt{\varepsilon_{r_2}}}{\sqrt{\varepsilon_{r_2}}+\sqrt{\varepsilon_{r_1}}}$$

$$=\frac{1-\sqrt{8}}{1+\sqrt{8}}=-0.477$$ Choice (A)

60. $$X[e^{j\omega}]=\frac{1}{2j}\left[e^{+j\frac{10\pi\omega}{31}}-e^{-\frac{j10\pi\omega}{31}}\right]$$

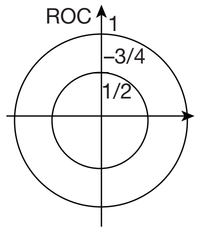
$$=\frac{1}{2j}\left[e^{+j\left(\frac{2\pi}{31}\right)5\omega}-e^{-j\left(\frac{2\pi}{31}\right)5\omega}\right]$$

$$=\frac{1}{2j}\{\delta[n+5]\}-\delta[2-5]\ DTFT$$

$$=\frac{1}{2j}\left[e^{j\frac{2\pi}{31}5\omega}-e^{-j\frac{2\pi}{31}5\omega}\right]$$

Choice (B)

61.



As two poles are at $z = \frac{1}{2}$ and – 1 and ROC includes the point $z = \frac{3}{4}$. So ROC will be the ring and one pole due to causal signal and one pole due to the anti causal signal.

So $x[n] = a.\left(\frac{1}{2}\right)^n u[n] - b\,.\,(-1)^n u[-n-1]$

Now for $n = 2$

$x(2) = \left(\frac{1}{2}\right) = a.\left(\frac{1}{2}\right)^2 .1 - 0$

$\Rightarrow \quad a = \frac{1}{2}.2^2$

$a = 2$

Now for $n = -2$

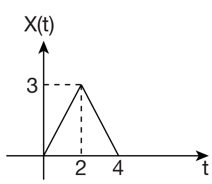
$x(-2) = -b.(-1)^{-2}\,.\,1 = -1$

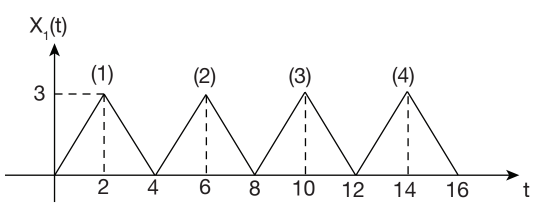
$\Rightarrow \quad b = 1$

So $x[n] = \left(\frac{1}{2}\right)^{n-1} u[n] - (-1)^n u(-n-1)$

Choice (C)

62.





$$x(t) = \overset{(1)}{x_1(t)} + \overset{(2)}{x_1(t-4.1)} + \overset{(3)}{x_1(t-4.2)} + \overset{(4)}{x_1(t-4.3)}$$

$$= \sum_{k=0}^{\infty} x_1(t-4k)$$

Choice (D)

63. **As we know that auto correlation and PSD makes the Fourier transform pair ________**

$R_{XX}(t, t+\tau) = E[X(t)\,X(t+\tau)]$

$$= \frac{A^2}{2\pi}\int_{-\pi}^{+\pi}\left[\cos(2\omega_c t+\theta)\cos\left[2\omega_c(t+\tau)\right]+\theta\right]d\theta$$

$$= \frac{A^2}{2\pi}\int_{-\pi}^{\pi}\cos(2\omega_c t+\theta)\cos\left[2\omega_c(t+\tau)+\theta\right]d\theta$$

$$= \frac{A^2}{2.2\pi}\left[\int_{-\pi}^{\pi}\cos(4w_c t+2\theta+2\omega_c\tau)^{d\theta} + \int_{-\pi}^{\pi}\cos 2\omega_c\tau\,d\theta\right]$$

So $Rx(\tau) = \frac{A^2}{2.2\pi}\text{Cos}\,2\omega_c\tau.(2\pi)$

$= \frac{A^2}{2}\text{Cos}\,2\omega_c\tau$

So PSD $= \frac{A^2}{4}\left[\delta(f+2f_c)+\delta(f-2f_c)\right]$

And mean square value is $Rx(0)$

$R_x(0) = \frac{A^2}{2}$ Choice (D)

64. Let output = $Y(t)$

Input = $X(t)$

So after square law device

$y(t) = x^2(t)$

& $X(t)$ is PM signal

So $X(t)PM = A\cos[w_c t + kpf(t)]$

So $\Delta w = w_n K\,pf(t)$

$\Delta f = 70$ KHz (given)

Now $x^2(t) = A^2\text{Cos}^2[w_c t + kpf(t)]$

$$= A^2\left(\frac{1+\text{Cos}\,2\left[\omega_c t + Kpf(t)\right]}{2}\right)$$

Now $Wi^1 = 2[\omega_c t + K_p f(t)]$

$\Delta w^1 = 2K_p f(t).\,\omega_m$

(Where ω_m is frequency of $f(t)$]

But the frequency of $f(t)$ remains same

So bandwidth $= 2(\Delta f^1 + f_m) = 288$kHz

2nd method

$BW^1 = 2(\Delta f^1 + f_m)$

Where $\Delta f^1 + n.\,\Delta f$

Square law device so $n = 2$

$\therefore$ $\text{BW}^1 = 2[2 \times 70k + 4k]$

$= 288$ kHz Ans : 285 to 290

65. SNR $= \frac{E_b}{N_0} = \frac{10^{-7}}{2\times 0.5\times 10^{-9}} = 100$

SNR in dB = 10 $log_{10}100$ = 20dB

Choice (B)