Mock Test 3

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 pair that best expresses a relationship similar to that expressed in the pair:

1. Road : Footpath
(A) Drawing room : Kitchen
(B) River : Riverbank
(C) Box : Lock
(D) Window : Shutter

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

2. What is the total weight of 25 discs?
Statements:
I. Two-fifth of the weight of a disc is 13 kg.
II. The weights of no two discs are equal.
(A) Statement I alone is sufficient.
(B) Statement II alone is sufficient.
(C) Combining I and II sufficient.
(D) Both statements I and II together are not sufficient.

3. A function $f(x)$ is linear and has a value of 50 at $x = -4$, and a value of 6 at $x = 7$. The value of the function at $x = 8$ is _______.

***Directions for question* 4:** Fill in the blank with the correct idiom or phrase:

4. An upholder of the truth will never hesitate ________.
(A) to let the grass grow under one's feet
(B) to see red
(C) to throw in the towel
(D) to call a spade a spade

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

5. The five corporate offices of HUL are located in five metros namely A, B, C, D and E. E is 5 km to the North-east of A, and is 2 kms to the South-east of B. D is 5 km to the North-east of B. DE = ______.
(A) 6.92 km (B) 29 km
(C) 47.27 km (D) 5.39 km

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

6. (A) In the olden days, people used to worship the nature.
(B) In the olden days, people used to be worshipping nature.
(C) In the olden days, people worshipped nature.
(D) In the olden days, people used to be worshipping the nature.

Directions for question 7: Read the following paragraph and choose the correct statement:

7. One can understand, although one cannot excuse, a frightened person misbehaving, even though there was no real reason for his fright. But what amazed and angered India was the contemptuous justification of the deed when General Dyer, who had been responsible for the firing at Amritsar, and his subsequent barbarous neglect of the thousands of wounded. "That was none of my business," he had said. Some people in England and in the British government mildly criticized Dyer, but the general attitude of the British people was displayed in a debate at the House of Lords, in which praise was showered on him. All this fed the flame of wrath in India, and a great bitterness rose all over the country.
(A) General Dyer is an example of a frightened person misbehaving.
(B) The general attitude of the British people was displayed in the fact that the victims of the massacre received a fair trial.
(C) When the British government saw a great movement uprising in India, their fears grew.
(D) General Dyer's actions can neither be understood nor excused.

Directions for questions 8: The following question is based on a short argument, a set of statements, or a plan of action. For each question, select the best answer from the given choices.

8. The coolant Freon used in refrigerators was found to damage the ozone layer of the earth. Hence an urgent need was felt to substitute Freon with some other coolant which will not damage the ozone layer.
Which of the following can be a direct inference from the above statements?
(A) A coolant cheaper than Freon is available for use in the refrigerator.
(B) Coolants which do not have any damaging effects are available for use in the refrigerators.
(C) The ozone layer is on the verge of extinction.
(D) Preserving the ozone layer intact is essential for the inhabitants of the earth.

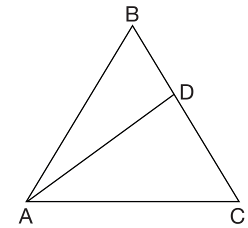
***Directions for question* 9:** In the following question, the first and the last sentence of a passage are in order and numbered 1 and 6. The rest of the passage is split into 4 parts and numbered 2, 3, 4 and 5. These 4 parts are not arranged in the proper order. Read the sentences and arrange them in a logical sequence to make a passage and choose the correct sequence from the given options.

9. 1. Upon the same tree there are two birds of beautiful plumage, most friendly to each other.
2. This is the picture of the human soul.
3. One of the birds is eating fruits noisily while the other is sitting calm and silent without eating.
4. But the other one on top is calm and majestic.
5. The one on the lower branch is eating sweet and bitter fruits and is becoming sad and happy by turns.
6. Man is eating sweet and bitter fruits of this life, pursuing gold, sensory pleasures and the vanities of life so he is immersed in sorrow.

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

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

10.



In triangle ABC, AD is the angle bisector of $\angle BAC$. $\angle CAD = 60°$ $AB = 10$ cm and $CA = 12$ cm. Find the length of AD.

(A) 5 cm (B) 5.45 cm
(C) 4.55 cm (D) 4.03 cm

ELECTRONICS AND COMMUNICATION ENGINEERING

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

11. If 10 apples are to be distributed among Mahesh, Naresh and Ramesh, then the probability that Mahesh and Naresh together get exactly 7 apples is ______________

(A) $(2/3)^{10}$ (B) $15 \times \left(\frac{2}{3}\right)^{10}$
(C) $5 \times \left(\frac{2}{3}\right)^{10}$ (D) $3 \times \left(\frac{2}{3}\right)^{10}$

12. If $z = x + iy$ and $i = \sqrt{-1}$, then the period of the complex function $f(z) = e^z$ is __________

(A) π (B) πi
(C) 2π (D) $2\pi i$

13. The value of the definite integral $\int_1^5 \frac{\sqrt{x+5}}{\sqrt{x+5}+\sqrt{11-x}}dx$ is _______

14. If $3\frac{dy}{dx} - 2\frac{y}{x} = 0$ with $y(1) = 2$, then $y\left(2\sqrt{2}\right)$ is _________

15. The iterative formula to find the 5th root of a positive real number 'R' by Newton-Raphson method is __________

(A) $x_{K+1} = \frac{x_K^5 + R}{x_K^4}$ (B) $x_{K+1} = \frac{5x_K^4 + R}{4x_K^5}$
(C) $x_{K+1} = \frac{4x_K^5 + R}{5x_K^4}$ (D) $x_{K+1} = \frac{4x_K^5 - R}{x_K^4 + R}$

16. A Ge diode carries a current of 1.5 mA at room temperature when a forward bias of 0.2 V is applied. Then the reverse saturation current at room temperature is (in μA) _______.

17. In a common base configuration, the emitter current is 1.5 mA. The collector current with emitter circuit open is 8 μA. Then the total collector current is ______ mA. (Consider $\beta = 99$)

18. Calculate breakdown power of a circular waveguide which is excited by dominant mode at 10 GHz. Diameter of waveguide is 6cm.

(A) 10.29 kW (B) 15.4 kW
(C) 13.2 kW (D) 12.32 kW

19. A rectangular wave guide 2.5 cm × 1.8 cm carries an unknown signal in the dominant mode. If the characteristic impedance of dominant mode is 250 Ω. Then find frequency of the signal?

(A) 6 GHz (B) 4.48 GHz
(C) 8 GHz (D) 5.3 GHz

20. In a loss less dielectric for which $\eta = 40\ \pi\Omega$ and $E = 0.3 \cos(\omega t - z)a_x - 0.8\sin(\omega t - z)\ \hat{a}_y\ V/m$, then find frequency of wave propagation.

(A) 10^8 Hz (B) 3×10^8 Hz
(C) 30 MHz (D) 15.9 MHz

21. For the signal $f(t) = 3\sin 6\pi t + 4\sin 8\pi t + 8\cos 18\pi t$. If the sampling rate is 1.5 times of the Nyquist rate, then the sampling rate of the signal is (in samples/sec) ______

22. For an anti-causal signal and if the line $R_e(s) = \sigma_o$ is in the ROC, then ROC of the signal bilateral laplace transform is _____

(A) The entire S-plane
(B) $R_e(s) < \sigma_o$
(C) $R_e(s) > \sigma_o$
(D) A parallel strip containing the $j\omega$ axis.

23. Fourier Series coefficients of a signal $x(t)$ are given as –

$$C_2 = \frac{1}{\sqrt{3}}\ (2 + j)$$

$C_{-2} = \frac{1}{\sqrt{3}}\ (2 - j)$

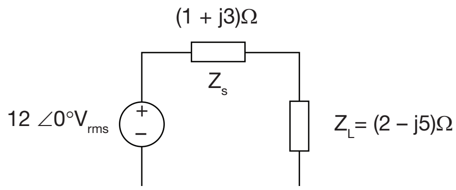
$C_n = 0$ otherwise

The power of the signal $x(t)$ is

(A) 2W (B) 1W

(C) 3W (D) 3.33W

24. Consider the circuit shown in below

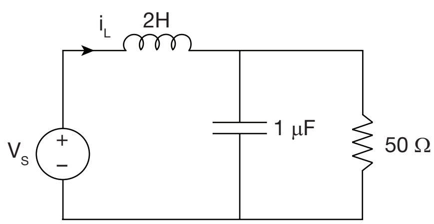


The reactive power consumed by the load Z_L is ______.

(A) 55 VAR (B) 50 VAR

(C) 48.5 VAR (D) 5.32 VAR

25.



If $V_S = 5 + 10u(t)$, then the value of $\frac{di_L}{dt}$ at $t = 0^+$ is ________ A/S.

26. A_{vmid} is mid frequency gain of RC coupled Transistor Amplifier. f_H is higher cutoff frequency. Higher frequency gain of RC coupled Transistor Amplifier is

(A) $\frac{A_{vmid}}{\sqrt{1+(\frac{f_H}{f})^2}}$ (B) $A_{vmid}\sqrt{1+(\frac{f_H}{f})^2}$

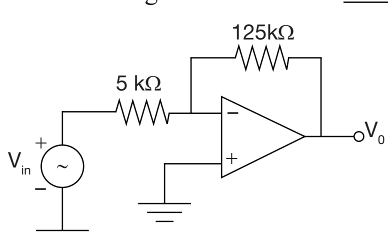
(C) $\frac{A_{vmid}}{\sqrt{1+(\frac{f}{f_H})^2}}$ (D) $A_{vmid}\cdot\sqrt{1+\left(\frac{f}{f_H}\right)^2}$

27. In high frequency amplifier, if frequency increases. Current gain A_i

(A) increases (B) reduces

(C) no changes (D) None of the above

28. The output offset voltage of the circuit is ______mV.



Consider the op-amp input offset voltage $V_{IO} = 1.5$ mV.

29. The address lines A_{15} to A_{10} of 8085 microprocessor are connected to the active High chip select line of a 1024 Byte EEPROM through NOR gate. Its memory map ranges from 0000 to

(A) 03FFH (B) 01FFH

(C) 00FFH (D) 02FFH

30. A semiconductor RAM has 16 bit address register and an 8 bit data register. The total number of bits in the memory is

(A) 1, 0 2 4 bits (B) 4, 0 9 6 bits

(C) 5, 2 4,2 8 8 bits (D) 10, 48, 5 7 6 bits

31. Which of the following are the effects of addition of poles?

(1) The break point shifted towards the imaginary axis

(2) Relative stability decreases

(3) Rise time decreases

(4) the damping ratio increase.

(A) 1 and 2 only (B) 2 , 3 and 4 only

(C) 1 , 2 and 3 only (D) 1 , 2 and 4 only

32. Match list – I (plot/model) with list – II (Related parameter) and select the correct answer using the codes given below:

List-I		**List - II**	
w	Bode plot	1	Transmittance
x	Root locus	2	Critical point
y	Nyquist plot	3	Break point
z	signal flow graph	4	Corner frequency
		5	ω_{pc}

(A) w–5; x–3; y–2; z–4 (B) w-4, x-3, y-2, z-1

(C) w–4, x–2, y–3, z–1 (D) w-5, x-2, y-3, z-1

33. The response $y(t)$ of a linear system to an excitation of $x(t) = e^{-3t}.u(t)$ is $y(t) = (3t + 1).\ e^{-2t}.u(t)$ then the poles and zeros of the transfer function would be _______ respectively.

(A) –3, –5 and –2, –2 (B) –2, –3 and –1, –5.

(C) –3, –2 and –2, –5 (D) –2, –2 and –3, –5

34. Inter symbol interferences (ISI) occurs due to

(A) Insufficient power (B) Image frequencies

(C) Redundancy. (D) Insufficient bandwidth

35. An audio signal consisting of the sinusoidal waveform given as $x(t) = 5\cos(800\pi t)$. The SNR when this is quantized by using 8 – bit PCM encoder is ______dB.

36. If $P = \begin{bmatrix} 2 & 131 & -243 & 566 \\ 0 & -2i & 174 & -237 \\ 0 & 0 & 2i & 0 \\ 0 & 0 & -713 & -2 \end{bmatrix}$ then which of the following is equal to 16 P^{-1}, where P^{-1} is the inverse of the matrix P?

(A) P^2 (B) $P^2 + 16P$
(C) P^3 (D) $P^3 + 16P^2 + P$

37. In a PSU (Public Sector Undertaking), if an employee is selected at random, then
(i) Probability that the employee has a Two Wheeler (TW) or a Four Wheeler (FW) is $\frac{7}{10}$
(ii) Probability that the employee has both a TW and a FW is $\frac{2}{5}$ and
(iii) Probability that the employee has a TW given that the employee has a FW is $\frac{2}{3}$.

Then the probability that the randomly selected employee has a TW is ______

(A) $\frac{3}{5}$ (B) $\frac{1}{2}$
(C) $\frac{1}{3}$ (D) $\frac{1}{4}$

38. The number of distinct stationary points of the function $f(x, y) = x^4 + y^4 - x^2 - y^2 + 1$ is __________
(A) 3 (B) 4
(C) 7 (D) 9

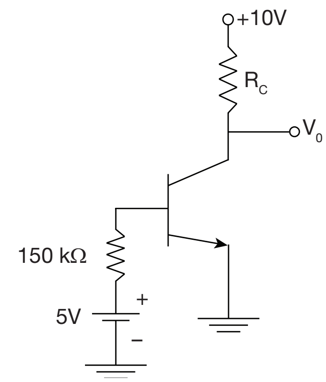
39. The line integral $\int[(2x + y^2)dx + (3y - 4x)dy]$, when evaluated along a line segment from (0, 0) to (2, 1) is equal to ______

40. Which of the following two statements is/are TRUE?
P: If $f(x)$ is continuous in $[a, b]$ then $f(x)$ assumes every value between $f(a)$ and $f(b)$
Q: If a function $f(x)$ assumes every value between $f(a)$ and f(b), then $f(x)$ is continuous in $[a, b]$.
(A) P only
(B) Q only
(C) Both P and Q
(D) Neither P nor Q

41. The silicon crystal having donor concentration of $1.5 \times 10^{22}\ m^{-3}$, when the intrinsic carrier concentration is 1.5×10^{10} per cm^3. The ratio of electron to hole concentration is ______.
(A) 1.25×10^4 (B) 1×10^{12}
(C) 2.25×10^8 (D) 1.5×10^4

42. Consider a p-channel E-MOSFET with $k_p^1 = 60\ \mu A/V^2$.
The device has the following observations:
$I_D = 0.3$ mA at $V_{SG} = V_{SD} = 2$ V
$I_D = 1.5$ mA at $V_{SG} = V_{SD} = 4$ V
Then the value of threshold voltage $|V_{TP}|$ is ________ volts.

43. A Si transistor with $V_{BE(Sat)} = 0.8$ V, $\beta = 90$, $V_{CE(sat)} = 0.3$V is used in circuit shown below.



The value of R_C for which the transistor remains in saturation region is _____.
(A) 3.5 kΩ (B) 4 kΩ
(C) 3.2 kΩ (D) 2.5 kΩ

44. Find the total magnetic flux crossing the surface $0 < \phi < \frac{\pi}{6}$, $0 < \rho < 2$m, $z = 4$m. If magnetic vector potential $\vec{A}$ is $\frac{+\rho^2}{5}\ \hat{a}_\varphi$.

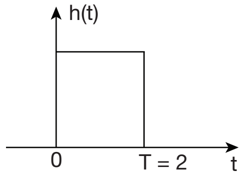
(A) $\frac{6}{5}$Wb (B) $\frac{4\pi}{15}$Wb
(C) $\frac{2\pi}{15}$Wb (D) $\frac{24}{5}$Wb

45. Find curl of electric field intensity where magnetic field at a point is 200sin 120 πt $\hat{a}_z$ A/m.
(A) –200 cos 120 πt $\hat{a}_z$ mV/m
(B) –94.24 cos 120 πt $\hat{a}_z$ mV/m
(C) –0.53 sin 120 πt $\hat{a}_z$ mV/m
(D) –78 sin 120 πt $\hat{a}_z$ mV/m

46. A rectangular wave guide of dimensions $a \times b$ has a cut-off frequency of 7.5 GHz for TE_{01} mode. For the same wave guide, if the cut-off frequency of the TM_{11} mode is 9.6 GHz, the cutoff frequency of the TE_{10} mode is ________GHz.

47. If the finite length input $x[n]$ and corresponding finite length output, $y[n]$ of an LTI system is given. The impulse response of the system is _____
$x[n] = [2, -2]$
$y[n] = [2, 0, 0, -2]$
(A) [1, 1, 1] (B) [1, 0, 0, 1]
(C) [1, 1, 1, 1] (D) [1, 0, 1]

48. An LTI system is excited by an input $x(t)$ given as $x(t) = \delta(t-2) + \delta(t-4)$, If the impulse response is given as

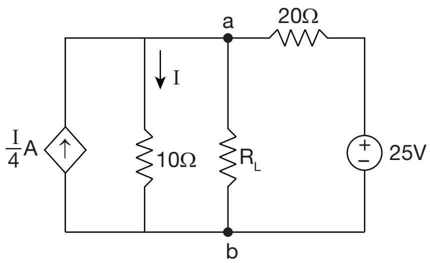


Then the output $y(t)$ will be ____

(A) $u(t-2) - u(t-6)$ (B) $u(t-2) + u(t-6)$

(C) $u(t-2) - u(t-4)$ (D) $u(t-2) + u(t-4)$

49. Consider the network shown in figure



The Norton's equivalent model of the circuit across R_L is ______.

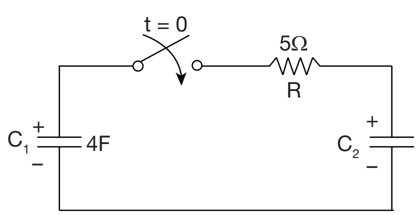
(A) $I_N = 1.25\ A$ and $R_N = 8\Omega$

(B) $I_N = 0.8\ A$ and $R_N = 8\Omega$

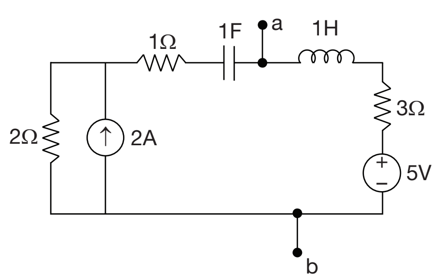
(C) $I_N = 1.25\ A$ and $R_N = 6\Omega$

(D) $I_N = 0.8\ A$ and $R_N = 6\Omega$

50. In the circuit shown the initial voltages across the capacitors C_1 and C_2 are 2V and 4V respectively. The switch is closed at time $t = 0$. The total energy dissipated (in Joules) in the resistor R until steady state is reached, is ______.



51. The Thevenin equivalent impedance Z_{th} between the nodes 'a' and 'b' in the following circuit is



(A) $Z_{ab} = \dfrac{3S^2 + 10S + 2}{S^2 + 6S + 3}$ (B) $Z_{ab} = \dfrac{3S^2 + 10S + 3}{2S^2 + 3S + 1}$

(C) $Z_{ab} = \dfrac{S^2 + 4S + 3}{S^2 + 6S + 1}$ (D) $Z_{ab} = \dfrac{3S^2 + 10S + 3}{S^2 + 6S + 1}$

52. A capacitor of 80 μF stores 6 mJ of energy. How much time required, if the charging current is 0.1A?

(A) 9.8 ms (B) 4.9 ms

(C) 2.5 ms (D) 5.6 ms

53. Three signals $x_1[n]$, $x_2[n]$ and $x_3[n]$ are given as _____

$$x_1[n] = \cos\left(\frac{4\pi n}{20}\right)$$

$$x_2[n] = \sin\left(\frac{2\pi n}{25}\right)$$

$$x_3[n] = e^{j\frac{4\pi n}{40}}$$

The signal $y[n] = x_1[n] + 2x_2[n] + 3x_3[n]$ is

(A) aperiodic

(B) periodic with period of 25 sec

(C) periodic with period of 100 sec

(D) periodic with period of 10 sec

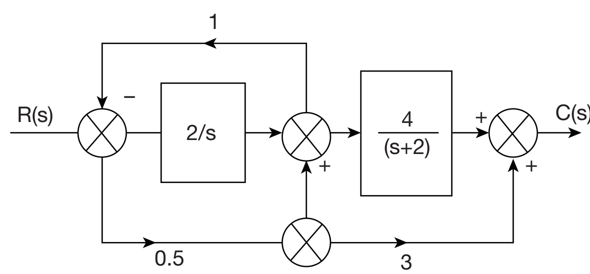
54. A memoryless discrete source produces symbols with probabilities {0.40, 0.20, 0.12, 0.10, 0.08, 0.04, 0.03, 0.02, 0.01} the expected codeword length for the code is

(A) 2.57 bits/symbol (B) 2 bits/symbol

(C) 2.32 bits/symbol (D) 1.91 bits/symbol

55. Bandwidth of the modulating signal is 4kHz. Amplitude of the input varies form –4.0V to +4.0V and has average power is 50mW, the required SNQR is 30dB. For uniform quantization the number of bits/sample required is _________.

56. For the block diagram shown in below



The transfer function of the system is

(A) $\dfrac{(s+2)(1.5s+1)}{(1.5s^2+5s+4)}$ (B) $\dfrac{(s+2)}{(1.5s^2+8s+14)}$

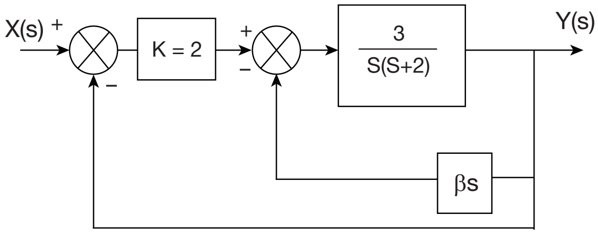
(C) $\dfrac{\left(1.5s^2+5s+8\right)}{\left(1.5s^2+5s+4\right)}$ (D) $\dfrac{(3.5s+11)}{(1.5s^2+5s+4)}$

57. $$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 2 & 1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \text{u}$$

For the system described by the state equation, If the control signal is given by $u = [-0.5\ , -2\ , 1]\ x + v$, then the eigen values of the closed loop system will be

(A) –2.46 , 1.7 , –0.24 (B) –0.24 , –1.7 , 2.4
(C) –0.24 , –1.7 , (D)–2.46 , 1.7 , 0.24 , –2.4

58. Consider the block diagram shown in figure



if the damping ratio of the system is equal to 0.5 , then the value of β is …….

59. In a PCM system, the analog samples are represented by 0.4% of accuracy, minimum number of quantization levels required are ________
(A) 62.5 levels (B) 125 levels
(C) 250 levels (D) 500 lelvels

60.

x	y	z	F(x, y, z)
0	0	0	1
0	0	1	X
0	1	0	0
0	1	1	0
1	0	0	X
1	0	1	0
1	1	0	1
1	1	1	1

The number of 2 input NOR gates are required to implement the function $F(x, y, z)$ is______.

61. Consider the following program intended to transfer a block of 16 bytes starting from 2010H to 3010H.

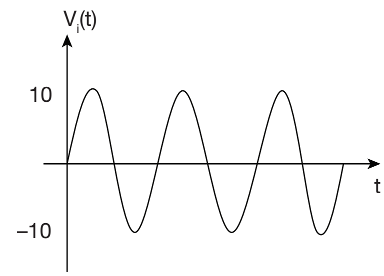
```
START :    LXI B, 3010H
LXI H, 2010H
MVI C, 10H
LOOP:      MOV A, M
STAX B
INX B
INX H
DCR C
JNZ LOOP
HLT
```

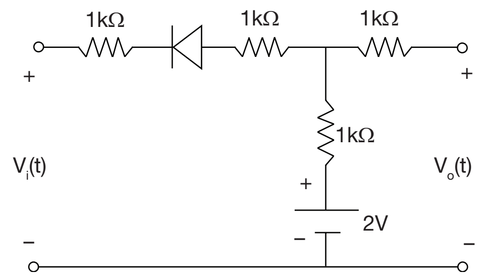
The above program will not work because,
(A) MVI C, 10H will copy 10 locations.
(B) DCR C, instruction do not effect zero flag
(C) JNZ instruction is used instead of *JZ*
(D) *C* register is used as counter.

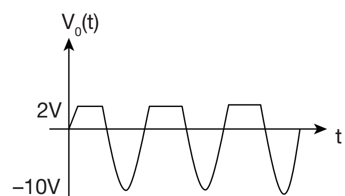
62. Let $f(w, x, y, z) = \sum m(0, 2, 5, 6, 7, 8, 9, 10, 11, 13, 15)$ which of the following expressions are not equivalent to f?
(P) $w^1x^1z^1 + w^1yz^1 + xz + wx^1$
(Q) $x^1z^1 + wz + xz + w^1x$
(R) $wz + xz + x^1z^1 + w^1yz^1$
(S) $x^1z^1 + xz + w^1xy + wx^1$

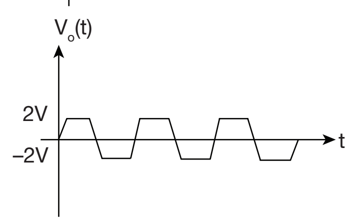
(A) *P* and *Q* (B) *R* only
(C) *Q* and *S* (D) *Q* only

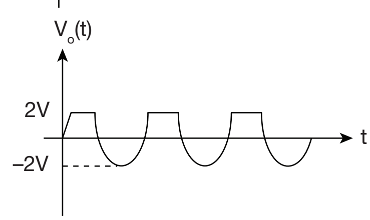
63. *A* 10 sinωt signal excited to a given circuit in the shown figure, the output waveform in the following is





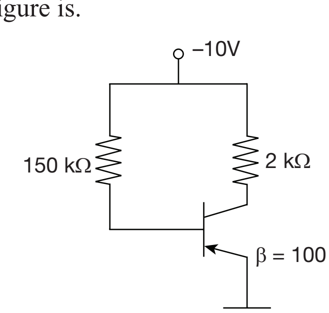
(A)


(B)


(C)


(D) None of these

64. The region of operation of the transistor in the circuit shown in figure is.



(A) Active region
(B) Saturation region
(C) Cut off region
(D) Reverse active region

65. A single stage *RC* coupled amplifier has a mid band gain of 1000 is made into a negative feedback amplifier by feeding 10% of the output voltage in series with input opposing. The ratio of the lower half power frequencies with feedback to those without feedback is

(A) 0.099 (B) 0.99
(C) 0.0099 (D) None of these

Answer Keys

1. B	**2.** D	**3.** 2	**4.** D	**5.** D	**6.** C	**7.** D	**8.** D	**9.** B	**10** B
11. B	**12.** D	**13.** 2	**14.** 4	**15.** C	**16.** 0.6 to 0.7		**17.** 1.3 to 1.5		**18.** B
19. D	**20.** D	**21.** 26 to 28		**22.** B	**23.** D	**24.** A	**25.** 4.5 to 5.5		**26.** C
27. B	**28.** 38 to 40		**29.** A	**30.** C	**31.** D	**32.** B	**33.** D	**34.** D	
35. 49 to 50		**36.** C	**37.** B	**38.** D	**39.** 2.15 to 2.18		**40.** A	**41.** B	
42. 0.35 to 0.4		**43.** B	**44.** B	**45.** B	**46.** 5.8 to 6.2		**47.** A	**48.** A	**49.** A
50. 2.5 to 3		**51.** D	**52.** A	**53.** C	**54.** A	**55.** 9	**56.** C	**57.** A	
58. 0.13 to 0.16		**59.** C	**60.** 4	**61.** D	**62.** D	**63.** C	**64.** B	**65.** A	

Hints and Explanations

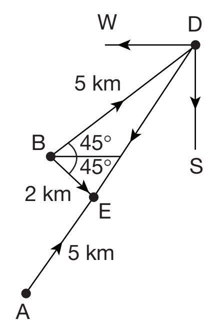
1. Choice (*B*) is correct. A footpath runs along the road on either side. Similarly, a riverbank runs along the river on either side. Choice (B)

2. I.2/5th of the weight of a single disc is 13 *kg*. But we don't know if each disc has the same weight or not. I alone is not sufficient.
We do not know the weight of each disc.
∴ We cannot find the total weight of 25 discs.
II alone is not sufficient
I, II we still cannot answer the question.
Choice (D)

3. Let $f(x) = ax + b$ where a and b are constants.
$f(-4) = 50$ and $f(7) = 6$
$-4a + b = 50$ …… (1)
$7a + b = 6$ …… (2)
$-11a = 44$
$a = -4$
Substituting in (1), we get
$16 + b = 50$
$\Rightarrow b = 34$
$\therefore f(x) = -4x + 34.$
When $x = 8$
$f(x) = -4(8) + 34 = -32 + 34 = 2$
$\therefore f(8) = 2.$ Ans:2

4. The right choice is "to call a spade a spade" which means to speak very frankly and openly. None of the other options go as they are negative in connotation. "To see red" is to be afraid, "to throw in the towel" is to accept defeat and "to let the grass grow under one's feet" is to idle too long without any work. Choice (D)

5.



$\angle B = 90°$

$DE = \sqrt{DB^2 + BE^2} = \sqrt{5^2 + 2^2}\text{km} = \sqrt{29}\text{km}$

≈ 5.39 km. Choice (D)

6. "Nature" is not preceded by "the" so choices (*A*) and (*D*) are ruled out. In (*B*) the tense is incorrect for a completed action. Choice (C) uses the simple past tense for a completed action and it is correct.
Choice (C)

7. All the statements except (*D*) can be proved false by the passage itself. (*A*) is not what General Dyer was. Statement (*B*) too is a distortion of what is stated in the passage. The passage does not state that the victims got a fair trial. In fact, the trial was a travesty of justice and the public supported general Dyer's actions. Statement (*C*) is out of the scope of the text. Statement (*D*) is correct as understood from the first two lines of the passage. General Dyer was not a frightened person misbehaving so his actions can neither be understood nor excused. Choice (D)

8. Freon damages ozone layer. A need is felt to substitute Freon with some other coolant. This means that damage to ozone layer is harmful. Hence (*D*) is the correct answer.
As the cost is not the focus of the argument, (*A*) is wrong. (*B*) and (*C*) cannot be inferred. Choice (D)

9. Choice (*B*) is apt. The para, when rearranged, is the story of human life, metaphorically presented. 1 mentions two birds. In 3 both are described as "one" eating and the other not eating. 5 follows next as it tells as to what is being eaten, and more importantly, where it is sitting. 4 is a continuation of 5 as it tells the position of the other bird. So 5 and 4 is a definite pair. 2 is then concluding the analogy. 6 explains why it is the story of the human soul. Choice (B)

10. Area of triangle *ABC* = Area of *ABD* + Area of *ADC*
$\frac{1}{2}(AB)(AC)\sin\angle A = \frac{1}{2}(AB)(AD)\sin\angle BAD + \frac{1}{2}$
$(AD)(AC)\sin\angle DAC = (AB)(AC)\sin 120°$
$= (AB)(AD)\sin 60° + (AD)(AC)\sin 60°$
$$AD = \frac{(AB)(AC)\sin 120°}{AB\sin 60° + AC\sin 60°}$$
$$= \frac{(AB)(AC)}{AB+AC} = \frac{60}{11} = 5.45 \text{ cm.}$$ Choice (B)

11. Total number of ways of distributing 10 apples among three persons Mahesh, Naresh and Ramesh = 3^{10}
Mahesh and Naresh together has to get exactly 7 apples
$\Rightarrow$ Mahesh and Naresh together gets 7 apples and Ramesh gets 3 apples
The number of ways of selecting 7 apples from 10 to distribute to Mahesh and Naresh = ${}^{10}C_7$
The number of ways of distributing these 7 apples to Mahesh and Naresh = 2^7
$\therefore$ The total number of ways of distributing 10 apples among the three persons such that Mahesh and Naresh together get 7 apples = ${}^{10}C_7 \times 2^7$
$\therefore$ Required probability = $\frac{{}^{10}C_7 \times 2^7}{3^{10}}$
$$= \frac{\frac{10!}{3!\times 7!}\times 2^7}{3^{10}} = 15 \times \left(\frac{2}{3}\right)^{10}$$ Choice (B)

12. We have $e^z = e^{x+iy} = e^x(\cos y + i\sin y)$
$= e^x[\cos(y+2\pi) + i\sin(y+2\pi)]$
$= e^x \cdot e^{i(y+2\pi)}$
$= e^{x+iy+2\pi i} = e^{z+2\pi i}$
$\therefore$ e^z is a periodic function with period $2\pi i$.
Choice (D)

13. We have $\int_1^5 \frac{\sqrt{x+5}}{\sqrt{x+5}+\sqrt{11-x}}dx$
$$= \int_1^5 \frac{\sqrt{x+5}}{\sqrt{x+5}+\sqrt{(1+5-x)+5}}dx = \frac{5-1}{2}$$
$\left(\because \int_a^b \frac{f(x)}{f(x)+f(a+b-x)}dx = \frac{b-a}{2}\right.$ and here
$f(x) = \sqrt{5+x}$; a = 1 and $b = 5) = 2$ Ans: 2

14. Given differential equation is $3\frac{dy}{dx} - 2\frac{y}{x} = 0$ $\rightarrow$ (1)
Also given $y(1) = 2$
$$3\frac{dy}{dx} - 2\frac{y}{x} = 0$$
$$\Rightarrow 3\frac{dy}{dx} = 2\frac{y}{x}$$
$$\Rightarrow \frac{3}{y}dy = \frac{2}{x}dx$$
Integrating on both sides, $\int\frac{3}{y}dy = \int\frac{2}{x}dx$
$\Rightarrow$ $3\ell n\, y = 2\ell n\, x + \ell n\, c$
$\Rightarrow$ $\ell n y^3 = \ell n\, x^2 + \ell n\, c$
$\Rightarrow$ $\ell n y^3 = \ell n c x^2$
$\Rightarrow$ $y^3 = cx^2$ $\rightarrow$ (2)
Given $y(1) = 2 \Rightarrow y = 2$ at $x = 1$
$\therefore$ From (2), $2^3 = c \times 1^2 \Rightarrow c = 8$
Substituting in (2), we get a solution of (1) as
$y^3 = 8x^2 \Rightarrow y = (8x^2)^{1/3} = 2x^{2/3}$
$\therefore$ $y\left(2\sqrt{2}\right)$ is y at $x = 2\sqrt{2}$
$$y = 2\left(2\sqrt{2}\right)^{\frac{2}{3}} = 2\times 2$$
$\therefore$ $y = 4$ Ans: 4

15. We have to find the 5th root of '*R*'
i.e., we have to find x such that $x = \sqrt[5]{R}$
$\Rightarrow$ $x^5 = R$
Let $f(x) = x^5 - R = 0$
$\Rightarrow$ $f'(x) = 5x^4$
$\therefore$ By Newton-Raphson method, we have
$$x_{K+1} = x_K - \frac{f(x_K)}{f'(x_K)}$$
$$= x_K - \frac{\left(x_K^5 - R\right)}{5x_K^4}$$
$$= \frac{5x_K^5 - x_K^5 + R}{5x_K^4}$$
$$\therefore\ x_{K+1} = \frac{4x_K^5 + R}{5x_K^4}$$ Choice (C)

16. $I = I_o.(e^{\frac{V}{\eta V_T}} - 1)$
For Ge $\eta = 1$
$1.5 \times 10^{-3} = I_o\{e^{0.2/0.026} - 1\}$
$I_o = 6.84 \times 10^{-7} A = 0.684\ \mu A$ Ans: 0.6 to 0.7

17. $I_C = \alpha I_E + I_{Co}$

$I_E = 1.5$ mA

$I_{CEO} = 8\ \mu A\ ;\ I_{CO} \approx 0$

$$\alpha = \frac{\beta}{1+\beta} = \frac{99}{100} = 0.99$$

$I_C = 0.99 \times 1.5 \times 10^{-3} + 0$

$= 1.485$ mA Ans: 1.3 to 1.5

18. Dominant mode of circular waveguide TE_{11}

$$\lambda_{C_{11}} = \frac{\pi \times 6}{1.841} = 10.23cm$$

$$(P_{bd})_{TE_{11}} = 1790a^2\left[1-\left(\frac{\lambda_0}{\lambda_{C_{11}}}\right)^2\right]^{\frac{1}{2}}$$

$$\Rightarrow \lambda_0 = \frac{3\times 10^{10}}{10^{10}} = 3$$

$$(P_{bd})_{TE_{11}} = 1790 \times 3^2\left[1-\left(\frac{3}{10.23}\right)^2\right]^{\frac{1}{2}}$$

$= 15.401$ kW Choice (B)

19. Mode : TE_{10}, $Z_{TE} = 250\Omega$

$$Z_{TE} = \frac{\eta}{\sqrt{1-\left(\frac{f_c}{f}\right)^2}}$$

$$f_c = \frac{c}{\lambda_c} = \frac{c}{2a} = 6 \text{ GHz}$$

$c = 3 \times 10^{10}$ cm/s

$\lambda_c = 2a$

$f = 5.32$ GHz Choice (D)

20. $\eta = 40\,\pi = \dfrac{\eta_0}{\sqrt{\varepsilon_r}}$

$$\sqrt{\epsilon_r} = \frac{120\pi}{40\pi} = 3$$

$\Rightarrow$ $\varepsilon_r = 9$

$\beta = \omega\sqrt{\mu\varepsilon}$

From the field equation $\beta = 1$

$$\Rightarrow \frac{1}{\sqrt{\mu_0\mu_r\varepsilon_0\varepsilon_r}} = \omega$$

$$= \frac{C}{\sqrt{\varepsilon_r}} = \omega = \frac{3\times 10^8}{3} = 10^8\, rad/\sec$$

$$f = \frac{10^8}{2\pi} = 15.9 \text{ MHz}$$ Choice (D)

21. $f(t) = 3\ \mathrm{Sin}6\pi t + 4\ \mathrm{Sin}8\pi t + 8\ \mathrm{Cos}18\pi t$

maximum frequency component present in $f(t) = 9$ Hz

So Nyquist frequency $= 2 \times 9 = 18$ Hz

Sampling rate $= 1.5 \times$ Nyquist rate

$= 1.5 \times 2 \times 9$ samples/sec

$= 27$ samples/sec Ans: 26 to 28

22. For a left side signal the all value of S for which $R_0(s) < \sigma_o$ will be the ROC. Choice (B)

23. From Parseval's theorem

$$P_x = \sum_{n=-\infty}^{+\infty} |C_n|^2$$

$$= |C_2|^2 + |C_{-2}|^2$$

$$= \frac{1}{3}\times 5 + \frac{1}{3}\times 5 = 3.33$$ Choice (D)

24. From the given circuit

$$I = \frac{12}{3-j2} = 2.769 + j1.846$$

$= 3.32\ \angle\ 33.69^o$ Amp

$I_{rms} = 3.32\ A$

Reactive power $Q = I_{rms}^2 . X_C = 11(5)$

$= 55$ VAR (Leading) Choice (A)

25. **For t < 0:**

At t = 0^-, $V_s = 5$V, circuit is in steady state

In $S.S$ $L \rightarrow$ short circuit

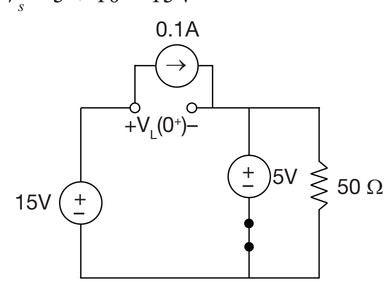
$C \rightarrow$ open circuit

$$\therefore\quad i_L(0^-) = \frac{5}{50} = 0.1\ A$$

$V_C(0^-) = 50 \times 0.1 = 5$V

For t > 0:

at $t = 0^+$; $V_s = 5 + 10 = 15$V



$15 - V_L(0^+) - 5 = 0$

$V_L(0^+) = 10$V

We know $V_L = L.\dfrac{di_L}{dt}$

$\therefore$ at $t = 0^+$

$$\frac{di_L}{dt} = \frac{V_L(0^+)}{L} = \frac{10}{2}\text{ A/sec}$$

$$\frac{di_L}{dt} = 5\ A/\text{sec}$$ Ans: 4.5 to 5.5

26. $A_{high} = \dfrac{A_{vmid}}{\sqrt{1+\left(\frac{f}{f_H}\right)^2}}$ Choice (C)

27. Choice (B)

28. $V_{\cdot}(\text{offset}) = \left(1+\frac{R_f}{R_1}\right)V_{IO}$

$= (1 + 25) \times 1.5$ mV

$= 39$ mV Ans: 38 to 40

29.

A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	$A_7 \ldots A_0$	
0	0	0	0	0	0	0	0	0…..	$0 = 0000_H$
0	0	0	0	0	0	1	1	1….	$1 = 03FF_H$

Memory map range = $0000_H - 03FF_H$ Choice (A)

30. Memory is specified as $(2^{Addr} \times \text{data})$ bits

So $2^{16} \times 8$ bits = 5, 24, 288 bits Choice (C).

31. Choice (D).

32. Bode plot → corner frequency

Root locus → break point

Nyquist plot → critical point

signal flow graph – transmittance. Choice (B)

33. Apply the laplace transform to $x(t)$ and $y(t)$

$$X(s) = \frac{1}{s+3}$$

$$Y(s) = \frac{1}{s+2} + \frac{3}{(s+2)^2} = \frac{(s+5)}{(s+2)^2}$$

$$\therefore \quad \frac{Y(s)}{X(s)} = \frac{\frac{(s+5)}{(s+2)^2}}{\frac{1}{(s+3)}} = \frac{(s+3)(s+5)}{(s+2)^2}$$

∴ Poles –2, –2 and zeros –3, –5. Choice (D)

34. Choice (D)

35. $x(t) = 5\cos(800\pi t)$

$\frac{S}{N} = 1.8 + 6N$

$N = 8$

$\frac{S}{N} = 1.8 + 6 \times 8 = 1.8 + 48$

$= 49.8$dB Ans: 49 to 50

36. Given $P = \begin{bmatrix} 2 & 131 & -243 & 566 \\ 0 & -2i & 174 & -237 \\ 0 & 0 & 2i & 0 \\ 0 & 0 & -713 & -2 \end{bmatrix}$

The characteristic equation of P is $|P - \lambda I| = 0$

$$\Rightarrow \begin{vmatrix} 2-\lambda & 131 & -243 & 566 \\ 0 & -2i-\lambda & 174 & -237 \\ 0 & 0 & 2i-\lambda & 0 \\ 0 & 0 & -713 & -2-\lambda \end{vmatrix} = 0$$

$\Rightarrow (2 - \lambda)(-2i - \lambda)(2i - \lambda)(-2 - \lambda) = 0$

$\Rightarrow (2 - \lambda)(2 + \lambda)(2i + \lambda)(2i - \lambda) = 0$

$\Rightarrow (4 - \lambda^2)(-4 - \lambda^2) = 0$

$\Rightarrow -(4 - \lambda^2)(4 + \lambda^2) = 0$

$\Rightarrow 16 - \lambda^4 = 0$

$\Rightarrow \lambda^4 - 16 = 0$

∴ The characteristic equation of P is $\lambda^4 - 16 = 0$

Hence by Cayley – Hamilton theorem, we have

$P^4 - 16I_4 = 0$ → (1)

Where I_4 = Identity matrix of order 4.

Multiplying (1) on both sides with P^{-1}, we have

$P^{-1}(P^4 - 16\, I_4) = P^{-1} \times 0$

$\Rightarrow P^3 - 16\, P^{-1} = 0$

$\Rightarrow 16P^{-1} = P^3$ Choice (C)

37. Let A and B denote the events of a randomly selected employee has a Two Wheeler (TW) and a Four Wheeler (FW) respectively.

$\therefore \quad P(A \cup B) = \frac{7}{10}$, $P(A \cap B) = \frac{2}{5}$ and $P(A/B) = \frac{2}{3}$

We know that $P(A/B) = \frac{P(A\cap B)}{P(B)}$

$\Rightarrow P(B) = \frac{P(A\cap B)}{P(A/B)} = \frac{2/5}{2/3}$

$\Rightarrow P(B) = \frac{3}{5}$

We know that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$\Rightarrow \frac{7}{10} = P(A) + \frac{3}{5} - \frac{2}{5}$

$\Rightarrow P(A) = \frac{7}{10} - \frac{3}{5} + \frac{2}{5}$

$\Rightarrow P(A) = \frac{1}{2}$

Hence probability that a randomly selected employee has two wheeler (TW) = $\frac{1}{2}$

Choice (B)

38. Given function is $f(x, y) = x^4 + y^4 - x^2 - y^2 + 1$

$f_x = \frac{\partial f}{\partial x} = 4x^3 - 2x$ and $f_y = \frac{\partial f}{\partial y} = 4y^3 - 2y$

At a stationary point, $f_x = 0$ and $f_y = 0$

$\Rightarrow 4x^3 - 2x = 0$ and $4y^3 - 2y = 0$

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

$\Rightarrow x = 0$ or $x = \pm\frac{1}{\sqrt{2}}$ and $y = 0$ or $y = \pm\frac{1}{\sqrt{2}}$

∴ The stationary points of $f(x, y)$ are

$(0, 0)$, $\left(0,\frac{1}{\sqrt{2}}\right)$, $\left(0,\frac{-1}{\sqrt{2}}\right)$, $\left(\frac{1}{\sqrt{2}},0\right)$, $\left(\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$, $\left(\frac{1}{\sqrt{2}},\frac{-1}{\sqrt{2}}\right)$, $\left(\frac{-1}{\sqrt{2}},0\right)$, $\left(\frac{-1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$ and $\left(\frac{-1}{\sqrt{2}},\frac{-1}{\sqrt{2}}\right)$.

$\therefore$ The number of distinct stationary points = 9

Choice (D)

39. We have to evaluate $\int\left[(2x+y^2)dx+(3y-4x)dy\right]$

along a line segment from (0, 0) to (2, 1).

The equation of the line joining (0, 0) and (2, 1) is $x = 2y$

$\Rightarrow$ $dx = 2dy$

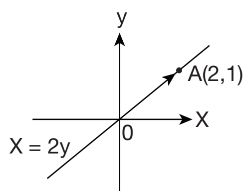
y varies from 0 to 1

$$\therefore \int\left[(2x+y^2)dx+(3y-4x)dy\right]$$

$$= \int_{y=0}^{1}\left[(2(2y)+y^2)2dy+(3y-4(2y))dy\right]$$

$$= \int_0^1\left[8y+2y^2+3y-8y\right]dy$$

$$= \int_0^1(2y^2+3y)dy = \left.\frac{2}{3}y^3+\frac{3}{2}y^2\right]_0^1$$



$$= \frac{2}{3}+\frac{3}{2} = \frac{13}{6} = 2.167$$

Ans: 2.15 to 2.18

40. Statement P is nothing but the intermediate value theorem and hence is TRUE.

Counter Example for statement Q:

Let $f(x) = \begin{cases} x & ; if\ 0 \le x < 1 \\ x-1; & if\ 1 \le x \le 3 \end{cases}$

Then, $f(x)$ assumes every value between $f(0)$ (=0) and $f(3)$ (= 2). But $f(x)$ is not continuous at $x = 1 \in [0, 3]$

$\therefore$ Statement Q is not TRUE.

Choice (A)

41. From the given data

$n \approx N_D = 1.5 \times 10^{22}$ m^{-3}

$n_i = 1.5 \times 10^{16}$ m^{-3}

$n.p = n_i^2$

$$\therefore p = \frac{n_i^2}{N_D} = \frac{n_i^2}{n} = \frac{2.25\times10^{16}\times10^{16}}{1.5\times10^{22}}$$

$p = 1.5 \times 10^{10}$ m^{-3}

$$\frac{n}{p} = \frac{1.5\times10^{22}}{1.5\times10^{10}} = 1\times10^{12}$$

Choice (B)

42. We know for p-channel E–MOSFET, from the given data it is operating in saturation mode

Given $V_{SD} = V_{SG}$

$I_D = k_p^1 .[V_{SG} + V_{TP}]^2$

$$\frac{I_{D_1}}{I_{D_1}} = \frac{[V_{SG_1}+V_{TP}]^2}{[V_{SG_2}+V_{TP}]^2}$$

$$\frac{I_{D1}}{I_{D2}} = \frac{\left[V_{SG1}+V_{TP}\right]^2}{\left[V_{SG2}+V_{TP}\right]^2}$$

$$\frac{0.3}{1.5} = \frac{\left[2+V_{TP}\right]^2}{\left[4+V_{TP}\right]^2}$$

$$\frac{4+V_{TP}}{2+V_{TP}}$$

$-0.472 = 1.236\ V_{TP}$

$|V_{TP}| = -0.3818$ Volts

Ans: 0.35 to 0.4

43. Applying KVL to input loop

$V_{BB} - I_B.R_B - V_{BE(sat)} = 0$

$$I_B = \frac{5-0.8}{150}mA = 28\,\mu A$$

$I_C = \beta.I_B = 2.52$ mA

Applying KVL to the output loop

$V_{CC} - I_C.R_C - V_{CE(sat)} = 0$

$10 - 2.52 \times 10^{-3}.R_C - 0.3 = 0$

$$R_C \ge \frac{9.7}{2.52}k\Omega = 3.9\ k\Omega$$

Choice (B)

44. $\Psi = \int \vec{B}.ds$

$\vec{B} = \nabla \times \vec{A}$

$$\nabla \times \vec{A} = \frac{1}{\rho}\begin{bmatrix} \hat{a}_\rho & \rho\hat{a}_\phi & \hat{a}_z \\ \frac{\partial}{\partial\rho} & \frac{\partial}{\partial\phi} & \frac{\partial}{\partial z} \\ 0 & \frac{+\rho^3}{5} & 0 \end{bmatrix}$$

$$= \frac{1}{\rho}\left[\hat{a}_z\frac{\partial}{\partial\rho}\left(\frac{+\rho^3}{5}\right)\right]$$

$$\vec{B} = \frac{+3\rho}{5}\hat{a}_z$$

$$\vec{ds} = d\rho\ \rho d\phi\ \hat{a}_z$$

$$\psi = \int B.ds = \int_0^{\frac{\pi}{6}}\int_0^2 \frac{+3\rho}{5}d\rho\ \rho d\varphi$$

$$= \frac{\pi}{6}\times\left.\frac{3\rho^3}{3\times5}\right|_0^2 = \frac{+4\pi}{15}Wb$$

Choice (B)

45. $\nabla \times E = \dfrac{-\partial B}{\partial t}$

$= \dfrac{-\partial}{\partial t}\mu H$, $\mu_O = 4\pi \times 10^{-7}$ H/m

$B = \mu_O H = 0.25 \sin 120\ \pi\ t\ \hat{a}_z$ mwb/m^2

$$\Rightarrow \quad \nabla \times E = -\frac{\partial}{\partial t}\,(0.25 \sin 120\,\pi t\ \hat{a}_z)$$

$$= -0.25 \times 120\,\pi \cos 120\,\pi t\ \hat{a}_z \ \text{ mV/m}$$

$$= -94.24 \cos 120\,\pi t\ \hat{a}_z \ \text{ mV/m}$$

Choice (B)

46. $a \times b$

TE_{01},

$f_{TE01} = 7.5 \times 10^9$ Hz

$$f_{TE01} = \frac{3\times10^{10}}{2b}$$

$$b = \frac{1.5\times10^{10}}{7.5\times10^{9}}$$

$b = 2$ cm

TM_{11}, $f_{TM11} = 9.6$ GHz

$$f_{TE\,mn} = \frac{c}{2}\left[\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2\right]^{\frac{1}{2}}$$

$$f_{TM11} = \frac{3\times10^{10}}{2}\left[\left(\frac{1}{a}\right)^2 + \frac{1}{4}\right]^{\frac{1}{2}}$$

$$\left(\frac{1}{a}\right)^2 + \frac{1}{4} = 0.4$$

$$\frac{1}{a^2} = 0.15$$

a = 2.5 cm

TE_{10}

$$f_{TE10} = \frac{c}{2a} = \frac{3\times10^{10}}{2\times2.5}\text{Hz}$$

$f_{TE_{10}} = 6$ GHz　　Ans: 5.8 to 6.2

47. Z transform of $x[n]$ and $y[n]$ are

$X(z) = 2 - 2z^{-1}$

$Y(z) = 2 - 2z^{-3}$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{2-2z^{-3}}{2-2z^{-1}}$$

$H(z) = 1 + z^{-1} + z^{-2}$

$h[n] = [\underset{\uparrow}{1}, 1, 1]$　　Choice (A)

48. Impulse $h(t) = u(t) - u(t - T)$

Now $x(t) = \delta(t - 2) + \delta(t - 4)$

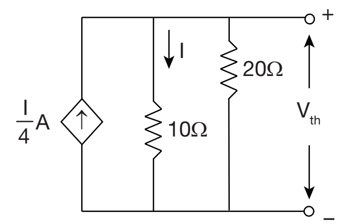
Now $h(t) \otimes x(t) = [u(t) - u(t - T)] \otimes [\delta(t - 2) + \delta(t - 4)]$

$= [u(t - 2) + u(t - 4) - u(t - 2 - T) - u(t - 4 - T)]$

$= u(t - 2) + u(t - 4) - u(t - 4) - u(t - 6)$

$y(t) = [u(t - 2) - u(t - 6)]$　　Choice (A)

49. The thevenin's equivalent circuit across the load terminals.



$$-\frac{1}{4} + I + \frac{V_{th} - 25}{20} = 0$$

$$\frac{3I}{4} + \frac{V_{th} - 25}{20} = 0$$

But $I = \dfrac{V_{th}}{10} A$

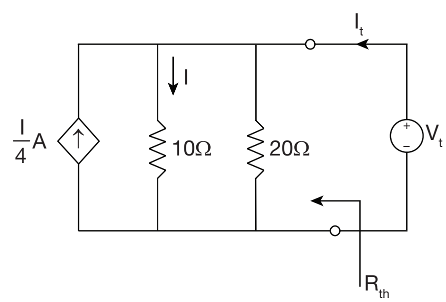
$$\frac{3V_{th}}{40} + \frac{V_{th} - 25}{20} = 0$$

$3V_{th} + 2V_{th} - 50 = 0$

$5V_{th} = 50$ V

$V_{th} = 10$ V.

Calculate R_{th}:



$$R_{th} = \frac{V_t}{I_t} \quad -I_t + \frac{V_t}{20} + I - \frac{1}{4} = 0$$

$$I_t = \frac{V_t}{20} + \frac{3I}{4}$$

But $I = \dfrac{V_t}{10}$

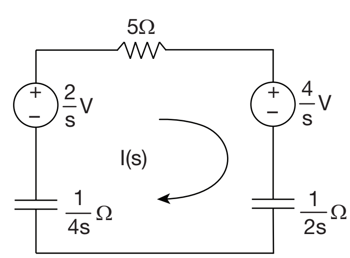
$40\,I_t = 5\,V_t$

$$\frac{V_t}{I_t} = R_{th} = 8\Omega = R_N$$

$$\therefore \quad I_N = \frac{V_{th}}{R_{th}} = 1.25A$$

Choice (A)

50. Redraw the given circuit in S-domain



$$i(s) = \frac{\frac{4-2}{S}}{5 + \frac{1}{2S} + \frac{1}{4S}} = \frac{2}{5S + 0.75}$$

$$I(s) = \frac{\frac{2}{5}}{S + 0.15}$$

$$i_C(t) = \frac{2}{5}.e^{-0.15t}\text{Amp}$$

$$E = \int_0^\infty p.dt$$

$$E = \int_0^\infty i^2(t)R.dt$$

$$E = \frac{4}{25} \times 5\int_0^\infty e^{-0.3t}.dt$$

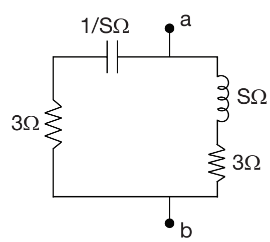
$$E = \frac{4}{5}\left[\frac{e^{-0.3t}}{-0.3}\right]_0^\infty = \frac{4}{5} \times \frac{1}{0.3} = 2.66$$ Ans: 2.5 to 3

51. Step 1: deactivate all the independent sources

∴ voltage source → short circuit

Current source → open circuit

Step 2: draw the equivalent circuit in S-domain



$$Z_{ab} = (3 + S) \parallel (3 + \frac{1}{S})$$

$$Z_{ab} = \frac{(3+S)(3+\frac{1}{S})}{3 + S + 3 + \frac{1}{S}}$$

$$Z_{ab} = \frac{9 + \frac{3}{S} + 3S + 1}{6 + S + \frac{1}{S}}$$

$$Z_{ab} = \frac{3S^2 + 10S + 3}{S^2 + 6S + 1}$$ Choice (D)

52. We know

$$W_c = \frac{1}{2}CV^2 = \frac{Q^2}{2C}$$

$$Q = \sqrt{2CW} = \sqrt{2 \times 80 \times 10^{-6} \times 6 \times 10^{-3}} = 9.8 \times 10^{-4}\ C$$

$$I = \frac{dq}{dt} = \frac{Q}{t} \rightarrow t = \frac{Q}{i} = \frac{9.8 \times 10^{-4}}{0.1} = 9.8 \text{ msec}$$

Choice (A)

53. Period of $x_1[n] = \cos\left(\frac{4\pi n}{20}\right) = \cos\left(\frac{2\pi n}{25}\right)$

$$N_1 = \frac{2\pi}{\Omega_1}(m) = \frac{2\pi}{\frac{\pi}{5}(m)};\ m \rightarrow \text{integer}$$

= 10; for m = 1

Period of $\sin\left(\frac{2\pi n}{25}\right)$!

$$N_2 = \frac{2\pi}{\Omega_2}(m) = \left(\frac{2\pi}{\frac{2\pi}{25}}\right)(m) = 25 \text{ for } m = 1$$

Period of $e^{j\frac{4\pi n}{40}}$

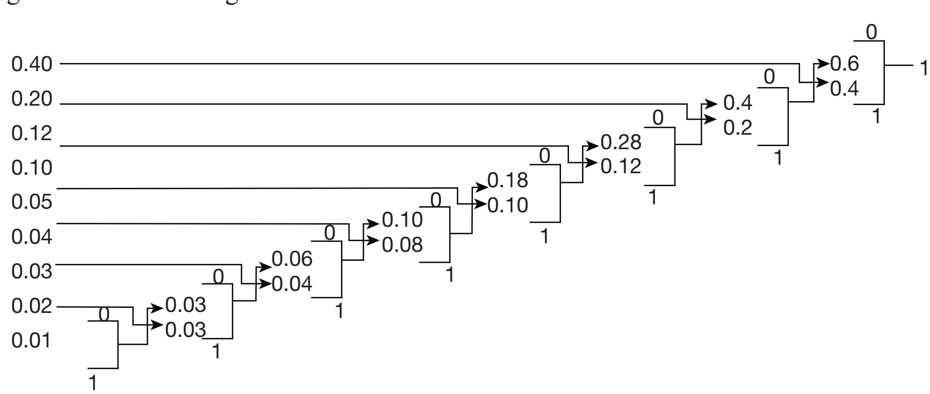
$$N_3 = \frac{2\pi}{\Omega_3}(m)$$

$$\frac{2\pi}{\frac{2\pi}{20}}(m) = 20 \text{ for } m = 1$$

So LCM of (10, 25, 20) = 100

Choice (C)

54. Now first giving the Huffman coding.



So Huffman code will be

P_r(ai)	Code	Li	P_r
0.40	1	1	0.40
0.20	000	3	0.60
012	010	3	0.36
0.10	0010	4	0.40
0.08	0011	4	0.32
0.04	0111	4	0.16
0.03	01101	5	0.15
0.02	011000	6	0.12
0.01	011001	6	0.06

code word length = $\sum_i l_i\, p_i$ = 2.57bits/symbol

Choice (A)

55. $\left(\frac{S}{N}\right)$ = 30dB

$10\log\left(\frac{S}{N}\right)$ = 30dB

$\frac{S}{N}$ = 1000

Quantizer step size = $\frac{2A}{L}$

$L = 2^n$, n is the number of binary digits.
Then, average quantizing power is

$N_q = (qe^2) = \frac{S^2}{12} = \frac{A^2}{3L^2}$

$1000 = \frac{50\times10^{-3}}{\frac{A^2}{3L^2}}$

$L = \sqrt{\frac{1000A^2}{50\times10^{-3}\times3}}$ $L = 326.59$

$2^n = L$

$n = \frac{\log 326.59}{\log 2}$

$n = 8.351$
$n = 9$ bits/sample

Ans: 9

56. Forward path gains:

$P_1 = \frac{8}{s.(s+2)}, \Delta_1 = 1$

$P_2 = \frac{0.5\times}{s+2} = \frac{2}{s+2}$ $\Delta_2 = 1$

$P_3 = 0.5 \times 3 = 1.5$
$\Delta_3 = 1.$
Individual loop gains:

$L_1 = \frac{-2}{s}$

$L_2 = -0.5$

$\Delta = 1 - \{L_1 + L_2\} = 1 + \frac{2}{s} + 0.5 = \frac{2+1.5s}{s}$

$$\frac{C(s)}{R(s)} = \frac{P_1\Delta_1 + P_2\Delta_2 + P_3\Delta_3}{\Delta} = \frac{\frac{8}{s(s+2)} + \frac{2}{s+2} + \frac{1.5}{}}{\frac{(2+1.5s)}{s}}$$

$$\frac{C(s)}{R(s)} = \frac{8+2s+1.5(s+2)s}{(2+1.5s)(s+2)} = \frac{1.5s^2+5s+8}{1.5s^2+5s+4}$$

Choice (C)

57. Characteristic equation

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 2 & 1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \begin{bmatrix} -0.5 & -2 & 1 \end{bmatrix} x + v$$

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -2 & 1 \\ 1 & 2 & 1 \end{bmatrix} x + v$$

Characteristic equations $|\lambda I - A| = 0$

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

$\lambda\,\{(\lambda + 2)\,(\lambda - 1) - 2\} + 1\,\{-1\} = 0.$
$\lambda\,\{\lambda^2 - \lambda + 2\lambda - 2 - 2\} - 1 = 0$
$\lambda\,\{\lambda^2 + \lambda - 4\} - 1 = 0$
$\lambda^3 + \lambda^2 - 4\,\lambda - 1 = 0.$
$\lambda = -2.46, 1.699, -0.24.$

Choice (A)

58. $$\frac{Y(s)}{X(s)} = \frac{6/s(s+2)}{1 + \frac{3\beta s}{s(s+2)} + \frac{6}{s(s+2)}}$$

$$= \frac{6}{s(s+2)+3\beta s+6} = \frac{6}{s^2+s(3\beta+2)+6}$$

$\omega_n^2 = 6$

$\Rightarrow$ $\omega_n = \sqrt{6}$ rad/sec
and given $\xi = 0.5$
$2\,\xi\,\omega_n = 3\beta + 2$
$\omega_n = 3\beta + 2 = \sqrt{6}$
$\beta = 0.149 \approx 0.15$

Ans: 0.13 to 0.16

59. Error tolerated 0.4% or 0.004A

Maximum error = $\frac{\Delta}{2}$

Δ = Step size

So $\frac{\Delta}{2} = 0.004\,A$

Since $\frac{\Delta}{2}$ is maximum error in PCM

So $\dfrac{\Delta}{2} = \dfrac{4}{1000}$ A

Or $\dfrac{2A}{\Delta} = \dfrac{1000}{4}$ = 250 levels Choice (C)

60. $F(x, y, z) = \sum m(0, 6, 7) + \varphi(1, 4)$

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

$F = \bar{x}\,\bar{y} + xy = x \odot y$

F is 2 input *X-NOR* gate, so we need 4 *NOR* gates.

Ans: 4

61. LXI *B*, 3010H instruction copies the destination address to *BC* register pair, so '*C*' should not be used as counter. Choice (D)

62. Min terms of *P*

$w^1x^1z^1 + w^1yz^1 + xz + wx^1$

00×0 0×10 $x1x1$ $10xx$

0, 2 2, 6   5,7,13,15   8,9,10,11

$\sum m(0, 2, 5, 6, 7, 8, 9, 10, 11, 13, 15)$

min terms of Q

$x^1z^1 + wz + xz + w^1x$

$x0x0$ $1xx1$ $x1x1$ $01x\,x$

0,2,8,10 9,11,13,15   5,7,13,15   4,5,6,7

$\sum m(0,2,4,5,6,7,8,9,10,11,13,15)$

which is not equal to *f* Choice (D)

63. V_R = 2 Volt at *P* side of Diode

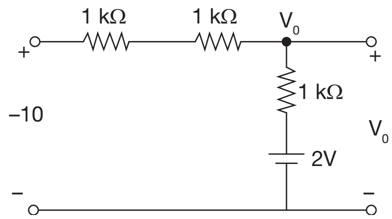
$V_i > 2$ volt

$V_0(t) = 2$ volt

$V_i < 2$ volt

$\vartheta_o(t) \Rightarrow \vartheta_i(t)$

but at –ve peak



$$\frac{V_o + 10}{2k} + \frac{V_o - 2}{1k} = 0$$

$V_o + 10 + 2V_o - 4 = 0$

$3\,V_o = -6$

$V_o = -2$ volt Choice (C)

64. Base emitter junction is in Forward bias

If V_{CE} is positive collector emitter junction is in Forward bias and transistor would be in saturation region otherwise it is in active region.

Apply KVL in *B-E* junction $10v = 150\,K\,I_B + 0.7$

$I_B = 62\ \mu$A

Apply KVL in *C-E* junction

$V_{E_C} = 10 - 2k \times 100 \times 62\ \mu$

$= 10 - 6.2 \times 2 = 10 - 12.4$

$= -2.4$ volts

$V_{CE} = +2.4$ volts

$\Rightarrow$ saturation region Choice (B)

65. $A_V = 1000$ and $\beta = 0.1$

$$\frac{f_{Hf}}{F_H} = 1 + \beta A_v = 1 + 0.1 \times 1000 = 101$$

$$\frac{f_{Lf}}{f_L} \quad \frac{1}{1 + \beta A_v}$$

$$= \frac{1}{1 + 0.1 \times 1000} = \frac{1}{101}$$

$= 9.9 \times 10^{-3}$ Choice (A)