Mock Test 5

Number of Questions: 65 **Section Marks: 65**

SECTION – I GENERAL APTITUDE

***Directions for question* 1**: Choose 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 _____.

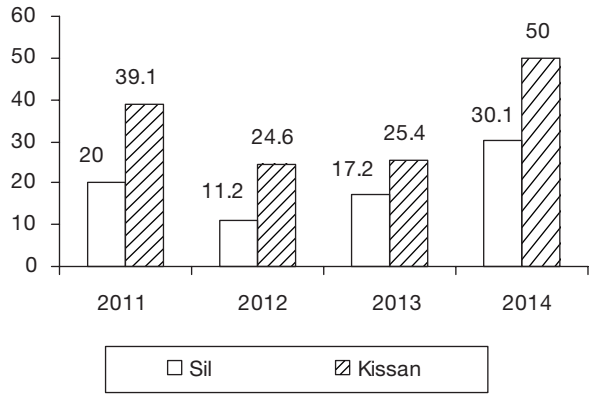
3. How is Khadar's wife's daughter's mother's daughter-in-law's husband's father related to Khadar?
(A) Grand-father B) Father
(C) Father-in-law (D) Himself

***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

***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) $\frac{\sqrt{13}-1}{2}$ (B) $\frac{\sqrt{17}-1}{2}$

(C) $\frac{\sqrt{17}+1}{2}$ (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.

SECTION – II ELECTRICAL ENGINEERING

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. In the LU decomposition of a matrix $A = \begin{bmatrix} 3 & 1 & 2 \\ 6 & 4 & 5 \\ 9 & 7 & 11 \end{bmatrix}$ with each of the principal diagonal element of L being equal to 1, the matrix L is equal to ____.

(A) $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 1 & 3 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 3 \\ 0 & 0 & 1 \end{bmatrix}$

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 the Laplace transform of $f(t)$ is $L[f(t)] = F(s)$ then $L\left[\frac{d^2f}{dt^2}\right]$ = _____.

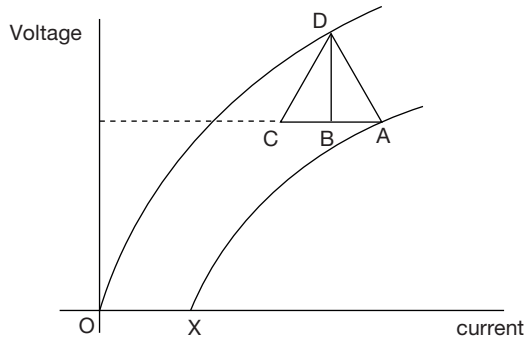
(A) $s^2 F(s) + s f(0) + f^1(0)$
(B) $s^2 F(s) + s F(0) + F^1(0)$
(C) $s^2 F(s) - sf(0) - f^1(0)$
(D) $s^2 F(s) - s F(0) - F^1(0)$

16. The primary and secondary windings of a 50 KVA, 7000/400 V, 1 – phase transformer have resistance of 20 ohms and 0.02 ohm respectively. The reactance of the transformer referred to the primary is 30 ohm. The primary voltage required to circulate full load current when the secondary is short circuited is_____ volts.

17. A 250V shunt motor develops an output of 18.50 kw when taking 20.8 kW. The field resistance is 40 Ω and armature resistance is 0.04 Ω. Then the constant losses of the motor is _____ watts.

(A) 2300W (B) 2063W
(C) 2536W (D) 2800W

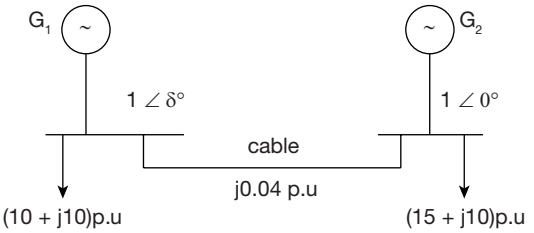
18. The characteristics of alternator is drawn below by zero power factor method



In the above figure
The AB line represent

(A) the field current required to overcome armature reaction.
(B) the field current drawn by the leakage reactance
(C) the armature current required to overcome armature reaction.
(D) the armature current drawn by the leakage reactance

19.



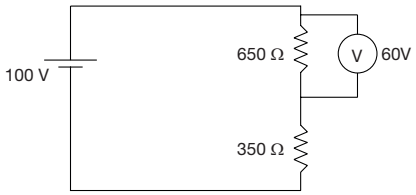
If the generator G_1 generating maximum real power of 15 p.u. Then the value of torque angle (δ) is _____ degrees.

20. The maximum and minimum stresses in the dielectric of a single core cable are 60 kV/cm (r.m.s) and 15 kV/cm (r.m.s) respectively. If the conductor diameter is 4 cm then the thickness of insulation is _____ cm.

21. The peak restriking voltage and time to reach the peak restriking voltage of a circuit breaker are 150 kV and 60 μsec respectively, if the natural frequency of oscillations is 8.33 kHz. Then the average RRRV is
(A) 2.5 kV/ μsec (B) 5 kV/ μsec
(C) 9 kV/ μsec (D) 9 V/sec

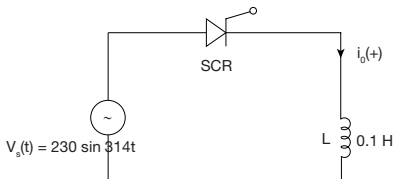
22. Two Resistances of $R_1 = 6\Omega \pm 2.5\%$ and $R_2 = 12\Omega \pm 3\%$ are connected in Parallel. What would be the tolerance in the equivalent resistance value of the parallel combination?
(A) 0.25% (B) 1.54%
(C) 2.67% (D) 4.52%

23. In the circuit shown in below figure, a voltmeter reads 60V when it is connected across 650 Ω resistor. What will be the voltmeter reading when it is connected across the 350Ω resistor?



(A) 30V (B) 32.3V
(C) 35V (D) 37.3V

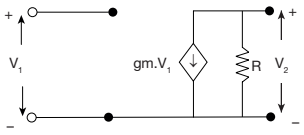
24. A thyristor connected in series with inductive load as shown in figure below is triggered at an angle $\alpha = 30^o$ in each positive half cycle. The load current at $\omega t = \frac{2\pi}{3}$ rad will be.



(A) 0A (B) 2A
(C) 10A (D) 18A

25. A capacitor is connected across an ac regulator feeding an inductor (*TCR*). Input is at 230V, 50 Hz and inductive reactance (X_L) = 20Ω, capacitive reactance (X_C) = 20Ω. Calculate the net VAR supplied by the circuit at α = 120°.
(A) 2.456 kVAR (B) 6.512 kVAR
(C) 8.396 kVAR (D) 12.312 kVAR

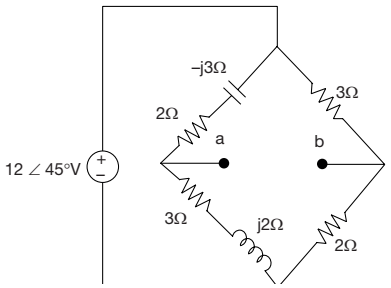
26. The circuit shown in the dependent source represents a



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

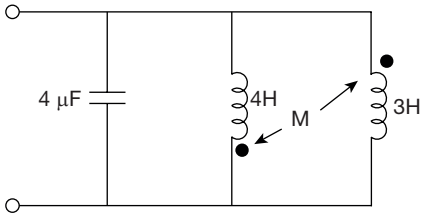
27. Which of the following are the effects of increasing the reverse bias voltage across a p-n junction?
(1) Increase reverse saturation current.
(2) Decrease in junction capacitance of the diode.
(3) Increase carrier recombination in the depletion layer.
(4) Increase depletion width.
Select the correct 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

28. Consider the network shown in figure



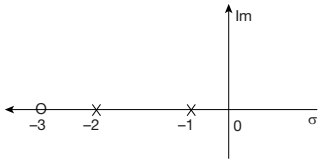
The Thevenin equivalent impedance at terminals '*a*' and '*b*' is _____.
(A) $(2.5 + j0.5)\ \Omega$ (B) $(-1.3 + j0.5)\ \Omega$
(C) $(3.7 - j0.5)\ \Omega$ (D) $(3.7 + j0.5)\ \Omega$=

29. 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 _____.

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



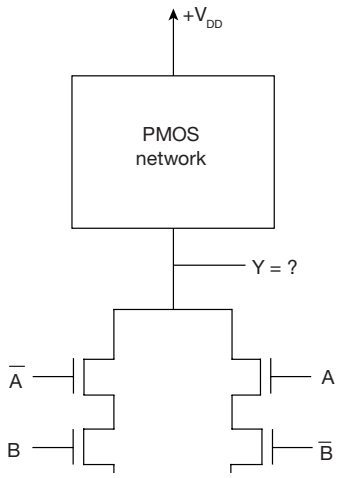
At break – in point the value of gain '*k*' is____.

31. Only Steady – state accuracy of a system can be improved by using
(A) Lead compensator
(B) lag compensator
(C) lag – lead compensator
(D) differentiator

32. 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

33. A system is described by a differential equation as follows $\frac{dy(t)}{dt} + 3y(t) = u(t)$.
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) $\frac{1}{3}[1 + e^{+3t}]$

34. 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)$(\overline{A} + \overline{B})$

35. 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

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 $P\left(X + Y = \frac{6}{X - Y} = 2\right)$ 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 $\bar{i} + 3\bar{k}$ is _____.
(A) $\frac{3}{5}$ (B) $\frac{6}{5}$
(C) $\frac{9}{5}$ (D) $\frac{12}{5}$

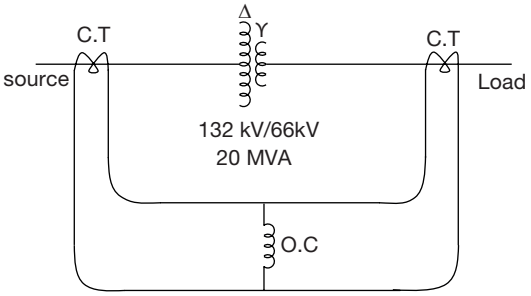
40. The value of Δy to be added to y_0 to get the value of y_1 at $x_1 = 0.2$ in the process of solving the differential equation $\frac{dy}{dx} = x + 2y$ with $y_0 = y(0) = 1$ by Runge Kutta method of the fourth order is _____.
(A) 0.3254 (B) 0.5147
(C) 0.7315 (D) 0.9164

41. A single phase, 20 KVA, 600/300V, 50 Hz transformer has the following constants
Resistance: Primary 0.5 Ω; secondary: 0.1 Ω
Reactance: Primary 0.2 Ω; Secondary: 0.6 Ω
Resistance of equivalent exciting circuit referred to primary is 1800 Ω and Reactance of equivalent exciting circuit referred to primary is 800 Ω. Calculate approximate No load primary input of the transformers
(A) 450W (B) 500W
(C) 492W (D) 34W

42. Calculate the line voltage of a star connected 3 – phase, 4 – pole alternator which runs at 1800 rpm, having flux per pole of 0.2 wb sinusoidally distributed. Its stator has 48 slots having double layer winding. Each coil has 6 turns and the coil is chorded by one slot.
(A) 2422.98 V (B) 4196.74 V
(C) 7268.97 V (D) 5139.93 V

43. The rotor of a 6-pole, 50 Hz slip ring induction motor has a resistance of 0.40 Ω per phase and runs at 950 rpm at full load. Calculate the external resistance per phase which must be added to lower the speed of 900 rpm. The torque being the same as before for negligible synchronous reactance
(A) 0.2 Ω (B) 0.4 Ω
(C) 1.2 Ω (D) 0.8 Ω

44.

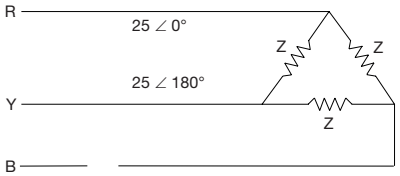


In the above figure if the circulating current of 5A in the pilot wires then the *CT* ratio on the high voltage side of the transformer is

(A) $87.47:5\sqrt{3}$ (B) 87.47:5

(C) 151.51:5 (D) $151.51:5\sqrt{3}$

45. A 3-phase transmission line supplies Δ-connected load *z* as shown in figure. The negative sequence current of phase *R* will be



(A) 14.43 ∠ –29.97° (B) 43.29 ∠ –29.97°

(C) 24.99 ∠ –29.97 (D) 43.29 ∠ 150.03

46. A star connected, 3-phase, 20 MVA, 6.6 kV alternator has a per phase reactance of 20%. It is protected by merz-price circulating current principle which is set to operate for a fault current of 180 A. Then calculate the reactance per phase of 20% of winding.

(A) 0.4 Ω (B) 0.8 Ω

(C) 0.042 Ω (D) 0.087 Ω

47. An electrodynamo wattmeter is employed to measure power in a single phase circuit. The load voltage is 230V and the load current is 10A at a lagging power factor of 0.1 lagging. The wattmeter potential coil has a resistance of 1000Ω and an inductive reactance of 25.12Ω. Determine the Percentage error in the wattmeter reading due to inductance of pressure coil.

(A) 1.25% (B) 12.5%

(C) 25% (D) 30%

48. In the case of power measurement by two wattmeter method in a balanced 3 phase system with a pure capacitive load.

(A) both the meters will read zero

(B) one wattmeter will read zero and the otherone will read 0.5

(C) both the meters will read same value but of opposite sign.

(D) both the meters will read same value and of the same sign.

49. The inductance of a moving iron instrument is given by $L = (0.02 + 8 \times 10^{-3}\theta)^2$ μH, where θ is angular deflection in radians from zero position. The angular deflection in radians corresponding to current of 3A is $\frac{\pi}{3}$.

Find the value of spring constant in Nm/rad.

(A) 0.5×10^{-9} (B) 1.42×10^{-9}

(C) 1.95×10^{-9} (D) 2.24×10^{-9}

50. Three phase diode rectifier connected to 400V, 50 Hz source is feeding a resistive load of 10Ω with High inductance. The distortion factor given to be $\frac{3}{\pi}$. What will be the power drawn at fundamental frequency from mains.

(A) 5.2 kW (B) 16.8 kW

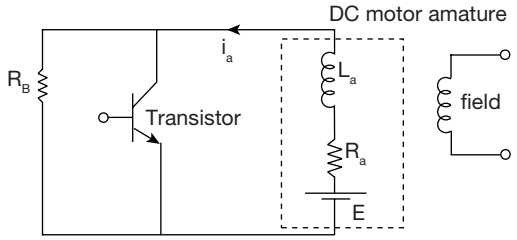
(C) 27.9 kW (D) 48.1 kW

51. A step down dc chopper has load resistance of 10 Ω. Chopper input voltage is 250V d.c. The chopper switch has a voltage drop of 1.5V when conducting. Find the chopper efficiency for the duty cycle of 0.5?

(A) 81.2% (B) 89.4%

(C) 93.2% (D) 99.4%

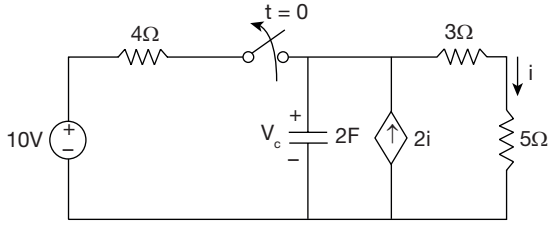
52. A 300V, 800 rpm and 150A separately excited dc motor has an armature resistance 0.02Ω. The motor is fed from a chopper which provides both motoring and braking operations. Motor is now operated in dynamic braking with chopper control has a braking resistance of 2 Ω. What will be the motor speed for a duty ratio 0.8 and motor torque equal to twice the rated torque?



(A) 169.69 rpm (B) 413.56 rpm

(C) 654.32 rpm (D) 832.1 rpm

53. Consider the network shown in below

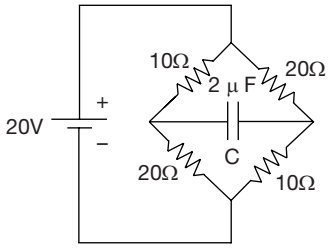


The value of V_c at $t = -4$ sec is _____.

(A) 15.58 V (B) 12 V

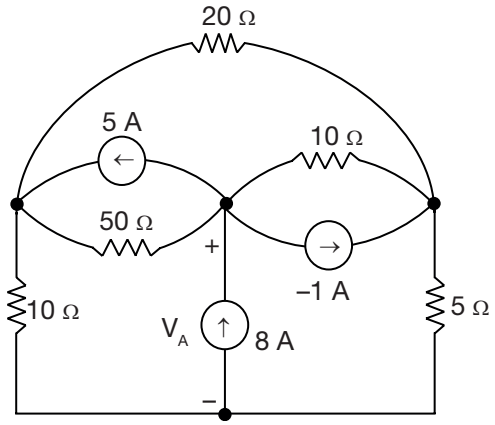
(C) 8 V (D) None

54. Consider the circuit show in below



The energy stored by the capacitor is _____ μJ.

55. Consider the circuit shown below



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

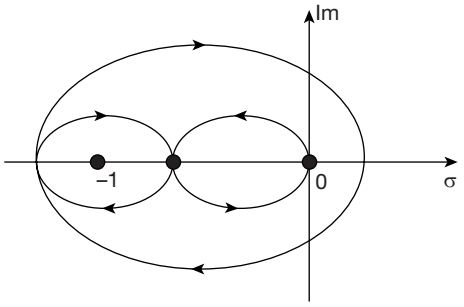
56. Consider the particular system state equations

$\dot{x}_1 = -x_1 + u$; $\dot{x}_2 = x_1 + 0.5x_2 + 2u$, 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

57. 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.

58. 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 ω = 0.1rad/sec is _____ dB.

59. If DTFT of a signal $x[n]$ is given as

$$X[e^{j\omega}] = \sin\left(\frac{10\pi\omega}{31}\right)$$

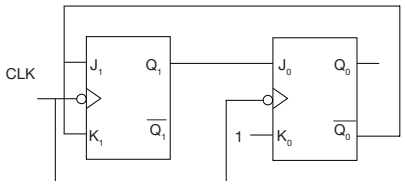
Then the signal $x[n]$ is

(A) $2j\,[\delta(n+5) - \delta(n-5)]$
(B) $\dfrac{1}{2j}[\delta(n+5) - \delta(n-5)]$
(C) $2j\,[\delta(n+5) + \delta(n-5)]$
(D) $\dfrac{1}{2j}[\delta[n+5) + \delta(n-5)]$

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

(A) $\dfrac{1}{2^n}\,u[n] - (-1)^n\,u[-n-1]$
(B) $\dfrac{1}{2^{n-1}}\,u[n] + u[-n+1]$
(C) $\dfrac{1}{2^{n-1}}\,u[n] - (-1)^n\,u[-n-1]$
(D) None of these

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

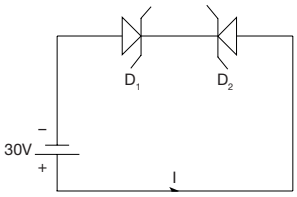
62. The following 8085 microprocessor program reads one data byte at a time from I/O, which of the following data byte, will transfer the program to location ACCEPT?

```
IN      PORT1
MVI     B, 40H
CMP     B
JC      REJECT
```

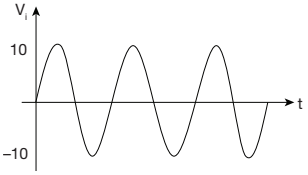
	JM	REJECT
	STA	2016H
	JMP	ACCEPT
REJECT:	JMP	INVALID

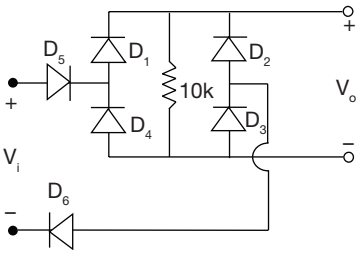
(A) 39H (B) F2H
(C) 8FH (D) D8H

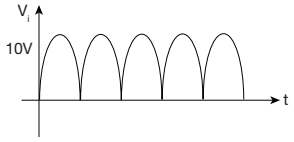
63. In the circuit given below the Zener diode D_1 has reverse bias breakdown voltage of 50V and reverse saturation current of 20 μA. The corresponding values for D_2 are 80V and 30 μA. The current in the circuit is _____ μA.

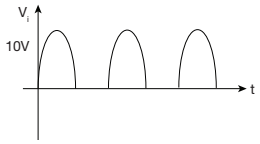


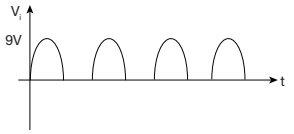
64. FOUR diodes (D_1, D_2, D_3, D_4 Ideal) and TWO diodes (D_5, $V\gamma$ = 0.7, D_6, $V\gamma$ = 0.3) are used in the circuit. 10 sin ωt signal is excited to a given circuit shown in figure. The output wave form in the following is.





(A) 

(B) 

(C) 

(D) None of these

65. If a vector field $D = e^{-x} \sin y\, a_x - e^{-x} \cos y\, a_y$, it is said to be a field of the following nature.
(A) solenoidal (B) Divergence
(C) Irrotational (D) Both A and C

Answer Keys

Section – I

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.** A	**14.** A	**15.** C	**16.** 383.12 to 383.14		**17.** B	**18.** A	
19. 11.53 to 11.54		**20.** 6	**21.** A	**22.** C	**23.** B	**24.** C	**25.** C	**26.** B	**27.** D
28. C	**29.** 80 to 81		**30.** 5.5 to 6		**31.** B	**32.** B	**33.** B	**34.** B	**35.** B
36. D	**37.** –0.32 to –0.31		**38.** B	**39.** A	**40.** B	**41.** C	**42.** B	**43.** B	**44.** B
45. A	**46.** D	**47.** C	**48.** C	**49.** C	**50.** C	**51.** D	**52.** A	**53.** A	
54. 98 to 102		**55.** 55 to 57		**56.** D	**57.** A	**58.** 41 to 43		**59.** B	**60.** C
61. B	**62.** C	**63.** 19 to 21		**64.** C	**65.** C				

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, $xt = (y)(yt)$;
⇒ $x = y^2$.
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 $x = \sqrt{5+\sqrt{5-\sqrt{5+\sqrt{5-\cdots\cdots}}}}$

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

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

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

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

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

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

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

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

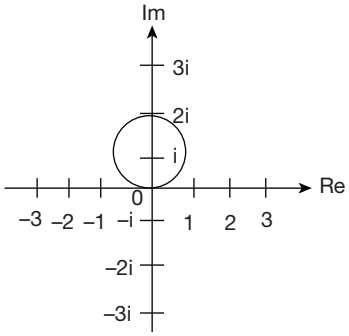
$\therefore \quad (x^2-5)^2 = \frac{18-2\sqrt{17}}{4} = \frac{9-\sqrt{17}}{2}$

$\therefore \quad x = \frac{\sqrt{17}+1}{2}$ 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 $\oint_C \frac{z^2+6z+10}{z^2+9}dz$

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

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

$z = \pm 3i$ 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 $\int_0^{\pi} \sin^8 x dx = 2\int_0^{\frac{\pi}{2}} \sin^8 x dx$

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

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

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

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

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

Choice (A)

13. Given $A = \begin{bmatrix} 3 & 1 & 2 \\ 6 & 4 & 5 \\ 9 & 7 & 11 \end{bmatrix}$

As the principal diagonal elements of L are equal to 1 in the LU decomposition of A, we have

$A = LU$ ---------- (1)

where $L = \begin{bmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{bmatrix}$ and $U = \begin{bmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{bmatrix}$

$\therefore$ From (1)

$$\begin{bmatrix} 3 & 1 & 2 \\ 6 & 4 & 5 \\ 9 & 7 & 11 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{bmatrix} \begin{bmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{bmatrix}$$

$$\begin{bmatrix} 3 & 1 & 2 \\ 6 & 4 & 5 \\ 9 & 7 & 11 \end{bmatrix}$$

$$= \begin{bmatrix} u_{11} & u_{12} & u_{13} \\ l_{21}u_{11} & l_{21}u_{12} + u_{22} & l_{21}u_{13} + u_{23} \\ l_{31}u_{11} & l_{31}u_{12} + l_{32}u_{22} & l_{31}u_{13} + l_{32}u_{23} + u_{33} \end{bmatrix}$$

Comparing the corresponding elements on both sides

We have

$u_{11} = 3$; $u_{12} = 1$ and $u_{13} = 2$

$l_{21}u_{11} = 6 \Rightarrow l_{21} = \frac{6}{3} = 2$

$l_{21}u_{12} + u_{22} = 4 \Rightarrow u_{22} = 4 - 2 \Rightarrow 1 = 2$

$l_{31}u_{11} = 9 \Rightarrow l_{31} = \frac{9}{3} = 3$

$l_{31}u_{12} + l_{32}u_{22} = 7 \Rightarrow 3 \Rightarrow 1 + l_{32} \Rightarrow 2 = 7$

$\Rightarrow \quad l_{32} = \frac{7-3}{2} = 2$

$\therefore \quad L = \begin{bmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$. Choice (A)

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

-------- (1)

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

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

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

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

15. Standard result. Choice (C)

16. $K = \frac{400}{7000}$; $X_{01} = 30\ \Omega$

$R_{01} = 20 + 0.08\left(\frac{70}{4}\right)^2 = 44.5\ \Omega$

$Z_{01} = \sqrt{R_{01}^2 + X_{01}^2} = 53.66$

$I_1 = \frac{50 \times 10^3}{7000} = 7.14\text{A}$

$V_{SC} = I_1 Z_{01} = 7.14 \times 53.66 = 383.13\text{V}$

Ans: 383.12 to 383.14

17. Output = 18,500 watts

Input = 20,800 watts

Total losses = 20,800 – 18,500

= 2300 watts

Input current $= \frac{20,800}{250} = 83.2\text{A}$

$I_{sh} = \frac{250}{40} = 6.25\text{A}$

$I_a = 83.2 - 6.25 = 76.95\text{A}$

Armature copper loss = $76.95^2 \times 0.04 = 236.85$ watts

Constant loss = 2300 – 236.85 = 2063.15 watts

Choice (B)

18. Choice (A)

19. Total load real power = 25 p.u

For equalizing station load P_{G1} = 15 p.u and P_{G2} = 10 *p.u* because there is zero Resistance of cable. Therefore no real power loss

$P_S = P_R = \frac{(|V_1|\,|V_2|)}{X} \sin \delta_0$`

$5 = \frac{1 \times 1}{0.04} \sin \delta_0$

$\Delta_0 = 11.53^o$ Answer: 11.53 to 11.54

20. $g_{max} = 60$ kV/cm

$g_{min} = 15$ kV/cm

$d = 4$ cm

$\frac{g_{max}}{g_{min}} = \frac{\text{thickness of cable}(D)}{\text{thickness of conductor}(d)}$

$\Rightarrow D = \frac{60}{15} \times 4 = 16$ cm

Insulation thickness $= \frac{16-4}{2} = 6\text{cm}$ Ans: 6

21. Average RRRV $= \frac{\text{peak restriking voltage}}{\text{Time to reach peak value}}$

$= \frac{150}{60} = 2.5 \times 10^6$ kV/sec

= 2.5 kV/ μsec Choice (A)

22. Equivalent resistance $= \frac{12 \times 6}{12+6} = 4\Omega$

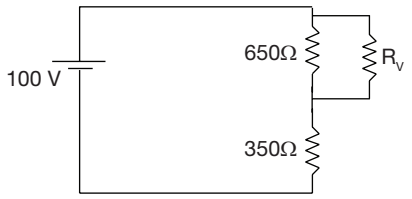
Tolerance in equivalent resistance

$= \frac{R}{R_1} \cdot \frac{\Delta R_1}{R_1} + \frac{R}{R_2} \cdot \frac{\Delta R_2}{R_2}$

$$= \frac{4}{6}.(2.5)+\frac{4}{12}(3)$$

$$= \frac{32}{12} = 2.67\% \qquad \text{Choice (C)}$$

23. When voltmeter connected across 650Ω



$R_{eq} = R_v \| 650$

$$60 = \frac{100 \times R_{eq}}{R_{eq}+350} \Rightarrow R_{eq} = 525\ \Omega$$

$$\frac{650\,R_V}{650+R_V} = 525 \Rightarrow R_v = 2730\ \Omega$$

When voltmeter connected across 350 Ω

$$V_{350} = 100 \times \frac{(350\,//\,2730)}{((35\,//\,2730)+350)}$$

$V_{350} = 32.3\text{V}$ Choice (B)

24. $V = \dfrac{Ldi}{dt}$

$$i(f) = \int_{\alpha}^{wt} \frac{v_m \sin wt}{L}\,dt$$

$$i_o = \frac{V_m}{\omega L}(\cos\alpha - \cos\omega t)$$

$$i_o = \frac{230}{314\times 0.1}(\cos 30^o - \cos 120^o)$$

$i_o = 10\text{A}$ Choice (C)

25. Reactance offered by *TCR*

$$X_L(\alpha) = \frac{X_L}{1-\frac{2\alpha}{\pi}-\frac{\sin 2\alpha}{\pi}}$$

$$X_L(\alpha) = \frac{j20}{1-\frac{2\times 120^o}{180^o}-\frac{\sin 2(120)}{\pi}} \quad \frac{j20}{-0.05766}$$

$X_L(\alpha) = -346.8j\Omega$

The effective impedance $X_L(\alpha) \| X_C$

$$X_{eq} = \frac{(-jX_C)(jX_L(\alpha))}{-jX_C + jX_L(\alpha)}$$

$= -j18.9\ \Omega$

Compensation degree, $\xi = \dfrac{X_C}{X_L + X_C} = 0.5$

The reactive power supplied is,

$$Q = \frac{2V^2}{X_{eq}} \times \frac{\xi}{1-\xi}(1-\cos\alpha)$$

$$Q = \frac{2\times(30)^2}{18.9} \times \frac{0.5}{1-0.5} \times (1 - \cos 120^o)$$

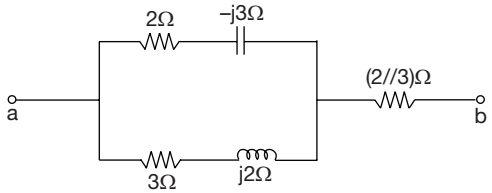
$Q = 8.396$ kVAR Choice (C)

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

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

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

28. 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)

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

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

$$= \frac{4\times 3 - 2.25}{4+3+3} = 0.975\,\text{H}$$

$$\therefore \quad f_o = \frac{1}{2\pi.\sqrt{0.975\times 4}}\,\text{kHz}$$

$f_o = 80.59$ Hz Answer range 80 to 81 Hz

30. From the given data

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

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

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

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

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 $K = 5.828$ Ans: 5.5 to 6

31. 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).

32. $y[n]$ will always periodic with period $N = 10$.
Choice (B)

33. By taking laplace transform $SY(s) + 3Y(s) = \frac{1}{s}$

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

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

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

34. NMOS transistor connected in series (AND)
So $\overline{A}B, A\overline{B}$

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

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

$= \left(A + \overline{B}\right)\left(\overline{A} + B\right)$ Choice (B)

35. Ratio of resistors $\frac{MSB}{LSB}$

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

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

36. Given system of linear equations is

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

(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 $f(x) = \frac{f^{111}(0)}{3!}$

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

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

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

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

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

$= \frac{-5}{16} = -0.3125$ 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

$$\therefore \quad P\left(X + Y = \frac{6}{X - Y} = 2\right) =$$

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

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

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

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

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

$$\frac{\frac{1}{6} \times \frac{1}{6}}{\frac{1}{6}\times\frac{1}{6} + \frac{1}{6}\times\frac{1}{6} + \frac{1}{6}\times\frac{1}{6} + \frac{1}{6}\times\frac{1}{6} + \frac{1}{6}\times\frac{1}{6} + \frac{1}{6}\times\frac{1}{6}} = \frac{1}{4}.$$ Choice (B)

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

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

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

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

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 $\nabla f.\ \hat{n} = \left(3\bar{i} - 11\bar{j} - 3\bar{k}\right).\left(\frac{4}{5}\bar{i} + \frac{3}{5}\bar{k}\right)$

$= \frac{12}{5} - \frac{9}{5} = \frac{3}{5}.$ 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 $x_1 = 0.2 \Rightarrow h = 0.2$

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

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

$\Delta y = \frac{1}{6}[k_1 + 2k_2 + 2k_3 + k_4]$ ---------- (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. $I_\mu = \frac{V_1}{X_0} = \frac{600}{800} = 0.75\ ;\ I_w = \frac{V_1}{R_0} = \frac{600}{1800} = 0.34$

$I_o = \sqrt{I_\mu^2 + I_\omega^2} = \sqrt{\left(\frac{3}{4}\right)^2 + \left(\frac{1}{3}\right)^2} = 0.82\text{A}$

No load primary input $= V_1 I_0 = 600 \times 0.82 = 492$ W

Choice (C)

42. $f = \frac{4 \times 1800}{120} = 60\text{ Hz}$

Short pitch angle $\alpha = \frac{180}{12} = 15°$

$K_P = \cos\frac{\infty}{2} = \cos 7.5 = 0.99$

$\beta = \frac{180}{12} = 15°$

$m = \frac{48}{12} = 4$

$K_d = \frac{\sin\frac{m\beta}{2}}{m\sin\frac{\beta}{2}} = \frac{\sin\frac{4 \times 15}{2}}{4\sin\frac{15}{2}} = 0.957$

$Z = \frac{48 \times 6}{3} = 96$

$T = \frac{Z}{2} = 48$

$E_{ph} = 4.44\ k_p\ k_d f\ \varphi\ T$

$= 4.44 \times 0.99 \times 0.957 \times 60 \times 0.2 \times 48$

$E_{ph} = 2422.99$

$E_L = \sqrt{3} \times E_{ph} = 4196.74$ V Choice (B)

43. $T = \frac{KSR_2}{R_2^2 + (SX_2)^2}$

$T\ \alpha\ \frac{KS}{R_2}$

$T_1 = T_2$

$\frac{R_2 + r}{R_2} = \frac{S_2}{S_1}$

$N_s = \frac{120 \times 50}{6} = 1000\text{ rpm}; S_1 = \frac{50}{1000} = 0.05$

$S_2 = \frac{100}{1000} = 0.1$

$\frac{0.4 + r}{0.4} = \frac{0.1}{0.05} \Rightarrow r = 0.4\ \Omega$ Choice (B)

44. The line current on HV side $= \frac{20000}{\sqrt{3} \times 132} = 87.47$

The $C.T$ ratio = 87.47:5 on HV side Choice (B)

45. Negative sequence current $I_2 = \left(\frac{1}{3}\right)\left(I_R + K\,I_Y + K^2\,I_B\right)$

$= \left(\frac{1}{3}\right)\left[\left(25\angle 0 + 25\angle 300^o + 0\right)\right]$

$= 12.5 - 7.21j$

$= 14.43\ \angle -29.97^o$ Choice (A)

46. Voltage per phase $= \dfrac{6.6\times10^3}{\sqrt{3}} = 3810\text{V}$

Full load current $I = \dfrac{20\times10^6}{\sqrt{3}\times6.6\times10^3} = 1749.54\text{ A}$

The reactance per phase is $x = \dfrac{20\times6600}{\sqrt{3}\times1749.54\times100}$
$= 0.4356$

Reactance of 20% winding $= 0.2 \times 0.4356 = 0.087$

Choice (D)

47. From impedance triangle of pressure coil, $\tan\beta = \dfrac{X_P}{R_P}$

$\tan\beta = \dfrac{25.12}{1000} = 25.12 \times 10^{-3}$

power factor of the load, $\cos\Phi = 0.1$ lagging
$\tan\Phi = \tan[\cos^{-1}(0.1)] = 9.949$
Error $= \tan\beta \tan\Phi = (25.12 \times 10^{-3})(9.949) = 0.25$
% Error = 25% Choice (C)

48. Wattmeter, $P_1 = VI\cos(30° + \Phi) = VI\cos(30° - 90°)$

$P_1 = VI\cos60 = \dfrac{VI}{2}$

Wattmeter $P_2 = VI\cos(30 - \Phi)$
$= VI\cos(30 + 90)$
$= VI\cos120 = -\dfrac{VI}{2}$

Hence $P_1 = -P_2$ Choice (C)

49. Torque balancing equation, $K\theta = \dfrac{1}{2}I^2\dfrac{dL}{d\theta}$

$K = \dfrac{1}{2}\dfrac{I^2}{\theta}\dfrac{dL}{d\theta}$

$K = \dfrac{1}{2}\dfrac{(3)^2}{\left(\dfrac{\pi}{3}\right)}.2(0.02 + 8\times10^{-3})(8\times10^{-3})\times10^{-6}$

$K = 1.95 \times 10^{-9}$ Nm/rad Choice (C)

50. $V_o = \dfrac{3V_{mL}}{\pi} = \dfrac{3\sqrt{2}\times400}{\pi} = 540.2\text{V}$

Fundamental source current $= I_{sr1}$

$= \dfrac{\sqrt{6}}{\pi}I_o = \dfrac{\sqrt{6}}{\pi}\times\left(\dfrac{540.2}{10}\right) = 42.1\text{A}$

Source power at fundamental frequency $= \sqrt{3}\,V_{sr1}\,I_{sr1}$

$P = \sqrt{3}\times400\times42.1\times\left(\dfrac{3}{\pi}\times1\right)$

$P = 27.9$ kW Choice (C)

51. Average output voltage, $V_o = \delta V_s = 0.5 \times (250 - 1.5)$
$= 124.25\text{V}$

Average load current, $I_o = \dfrac{V_o}{R}$

$= \dfrac{124.25}{10} = 12.425\text{A}$

RMS output voltage
$= \sqrt{\delta}\left(V_S - V.D\right) = \sqrt{0.5}\,(250 - 1.5)$
$= 175.71\text{V}$
Input powe $P_i = V_s I_o = 250 \times 12.425 = 3106.25\text{W}$

Output power $P_o = \dfrac{V_{or}^2}{R} = \dfrac{(175.71)^2}{10}$

$= 3087.61\text{W}$

Efficiency $= \dfrac{3087.61}{3106.25} \times 100 = 99.4\%$ Choice (D)

52. At rated operation, $E_1 = 300 - 150 \times 0.02 = 297\text{V}$
During dynamic braking, $E_2 = I_a\,[(1 - \delta)R_B + R_a]$
$E_2 = 300[(1 - 0.8)2 + 0.02]$
$E_2 = 126\text{V}$

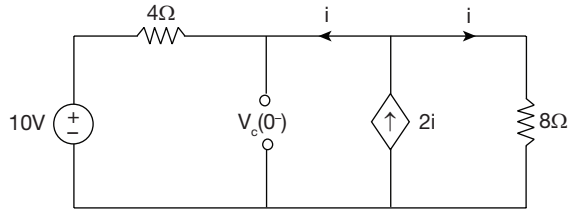
$\dfrac{E_1}{E_2} = \dfrac{N_1}{N_2}\times\dfrac{T_1}{T_2}$

$\dfrac{297}{126} = \dfrac{800}{N_2}\times\dfrac{T_1}{2T_1}$

$N_2 = 169.69$ rpm Choice (A)

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

At $t = 0^-$, the switch was closed, and the circuit is in steady state
In *S. S.*
Capacitor → open circuit
Inductor → short circuit

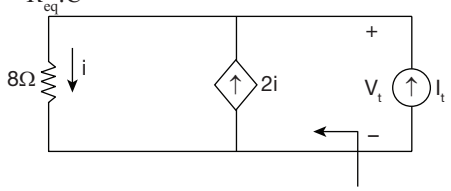


$i = \dfrac{V_C(0^-) - 10}{4}$

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 $V_C(0^-) = V_C(0^+) = 20\text{V}$
as $t \to \infty$. $V_C(\infty) = 0V$
$\Rightarrow \quad V_C(t) = 0 + \{20 - 0\}.e^{-t/\tau}$
$\tau = R_{eq}.C$



$I_t + 2i = i$
$I_t + i = 0$
$I_t + \dfrac{V_t}{8} = 0$

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

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

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

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

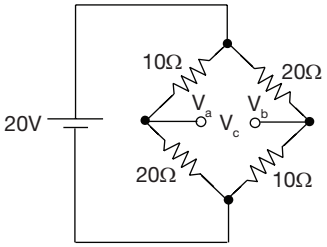
54. We know $W_c = \frac{1}{2}CV_c^2$ find the V_C value

$V_C = V_a - V_b$

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

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

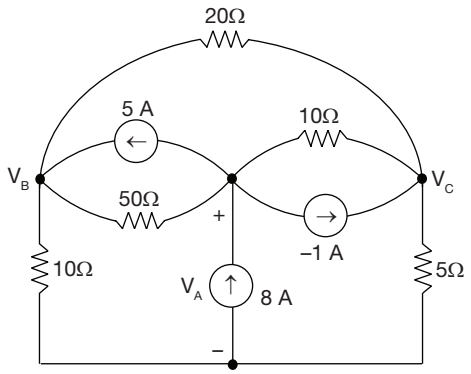
$V_c = V_a - V_b = 10\text{V}$



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

$= 100\ \mu\text{J}$ Ans: 98 to 102

55.



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

$V_A = 56.25\ \text{V}$

$V_B = 41.66\ \text{V}$

$V_C = 19.16\text{V}$ Ans: 55 to 57

56. From the given system

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

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

Controllability test $Q_C = [B\ AB]$

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

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

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

$|Q_C| = 2 + 2$

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

The system is controllable.

Observability test :

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

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

$$CA = [0\ \ 0.5]$$

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

$Q_O = 0.5 \neq 0$

$\therefore \quad |Q_O| \neq 0$

It is observable

$\therefore$ So the given system is controllable and observable.

Choice (D)

57. $N = P - Z$

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)

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

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

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

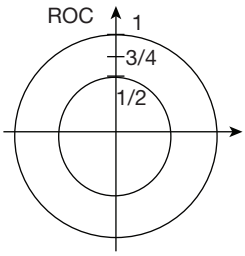
59. $X[e^{j\omega}] = \frac{1}{2j}\left[e^{+j\frac{10\pi\omega}{31}} - e^{-\frac{j10\pi\omega}{31}}\right]$

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

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

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

60.



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)

61. Here $J_1 = K_1 = \bar{Q}_0$, $J_0 = Q_1$, $K_0 = 1$

If *JK* flipflop has to be replaced with *D* flip flop then $D = J\,K$ characteristic equation $= J\bar{Q} + \bar{K}Q$

So, $D_1 = J_1\bar{Q}_1 + \bar{K}_1\,Q_1$

But here $J_1 = \bar{Q}_0, K_1 = \bar{Q}_0$ (as per connections given)

$D_1 = \bar{Q}_0.\bar{Q}_1 + \bar{\bar{Q}}_0 Q_1 = \bar{Q}_0\bar{Q}_1 + Q_0\,Q_1 \quad Q_0 = Q_1$

Similarly $D_0 = J_0\ \bar{Q}_0 + \bar{K}_0 Q_0$

$J_0 = Q_1, K_0 = 1$

So, $D_0 = Q_1.\bar{Q}_0 + 0.Q_0$

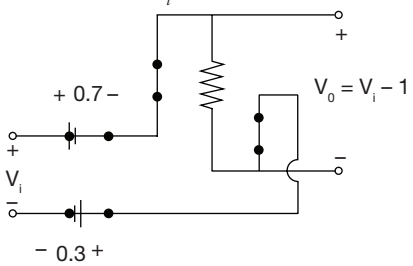
$D_0 = Q_1\ \bar{Q}_0$

(or) Find the sequence of given counter, and design the same sequence counter with *D*-flip flops. Choice (B)

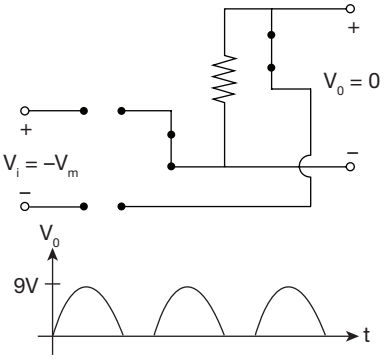
62. IN PORT1 will take input byte from I/O to Accumulator
MVI B, 40H → Copy $B = 40$ H
CMP B → Compare B with A, it will perform $(A - B)$ Subtraction
JC REJECT, JM REJECT → in the above operation if there is a carry $(A < B)$ or sign flag = 1$(A - B \geq 80)$ then sequence will go to REJECT.
Otherwise STA 2016H → 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)

63. 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 20

64. For positive values of V_i



For negative values of V_i



Choice (C)

65. $\nabla.D = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y}$

$= -e^{-x}\sin y + e^{-x}\sin y = 0$

$D \rightarrow$ solenoidal

$\nabla \times D = \begin{bmatrix} a_x & a_y & a_z \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ e^{-x}\sin y & -e^{-x}\cos y & 0 \end{bmatrix} = 0$

$D \rightarrow$ irrotational. Choice (C)