Mock Test 3

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

SECTION – I 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.

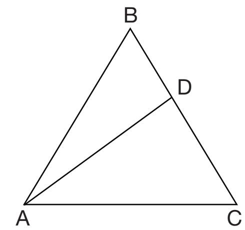
***Directions for question* 9:** In the following question, the first and the last sentence of a passage are in order and numbered 1 and 6. The rest of the passage is split into 4 parts and numbered 2, 3, 4 and 5. These 4 parts are not arranged in the proper order. Read the sentences and arrange them 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 happyby 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 10: 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

SECTION – II ELECTRICAL ENGINEERING

Directions for questions 1 to 10: Select the correct alternative from 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) p (B) pi
(C) $2p$ (D) $2pi$

13 If the Laplace Transform of a function $f(t)$ is $L\,[f(t)] = \frac{5s-4}{9s^2+25}$, then the values of $f(0^+)$ and $f(¥^-)$ respectively are ______

(A) 0 and $\frac{1}{5}$ (B) $\frac{1}{5}$ and 0
(C) 0 and $\frac{5}{9}$ (D) $\frac{5}{9}$ and 0

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

15. If 2, –3 and 5 are the eigenvalues of a 3 × 3 matrix A with $X_1 = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, X_2 = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$ and $X_3 = \begin{bmatrix} z_1 \\ z_2 \\ z_3 \end{bmatrix}$ as their corresponding eigenvectors respectively, then the rank of the matrix $P = \begin{bmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ x_3 & y_3 & z_3 \end{bmatrix}$ is ______

16. Which of the following test is predetermined test

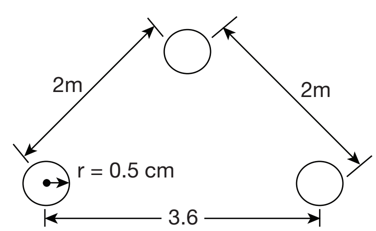
(A) Swinburne's test (B) Hopkinson's test
(C) Retardation test (D) None of the above

17. The rotor resistance and stand still reactance of a 3 – phase induction motor are 0.02 Ω/phase and 0.08 Ω per phase respectively. Then the power factor of the motor at a slip of 5 percent is ______

(A) 0.26 (B) 0.65
(C) 0.76 (D) 0.98

18. A 4 – pole, 50 Hz, 3 – Phase induction motor has rotor resistance of 0.20 Ω per phase and a maximum torque of 12 Nm at 1400 rpm. The torque when the slip of 4% is _____ Nm.

19. A 3-phase line operating at 50 Hz and conductors arrangement as shown in figure. Radius of each Conductor is 0.5 cm. Then the inductance is ________ mH/km.



20. The zero and positive sequence component of R-phase are $0.8 - j0.866$ and $3\angle 0°$ respectively. If the R-phase voltage is $4\angle 0$. Calculate the B-phase voltage.

(A) $1.14\angle -93.11°$ (B) $1.14\angle 93.11°$
(C) $0.88\angle 76.99°$ (D) $1.24\angle 82.45°$

21. A 220 kV, 3-phase, 50Hz, 250km transmission line has a capacitance to earth of 0.04 μF/km/phase. Calculate the rating of Peterson coil.
(A) 263.92 MVA (B) 152.38 MVA
(C) 50.79 MVA (D) 131.96 MVA

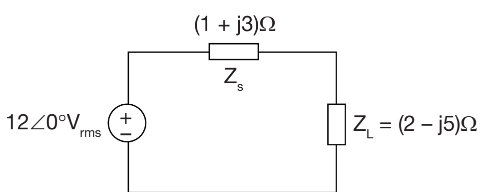
22. An ac energy meter is tested for one and half-an-hour run at a supply voltage of 230V with a current of 15A at 0.6 pf lagging. The meter constant is 1500 revolutions per kWh. The meter revolutions registered during the test were 4500. What will be the error in rpm of energy meter?
(A) 13.8% (B) 25.41%
(C) 31.2% (D) 35.6%

23. The dynamometer type watt meter measures
(A) peak value of active power
(B) average value of active power
(C) average value of reactive power
(D) peak value of reactive power

24. In a 300*v* (*dc*) single phase DC to AC inverter, using single pulse modulation for control of output voltage, harmonics of the order 9 can be eliminated.
(A) 10^{o}, $150\sqrt{2}v$ (B) 20^{o}, $150\sqrt{2}v$
(C) 40°, $100\sqrt{2}v$ (D) 80^{o}, $100\sqrt{2}v$

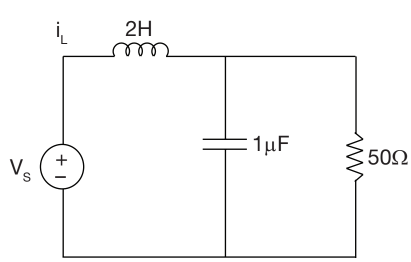
25. In a single phase voltage source full bridge inverter has the fundamental load current 15A (rms). The dc supply voltage is 200V. What is the power drawn by the resistive load due to fundamental component
(A) 340W (B) 541W
(C) 2701W (D) 3412W

26. 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

27.



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

28. 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

29. 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
v	Nyquist plot	3	Break point
z	signal flow graph	4	Corner frequency
		5	Phase cross over frequency

(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

30. The response $y(t)$ of a linear system to an excitation $x(t) = e^{-3t}.u(t)$ 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

31. 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) $\dfrac{A_{vmid}}{\sqrt{1+\left(\frac{f_H}{f}\right)^2}}$ (B) $A_{vmid}\sqrt{1+\left(\frac{f_H}{f}\right)^2}$

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

32. In high frequency amplifier, if frequency increases. Current gain A_i
(A) increases
(B) reduces
(C) no changes
(D) None of the above

33. 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

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

(A) 1,024 bits (B) 4,096 bits
(C) 5,24,288 bits (D) 10,48,576 bits

35. For a co-axial cable inner and outer diameters of conductor respectively are 0.5cm and 1.2 cm and capacitance of co-axial cable is 0.16 nF/m. Then find dielectric constant of the cable?

(A) 1.58 (B) 2.5
(C) 1.75 (D) 2.82

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 the

(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 TW and 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. The value of $y(0.2)$ in the process of solving an ordinary differential equation $\frac{dy}{dx} + 2xy = 0$ with $y(0) = 3$ by Runge-Kutta method of second order by taking the step size $h = 0.2$ is ______

(A) 2.88 (B) 3.12
(C) 3.56 (D) 4.62

41. A long shunt compound wound generator gives 250 volts and full load output of 200 A. The resistance of various windings are 0.2 Ω, 0.02 Ω, 0.03 Ω and 150 Ω of armature, series field, inter pole field and shunt fields respectively. The iron, windage and friction losses are 1500 W and 500 W respectively. The total loss of the motor is ______ watts

42. A single phase transformer has a 600 turns in the primary and 1200 turns in the secondary. The cross sectional area of the core is 905 sq.cm. If the primary winding is connected to a 50 Hz supply at 400V. The peak flux density is ______ wb/m^2

43. A three – phase, 11 kV, 50 Hz, 4 – pole, star connected cylindrical rotor synchronous motor is connected to an 11 kV, 50 Hz source. Its synchronous reactance is 60 Ω per phase and its stator resistance is negligible. The motor has a constant field excitation, At a particular load torque its stator current is 120 A at unity power factor. If the load torque is increased so that the stator current is 150 A. Then the load angle is

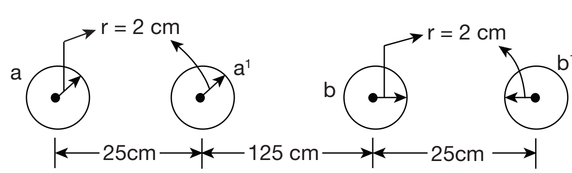
(A) 84.4° (B) 2.29°
(C) 32.6° (D) 14.5°

44. A star connected, 3-phase, 20 MVA, 6.6 kV alternator is protected by merz price circulating current principle using 500/5 A *CT*. The star point of the alternator is earth through a resistance of 8 Ω. If the minimum operating current for the relay is 0.8 A. Calculate the percentage of unprotected stator winding against earth faults in each phase.

(A) 30.60% (B) 33.58%
(C) 15.30% (D) 16.79%

45. A circuit breaker rated as 2000 *A*, 1500 MVA, 33 kV, 3-second, 3-phase oil circuit breaker the rated symmetrical breaking current is ______ A.

46. A single phase line as shown in the figure calculate the total inductance of the line per km. assuming that current is equally shared by the two parallel conductors

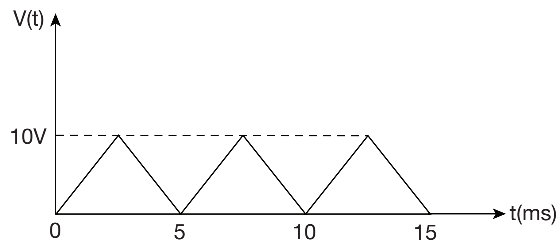


(A) 2.80 μH (B) 2.80 mH
(C) 1.40 μH (D) 1.40 mH

47. A moving coil ammeter has a fixed shunt of 0.05Ω with a coil resistance of the 1kΩ and needs potential difference of 0.5V across it for full scale deflection. What will be the value of shunt when the total current is 100A.

(A) 0.001 Ω (B) 0.01 Ω
(C) 0.005 Ω (D) 0.05 Ω

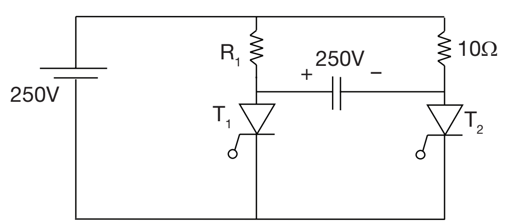
48. An average responding electronic voltmeter has its scale calibrated to indicate correctly the rms value of sinusoidal voltages. What will be the error in its reading if the instrument is used for measuring the wave shown below:



(A) – 3.86% (B) 3.86%
(C) – 4.1% (D) 4.1%

49. A current of $-5 + 4\sqrt{2}\sin(\omega t - 45^{o})$ A is passed through two meters respectively are, in center zero PMMC meter and moving iron instrument. The respective readings (in A) will be
(A) –5A, 6.4A
(B) 0A, 6.4A
(C) –5A, 5.75A
(D) 0A, 5.75A

50. A complementary commutated SCR circuit shown below:



If the thyristors T_1 and T_2 forcibly commutating by using the capacitor $C = 5$ μF. What will be the circuit turn-OFF time of T_2.
(A) 34.65 μsec (B) 45.21 μsec
(C) 60 μsec (D) 121.56 μsec

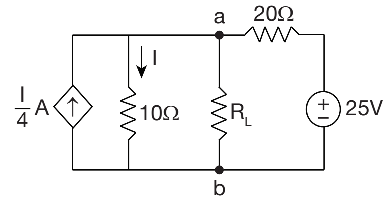
51. A single phase current source inverter is connected with a pure capacitive and resistive loads. The nature of the output voltage waveform for the constant current source will be respectively
(A) Step function, ramp function
(B) Square, triangular
(C) Triangular, square
(D) Sine wave, ramp function

52. What will be the ratio of input power factor of a single phase half controlled bridge rectifier to that of a single phase fully controlled bridge rectifier supplying an *RL* load for the same firing angle α = 0°.

(A) 1 (B) $\frac{\sqrt{2}}{0.31\pi}$

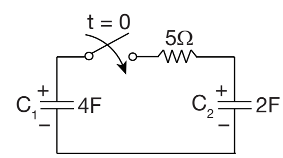
(C) $\frac{4\sqrt{2}}{0.54\pi}$ (D) 0

53. Consider the network shown in figure

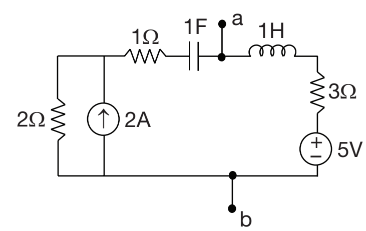


The Norton's equivalent model of the circuit across R_L is ______.
(A) $I_N = 1.25$ A and $R_N = 8$W
(B) $I_N = 0.8$ A and $R_N = 8$W
(C) $I_N = 1.25$ A and $R_N = 6$W
(D) $I_N = 0.8$ A and $R_N = 6$W

54. 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 ______*J*



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

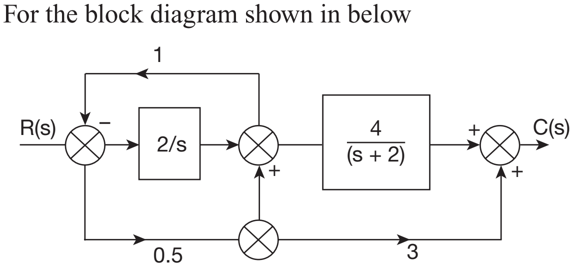


(A) $Z_{ab} = \frac{3S^2 + 10S + 2}{S^2 + 6S + 3}$ (B) $Z_{ab} = \frac{3S^2 + 10S + 3}{2S^2 + 3S + 1}$

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

56. 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

57. 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) $\dfrac{(s+2)}{(1.5s^2+8s+14)}$

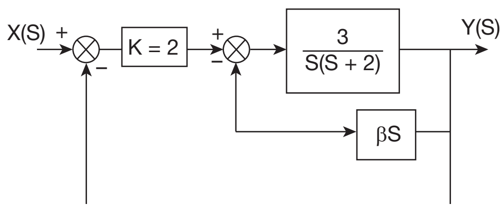
(C) $\dfrac{(1.5s^2+5s+8)}{(1.5s^2+5s+4)}$ (D) $\dfrac{(3.5s+11)}{(1.5s^2+5s+4)}$

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

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

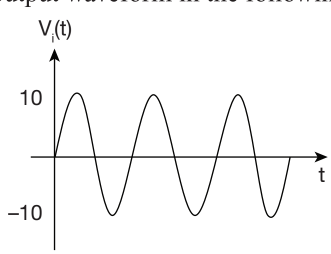
(A) –2.46 , 1.7 ,– 0.24
(B) – 0.24 , –1.7 , 2.4
(C) – 0.24 , –1.7 ,
(D) –2.46 , 1.7 , 0.24 , – 2.4

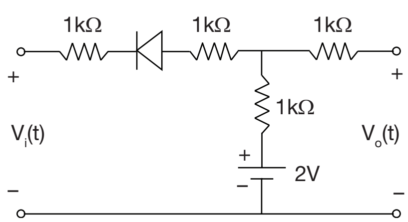
59. Consider the block diagram shown in figure

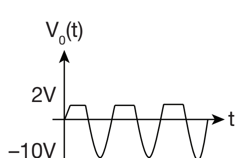


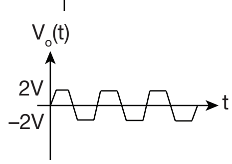
if the damping ratio of the system is equal to 0.5, then the value of β is …….

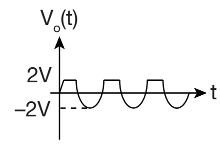
60. A 10 sinωt signal excited to a given circuit in the shown figure, the output waveform in the following is





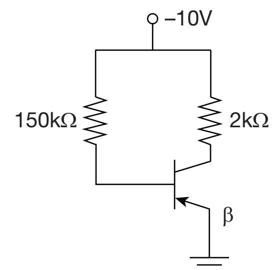
(A)


(B)


(C)


(D) None of these

61. 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

62. 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 half power frequencies with feedback to those without feedback is

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

63. 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.

64. 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

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

(A) $\frac{6}{5}$ Wb (B) $\frac{4\pi}{15}$ Wb

(C) $\frac{2\pi}{15}$ Wb (D) $\frac{24}{5}$ Wb

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.** D	**14.** 4	**15.** 3	**16.** A	**17.** D	**18.** 11.5 to 12.5		
19. 1.285 to 1.288		**20.** B	**21.** B	**22.** D	**23.** B	**24.** C	**25.** C	**26.** A	**27.** 5
28. D	**29.** B	**30.** D	**31.** C	**32.** B	**33.** A	**34.** C	**35.** B	**36.** C	**37.** B
38. D	**39.** 2.15 to 2.18		**40.** A	**41.** 12575 to 12595		**42.** 0.003 to 0.004		**43.** B	**44.** D
45. 26243.18 to 26243.20			**46.** D	**47.** C	**48.** A	**49.** A	**50.** A	**51.** C	**52.** A
53. A	**54.** 0.45 to 0.5		**55.** D	**56.** A	**57.** C	**58.** A	**59.** 0.15	**60.** C	**61.** B
62. C	**63.** D	**64.** D	**65.** B						

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

$16 + b = 50 \Rightarrow b = 34$

∴ $f(x) = -4x + 34.$

When $x = 8$

$f(x) = -4(8) + 34 = -32 + 34 = 2$

∴ $f(8) = 2$

Ans: 2

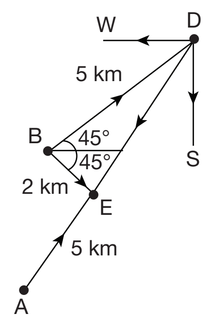
4. The right choice is "to call a spade a spade" which means to speak very frankly and openly. None of the other options go as they are negative in connotation. "To see red" is to be afraid, "'to throw in the towel" is to accept defeat and "to let the grass grow under one's feet" is to idle too long 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 $e^z = e^{x+iy} = e^x (\cos y + i \sin y)$

$= e^x [\cos(y + 2\pi) + i \sin(y + 2\pi)]$

$= e^x \,.\, e^{i(y+2\pi)}$

$= e^{x+iy+2\pi i}$

$= e^{z+2\pi i}$

$\therefore$ e^z is a periodic function with period $2\pi i$.

Choice (D)

13. Given $L[f(t)] = \frac{5s-4}{9s^2+25}$

$\therefore$ $f(0^+)$ = The initial value of $f(t) = \underset{s\to\infty}{Lt}\, sL[f(t)]$

$$= \underset{s\to\infty}{Lt}\left(s\left(\frac{5s-4}{9s^2+25}\right)\right)$$

$$= \underset{s\to\infty}{Lt}\frac{s^2\left(5-\frac{4}{s}\right)}{s^2\left(9+\frac{25}{s^2}\right)}$$

$\therefore$ $f(0^+) = \frac{5}{9}$

And $f(\infty^-)$ = Final value of $f(t) = \underset{s\to 0}{Lt}\, sL[f(t)]$

$$= \underset{s\to 0}{Lt}\, s\left(\frac{5s-4}{9s^2+25}\right)$$

$\therefore$ $f(\infty^-) = 0$ Choice (D)

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),

$2^3 = c \Rightarrow 1^2 \Rightarrow c = 8$

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 $x = 2\sqrt{2}$

$y = 2\left(2\sqrt{2}\right)^{2/3} = 22$

$\therefore$ $y = 4$ Ans: 4

15. Given that $X_1 = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$, $X_2 = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix}$ and $X_3 = \begin{bmatrix} z_1 \\ z_2 \\ z_3 \end{bmatrix}$ are eigen vectors of a 3 × 3 matrix A corresponding to the eigen values 2, –3 and 5 respectively. As all the eigen values of A are distinct, their corresponding eigen vectors X_1, X_2 and X_3 are linearly independent.

As the columns of the matrix $P = \begin{bmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ x_3 & y_3 & z_3 \end{bmatrix}$ are linearly independent, P is non-singular.

$\Rightarrow$ Rank of P = Order of P = 3. Ans: 3

16. Swinburne's test is predetermined test because the losses are calculated separately by conducting the test under no load condition. Choice (A)

17. Reactance per phase = $SX_2 = 0.05 \times 0.08 = 0.004\ \Omega$

Rotor impedance/phase = $\sqrt{0.02^2 + 0.004^2} = 0.0204$

Power factor = 0.98 Choice (D)

18. $N_S = \dfrac{120\times 50}{4} = 1500\text{rpm}$

$\omega_s = \dfrac{2\pi\times 1500}{60} = 157.07\text{ rad/sec}$

$S_{\max} = \dfrac{1500-1400}{1500} = 0.067$

$0.067 = \dfrac{R_2}{X_2} \Rightarrow X_2 = \dfrac{0.2}{0.067} = 2.985\ \Omega$

$T_{\max} = \dfrac{3}{\omega_s}\left(\dfrac{0.5V^2}{X_2}\right)$

$12 = \dfrac{3}{157.07}\times\left(\dfrac{0.5V^2}{2.985}\right)$

$V^2 = 3750.83$

$V = 61.24\text{V}$

$T = \dfrac{3}{\omega_s}\times\dfrac{V^2\left(\dfrac{R_2}{S}\right)}{\left(\dfrac{R_2}{S}\right)^2 + X_2^2}$

$\dfrac{3}{157.07}\times\dfrac{61.24^2\times\left(\dfrac{0.2}{0.067}\right)}{\left(\dfrac{0.2}{0.067}\right)^2+(2.985)^2}$

$T = 11.99$ Nm   Ans: 11.5 to 12.5 Nm

19. Self GMD = 0.7788 × 0.5 = 0.3894 cm

Mutual GMD $= \sqrt[3]{2\times 2\times 3.6} = 2.432$

Inductance per km = $2\times 10^{-4}\ \ln\left(\dfrac{2.432\times 100}{0.3894}\right)$

= 1.287 mH/km   Answer: 1.285 to 1.288

20. $E_R = E_{R0} + E_{R1} + E_{R2}$

$4 = 0.8 - j0.866 + 3 + E_{R2}$

$E_{R2} = 0.2 + j0.866$

$= 0.88\ \angle 76.99^\circ$

$E_{R0} = 1.17\ \angle -47.26^\circ$

$E_B = E_{R0} + K\,E_{R1} + K^2\,E_{R2}$

$= 1.7\angle -47.26 + (1\angle 120)\,(3\angle 0) + (1\angle 240)$

$(0.88\ \angle 76.99^\circ)$

$= -0.062 + 1.138_j$

$= 1.14\ \angle 93.11^\circ$ Choice (B)

21. Inductance of Peterson coil $L = \dfrac{1}{3\omega^2 C}$

$= \dfrac{1}{3\times(2\pi\times 50)^2\times 0.04\times 250\times 10^{-6}} = 0.337\text{ H}$

Rating of Peterson coil $= \dfrac{V_{ph}^2}{X_L}$

$= \dfrac{(220\times 10^3)^2}{3\times 0.337\times 2\times\pi\times 50}$

= 152.38 MVA   Choice (B)

22. Revolutions/minute = (Energy Consumed Per minute) × (meter constant)

$\dfrac{\left(230\times 15\times 0.6\times\dfrac{3}{2}\times 10^{-3}\right)}{60}\times 1500 = 77.62$

Registered revolutions/minute $= \dfrac{4500}{90} = 50$

%Error in rpm of the energy meter $= \dfrac{77.62-50}{77.62}\times 100$

= 35.6%   Choice (D)

23. Dynamometer responds for average value of circuit power.   Choice (B)

24. The output voltage = $\sum_{n=1,3,5}^{\infty}\dfrac{4V_s}{n\pi}\sin\dfrac{n\pi}{2}\sin\ nd\sin n\omega t$

To eliminate n^{th} harmonic, $nd = \pi$, $d = \dfrac{\pi}{n}$

Pulse width $2d = \dfrac{2\pi}{n}$,

To eliminate 9^{th} harmonic, $2d = \dfrac{2\pi}{9}\,(or)\,2d = 40^\circ$

$V_{or} = V_{dc}\sqrt{\dfrac{2d}{\pi}} = 300\sqrt{\dfrac{40}{180}}$ Choice (C)

25. Load power = $V_{or}\,I_{or}\cos\phi$

$= \dfrac{2\sqrt{2}\,V_s}{\pi}\times I_{or}\times 1$

$= \dfrac{2\sqrt{2}\times 200}{\pi}\times 15\times 1 \cong 2701$ W   Choice (C)

26. From the given circuit

$I_{rms} = \dfrac{12}{3-j2} = 2.769 + j1.846$

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

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

= 55 VAR (Leading)   Choice (A)

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

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

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

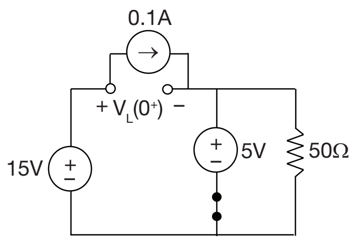
$C \to$ open circuit

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

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

For $t > 0$:-

at $t = 0^+$; $V_s = 5 + 10 = 15\text{V}$



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

$V_L(0^+) = 10V$

We know

$$V_L = L.\frac{di_L}{dt}$$

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

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

$$\frac{di_L}{dt} = 5\text{ A/sec}$$

Ans: 5

28. Choice (D)

29. Bode plot $\rightarrow$ corner frequency
Root locus $\rightarrow$ break point
Nyquist plot$\rightarrow$critical point signal flow graph –transmittance.

Choice (B)

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

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

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

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

$\therefore$ Poles – 2, –2 and zeros – 3, – 5. Choice (D)

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

32. Choice (B)

33.

A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7		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)

34. Memory is specified as ($2^{\text{Addr}} \times$ data) bits
So $2^{16} \times 8$ bits = 5, 24, 288 bits Choice (C)

35. $C = 0.16 \times 10^{-9}$ F/m

$$L = 2 \times 10^{-7} \ln\left(\frac{1.2}{0.5}\right)$$

$= 1.75 \times 10^{-7}$ H/m

$$\text{Velocity } V_P = \frac{1}{\sqrt{LC}} = 1.89 \times 10^8 \text{ m/sec}$$

$$\sqrt{\varepsilon_r} = \frac{C}{V_P} = \frac{3\times10^8}{1.89\times10^8} = 1.58$$

$\varepsilon_r = 2.5$ Choice (B)

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 $|P - \lambda I| = 0$

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

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

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

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

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

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

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

$\therefore$ The characteristic equation of P is $\lambda^4 - 16 = 0$
Hence by Cayley – Hamilton theorem, we have
$P^4 - 16I_4 = 0$ $\rightarrow$ (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 who has a Two Wheeler (TW) and a Four Wheeler (FW) respectively.

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

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

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

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

We know that

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

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

$$\Rightarrow \quad P(A) = \frac{7}{10} - \frac{3}{5} + \frac{2}{5} \Rightarrow P(A) = \frac{1}{2}$$

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

Choice (B)

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

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

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 $y = \pm\frac{1}{\sqrt{2}}$

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

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

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

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

$\therefore$ 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 $x = 2y$

$\Rightarrow$ $dx = 2dy$

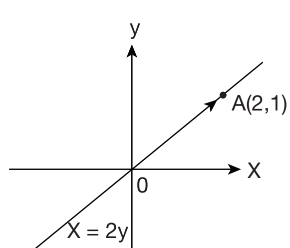
$$= \int_{y=0}^{1}\left[(2(2y) + y^2)2dy + (3y - 4(2y))dy\right]$$

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

$$= \int_0^1 (2y^2 + 3y)dy$$

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

$$= \frac{13}{6} = 2.167$$



Ans: 2.15 to 2.18

40. Given differential equation is $\frac{dy}{dx} + 2xy = 0$

$\Rightarrow$ $\frac{dy}{dx} = -2xy$

$\therefore$ $f(x, y) = -2xy$, $x_o = 0$ and $y_o = 3$

$h = 0.2$

By Runge-Kutta method of second order, we have

$$y(0.2) = y_1 = y_0 + \frac{1}{2}(K_1 + K_2) \quad \to (1)$$

Where $K_1 = hf(x_o, y_o) = h(-2x_oy_o)$

$= (0.2)\,(-2 \times 0 \times 3)$

$\therefore$ $K_1 = 0$

and $K_2 = hf(x_o + h, y_o + K_1)$

$= h[-2(x_o + h)\,(y_o + K_1)]$

$= (0.2)\,[-2 \times (0 + 0.2)\,(3 + 0)]$

$\therefore$ $K_2 = -0.24$

Substituting the values of K_1 and K_2 in (1), we get

$$y(0.2) = 3 + \frac{1}{2}(0 + (-0.24))$$

$\therefore$ $y(0.2) = 2.88$

Choice (A)

41. Output = 250 × 200 = 50,000W

Total armature resistance = 0.2 + 0.02 + 0.03 = 0.25 Ω

Shunt field current = $\frac{250}{150} = 1.67\text{A}$

Armature current = 200 + 1.67 = 201.67A

Armature circuit copper loss

= $201.67^2 \times 0.25$ = 10167.69W

Shunt field copper loss = 1.67 × 250 = 417.5W

Total loss = 2000 + 10167.7 + 417.5 = 12585.2 W

Answer: 12575 to 12595

42. $E = 4.44\,\varphi\, fT$

$400 = 4.44 \times \varphi \times 50 \times 600$

$\varphi = 3 \times 10^{-3}\ \omega b$

$$P_m = \frac{\varphi_m}{A} = \frac{3 \times 10^{-3}}{90 \times 10^{-2}} = 0.0034$$

Answer: 0.003 to 0.004

43. $E_f = V_t - I_a X_s$

$$= \frac{11}{\sqrt{3}} \times 10^3 - j120 \times 60 = \left(\frac{11}{\sqrt{3}} - j7.2\right) \times 10^3$$

$|E_f| = 9.6$ kV

$(I_a X_s)^2 = E_f^2 + V_t^2 - 2E_f V_t \cos\delta$

$(150 \times 60)^2 = (9.6 \times 10^3) + (6.35 \times 10^3) - 2 \times 9.6 \times 10^3 \times 6.35 \times 10^3 \cos\delta$

$\cos\delta = -0.66$

$\delta = 2.29°$

Choice (B)

44. $r = 8\ \Omega$

$$V_{pn} = \frac{6.6 \times 10^3}{\sqrt{3}} = 3810 \text{ volts}$$

Minimum fault current the relay will operate

$= \dfrac{500}{5} \times 0.8 = 80\text{A}$

$E.m.f$ induced in x% winding $= V_{pn} \times \dfrac{x}{100}$

$= 3810 \times \dfrac{x}{100} = 38.1x$

Earth fault current which x% winding will $= \dfrac{38.1x}{8}$

Unprotected winding $x = \dfrac{80 \times 8}{38.1} = 16.79\%$

Choice (D)

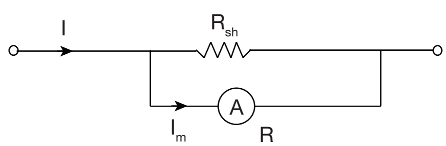
45. Given $V = 33$ kV
$S = 1500$ MVA

Rated symmetrical breaking current $I = \dfrac{1500 \times 10^6}{\sqrt{3} \times 33 \times 10^3} =$

26243.19A Answer: 26243.18 to 26243.20

46. Mutual GMD, $D_m = \sqrt[4]{150 \times 175 \times 125 \times 150}$
= 148.94 cm
Self GMD $D_s = \sqrt[4]{0.7788 \times 0.7788 \times 25 \times 25}$
= 4.41 cm
$L = 4 \times 10^{-4} \ln\left(\dfrac{148.94}{4.41}\right)$
= 1.40 mH/km Choice (D)

47. Meter current $I_m = \dfrac{0.5}{1000} = 0.5\text{mA}$



When the full scale current $I = 100$ A

$$R_{sh} = \frac{R_m}{\left(\dfrac{I}{I_m}\right) - 1} = \frac{1000}{\left(\dfrac{100}{0.5 \times 10^{-3}}\right) - 1}$$

$R_{sh} = 0.005\ \Omega$ Choice (C)

48. For triangular waveform, $V_{\text{rms(true)}} = \dfrac{V_m}{\sqrt{3}}$

$= \dfrac{10}{\sqrt{3}} = 5.773\text{V}$

Using electronic voltmeter, $V_{\text{rms}}(\text{ind}) = 1.11(V_o)_{\text{avg}}$

$= 1.11\left(\dfrac{V_m}{2}\right)$

$= 1.11\left(\dfrac{10}{2}\right) = 5.55\text{V}$

Error in the reading $= \dfrac{V_{rms(ind)} - V_{rms(true)}}{V_{rms(true)}} \times 100$

$= \dfrac{5.55 - 5.773}{5.773} \times 100 = -3.86\%$ Choice (A)

49. PMMC reads only $dc = -5$A
Moving iron meter reads rms value
$= \sqrt{(5^2 + 4^2)}$
$= \sqrt{25 + 16} = \sqrt{41} = 6.4$ A Choice (A)

50. Circuit turn-off time of T_2 is
$t_{c2} = R_2 C\ \ell_\eta(2)$
$= 10 \times (5 \times 10^{-6}) \times \ln(2)$
= 34.65 μsec Choice (A)

51. Load voltage = $V = \dfrac{1}{C}\int idt$.

$V = \dfrac{I_o}{C} t$

Which represents triangular wave form. Choice (C)

52. For single phase semi converter,

$IPF_1 = \sqrt{\dfrac{8}{\pi(\pi - \alpha)}} \cos^2(\alpha/2)$

For α = 0°, $IPF_1 = \sqrt{\dfrac{8}{\pi^2}} = \dfrac{2\sqrt{2}}{\pi}$

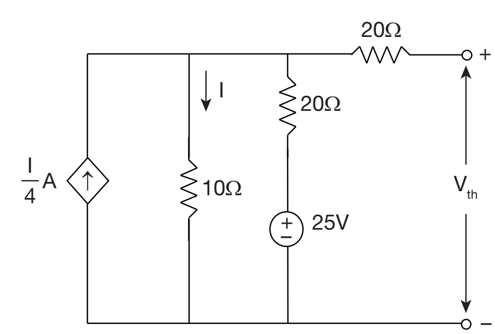
For single phase fully controlled converter,

$IPF_2 = \dfrac{2\sqrt{2}}{\pi} \cos\alpha$

For α = 0°, $IPF_2 = \dfrac{2\sqrt{2}}{\pi}$

The ratio, $\dfrac{IPF_1}{IPF_2} = 1$ Choice (A)

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



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

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

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

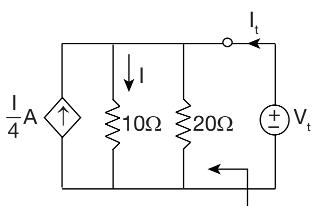
$$\frac{3V_{th}}{40}+\frac{V_{th}-25}{20}=0$$

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

$5V_{th} = 50$ V

$V_{th} = 10$ V.

Calculate R_{th}:-



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

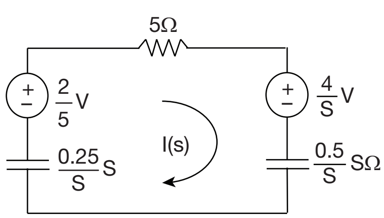
$$I_t=\frac{V_t}{20}+\frac{3I}{4}$$

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

$40\,I_t = 5\,V_t$

$$\frac{V_t}{I_t}=R_{th}=8\Omega, I_N=\frac{V_{th}}{R_{th}}=\frac{10}{8}=1.25\text{A}$$ Choice (A)

54. Redraw the given circuit in S-domain



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

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

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

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

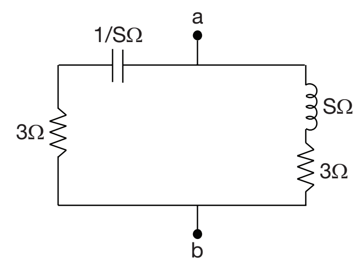
$$E=\int_0^\infty i^2(t).R.dt$$

$$E=\frac{4}{25}\times 5\int_0^\infty e^{-0.6t}.dt$$

$$E=\frac{4}{5}\left[-0.6.e^{-0.6t}\right]_0^\infty$$

$$E=\frac{4}{5}\times 0.6=0.4855\text{J}$$ Ans: 0.45 to 0.5

55. Step 1: deactivate all the independent sources



∴ voltage source → short circuit

Current source → open circuit

Step 2: draw the equivalent circuit in S-domain

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

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

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

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

56. We know

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

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

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

Choice (A)

57. Forward path gains:

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

$$P_2=\frac{0.5\times 4}{s+2}=\frac{2}{s+2}\quad \Delta_2=1$$

$P_3 = 0.5 \times 3 = 1.5$

$\Delta_3 = 1$.

Individual loop gains:

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

$L_2 = -0.5$

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

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

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

Choice (C)

58. 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)

59. $$\frac{Y(s)}{X(s)} = \frac{\dfrac{6}{(s+2)}}{1 + \dfrac{3\beta^s}{s(s+2)} + \dfrac{6}{s(s+2)}} = \frac{6}{s(s+2) + 3\beta^s + 6}$$

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

$\omega_n^2 = 6 \Rightarrow \omega n = \sqrt{6}$ rad/sec

$2\,\xi\,\omega n = 3\beta+2$

$\omega n = 3\beta+2 = \sqrt{6}$

$\beta = 0.149 \approx 0.15$

60. $V_R = 2$ Volt at P side of Diode

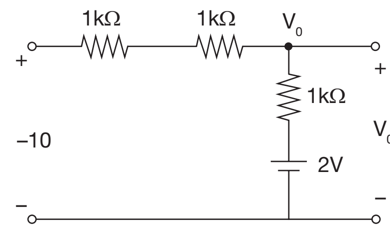
$V_i > 2$ volt

$V_0(t) = 2$ volt

$V_i < 2$ volt

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

but at –ve peak



$$\frac{V_0 + 10}{2k} + \frac{V_0 - 2}{1k} = 0$$

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

$3\,V_o = -6$

$V_o = -2$ volt

Choice (C)

61. 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

$10v = 150\,KI_B + 0.7$

$I_B = 62\ \mu$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)

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

$$\frac{f_{Hf}}{f_H} = 1 + \beta A_v$$

$= 1 + 0.1 \times 1000 = 101$

$$\frac{f_{Lf}}{f_L} = \frac{1}{1 + \beta A_V}$$

$$= \frac{1}{1 + 0.1 + 1000} = \frac{1}{101} = 0.0099$$

Choice (C)

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

Choice (D)

64. Min terms of *P*

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

00 × 0   0 × 10   *x*1*x*1   10*xx*

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*

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

*x*0*x*0 1*xx*1 *x*1*x*1 01*x 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)

65. $\psi = \int B.ds$

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

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

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

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

$$ds = d\rho\ \rho d\phi$$

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

$$= \frac{\pi}{6} \times \frac{3\rho^3}{3\times 5}\Bigg|_0^2 = \frac{+4\pi}{15}\text{Wb}$$

Choice (B)