Mock Test 1

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

SECTION – I GENERAL APTITUDE

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

1. There are _____candidates opting for Home Science today as a course of study at the college level.

(A) smaller (B) less
(C) fewer (D) lesser

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

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

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

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

A discount of 10% is offered on 'Ultra Microwave Oven' and in the above price table, the list price and the sale price of the above said article are adjacent to each other, not necessarily in the same order. What is its sale price?

(A) ₹4000 (B) ₹3600
(C) ₹1800 (D) ₹2000

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

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

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

5. In a certain code language, if REPTILE is coded as 49 and CROCODILE is coded as 81, then how is ALLIGATOR coded in that language?

(A) 95 (B) 100
(C) 49 (D) 81

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

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

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

7. If $|x| < 1$ and $1 + 3x + 5x^2 + 7x^3 + 9x^4 + \ldots\infty = 3$, then the value of x is ____.

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

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

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

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

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

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

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

10. Jane Davis, founder of Get Into Reading, which has helped Clare Ross so much, discovered the healing power of books by accident. An English lecturer at Liverpool University, England, she also taught literature courses in her community. In the process she discovered that people derived consolation from great writers and the support network the group provided. So she set up Get Into Reading, which now has more than 135 groups.
Which of the statement(s) below is/are logically valid and can be inferred from the above statements?
(i) Reading gives multiple benefits, both unexpected and wholesome.
(ii) Reading helps everyone to set up an association like Get Into Reading.

SECTION – II ELECTRICAL ENGINEERING

Directions for questions 11 to 65: Select the correct alternative form the given choice

11. If $z = x + iy$ is a complex number, then the complex mapping $w = \frac{1}{z}$ maps the points in the interior of the circle $|z| = 4$ to the _____

(A) points in the exterior of the circle $|w| = \frac{1}{4}$
(B) points in the interior of the circle $|w| = \frac{1}{4}$
(C) points in the exterior of the circle $|w| = \frac{1}{16}$
(D) points in the interior of the circle $|w| = \frac{1}{16}$

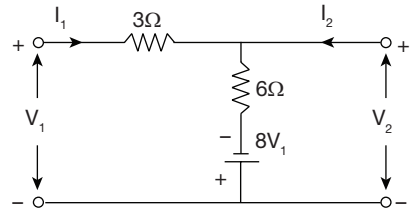
12. The order of convergence of secant method in the process of finding a root of the equation $f(x) = 0$ is ____

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

14. The unit outward drawn normal to the surface $z = x^2 + y^2 - 25$ at the point P (4, 2, –5) is ____
(A) $\frac{1}{3}(4i + 3j - k)$ (B) $\frac{1}{6}(8i + 4j - 2k)$
(C) $\frac{1}{9}(8i + 4j - k)$ (D) $\frac{1}{9}(8i + j + 4k)$

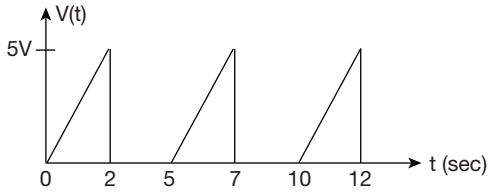
15. The value of $\lim_{x \to 2} \frac{(x^3 - 2x^2 - 9x + 18)}{(x^2 - 5x^2 + 4)}$ is _____

16. Consider the network show in below

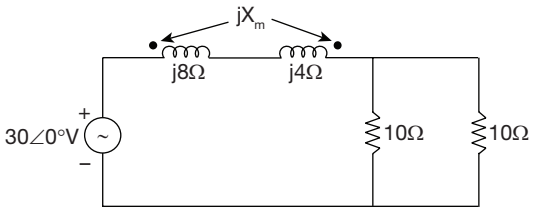


The h-parameters are
(A) Symmetrical and non reciprocal
(B) Asymmetrical and reciprocal
(C) Both symmetrical and reciprocal
(D) Asymmetrical and non reciprocal

17. The R.M.S value of the voltage waveform is _____ volts.



18. Power absorbed by the network excited by a $30\angle 0°$V sinusoidal source is 150W.

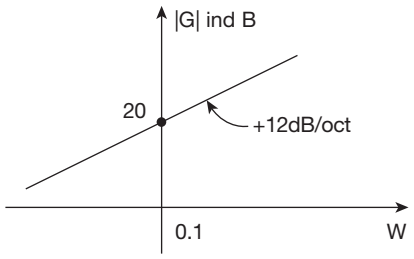


The value of mutual inductive reactance $|X_m|$ (In Ω) should be _____.

19. The open loop zero will effect the stability of
(A) Open loop system (B) Closed loop system
(C) A and B (D) None

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

21. Consider the Bode plot shown in below.

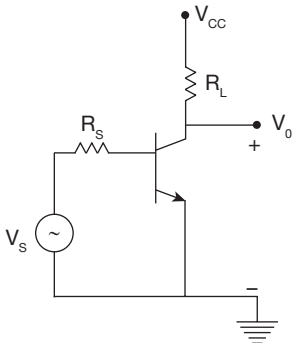


The value of gain K is _____.

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

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

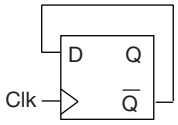
24. Determine output impedance (R_0), for the given circuit as shown in fig.

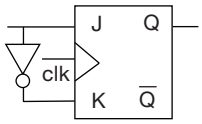


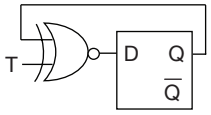
(A) 0 (B) ∞
(C) R_L (D) $R_L \| R_S$

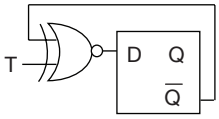
25. Find the minimum POS form of the following expression $f(a, b, c, d) = (a^1 + c^1 + d)\,(a^1 + b + d)(a^1 + b + c)\,(a + b + d)\,(b + c^1 + d)$.
(A) $(a^1 + c^1 + d)(a + b)(b + c^1 + d)$
(B) $(b + d)(a^1 + c^1 + d)(a^1 + b + c)$
(C) $(a^1 + c^1)(a + b + d)(b + c^1 + d^1)$
(D) $(a^1 + b)(a + b + d)(b^1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

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

(A)


(B)


(C)


(D)


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

28. The transfer function of a system is given as
$H(s)=\frac{s+2}{(s+3)(s-1)}$; ROC $-3 < R_e(s) < 1$.
The given system is
(A) causal only (B) stable only
(C) causal and Stable (D) None of these

29. A phase controlled SCR converter is feeding armature of a dc motor. The smoother voltage received by the armature at
(A) Rated motor speed (B) Half the rated speed
(C) Low motor speed (D) High motor speed

30. A single phase current source inverter is connected with a pure capacitive load. The nature of the output voltage waveform for the constant current source will be
(A) Step function (B) Square wave
(C) Triangular wave (D) Sine wave

31. Which one of the following bridge is used for measurement of dielectric loss and power factor of a capacitor?
(A) Kelvin's double bridge (B) Owen's bridge
(C) Maxwell's bridge (D) Shering's bridge

32. Which of the following compensation /adjustment is responsible for creeping in an induction type energy meter?
(A) Over friction compensation
(B) Over load compensation
(C) Lagging coil compensation
(D) Speed adjustment with connected to load.

33. The surge impedance loading of a 500 kV, 3-phase, 50 Hz, 400 Ω overhead, single circuit transmission line is _____ MW.

34. The concept of an electrically short, medium, and long line is primarily based on the **(GATE 2006)**
(A) nominal voltage of the line
(B) physical length of the line
(C) wavelength of the line
(D) power transmitted over the line

35. Universal motor can be used for
(A) DC supply
(B) Single phase AC supply
(C) Three phase AC supply
(D) Both A and B

36. If $f(t) = 4\sin^2 3t$, then the Laplace Transform of $\frac{f(t)}{t}$ is

(A) $\ln\left(\frac{s^2}{s^2+36}\right)$ (B) $\ln\left(\frac{s^2+36}{s^2}\right)$

(C) $\ln\left(\frac{s}{s^2+9}\right)$ (D) $\ln\left(\frac{s^2+9}{s}\right)$

37. The particular integral of the differential equation $\frac{d^2x}{dt^2}+4\frac{dx}{dt}+4x = 4\cos h2t$ is _____

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

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

38. A stationary value of a function $f(x)$ is a value of x, where $f^1(x) = 0$. The number of distinct stationary values of $f(x) = 8x^5 - 15x^4 + 10x^2$, where $f(x)$ has neither maximum nor minimum is ____

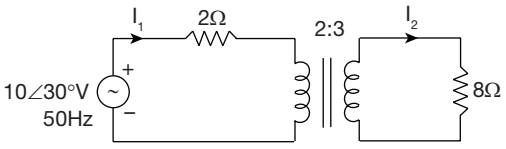
39. The mean of a continuous random variable X with its probability density function $f(x)$ given by
$f(x) = k(3 + 2x)$; $2 \le x \le 4$
0 ; otherwise
Is ____

(A) $\frac{83}{27}$ (B) $\frac{88}{27}$

(C) $.\frac{91}{27}.$ (D) $\frac{94}{27}$

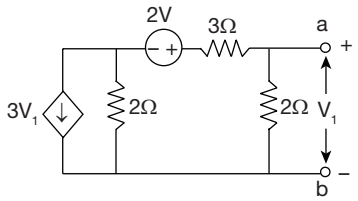
40. Which of the following statements is/are NOT TRUE?
(I) The product of two symmetric matrices A and B is symmetric if and only if $AB - BA = O$
(II) The product of two skew–symmetric matrices A and B is skew–symmetric if and only if $AB + BA = O$
(III) The eigenvectors corresponding to two distinct eigen values of a matrix are linearly independent
(IV) The eigenvectors corresponding to two distinct eigen values of a real symmetric matrix are orthogonal
(A) Only (I) (B) Only (II)
(C) Both (III) and (IV) (D) None of these

41. Consider the following circuit



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

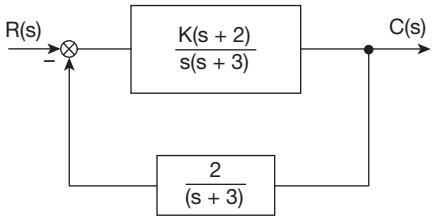
42. Consider the circuit shown in below



The Norton's equivalent resistance across the terminals 'a' and 'b' is _____ Ω.

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

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



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

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

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

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

The unit impulse response of the system $y(t)$ is _____.
(A) $(2.e^{-3t} - e^{-t}).u(t)$ (B) $(e^{-2t} - 2.e^{-t}).u(t)$
(C) $(3.e^{-2t} - e^{-t}).u(t)$ (D) None of these

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

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

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

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

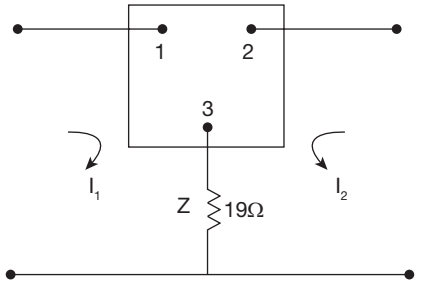
(C) $0 < \tau < \dfrac{3}{2}$

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

47. In an *N*-type silicon sample, the donor concentration is 1 atom per 2.5×10^3 silicon atoms. If the effective mass of an electron is equal to the true mass. The value of the absolute temperature at which the Fermi level coincides with the edge of the conduction band is _____. (Concentration of silicon atoms = 5×10^{22} atoms/cm^3).

(A) 0.2°K (B) 0.0258°K
(C) 2.5°K (D) 300°K

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



(A) $\dfrac{19}{29}\Omega, \dfrac{570}{29}\Omega$ (B) 1W, 20W
(C) 380W, 20W (D) 551W, 18.37W

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

(A) 1℧ and 2.5 ℧
(B) 0.05 ℧ and 10^{-3} ℧
(C) 0.01℧ and 25℧
(D) 1℧ and 1℧

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

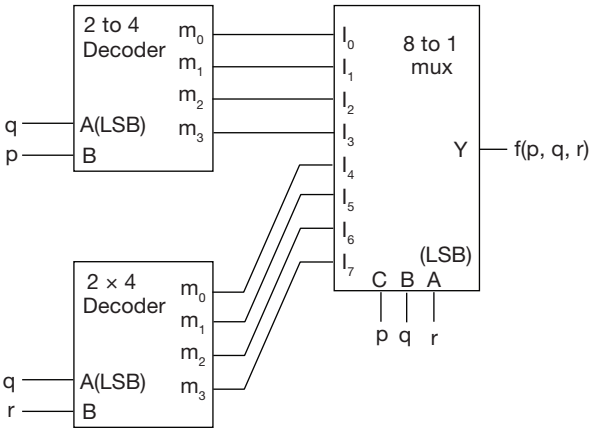
(A) 7.8 kHz (B) 8.8 kHz
(C) 7.8 Hz (D) 8.8 Hz

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

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

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

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



(A) Sm(0, 7) (B) Sm (3, 4)
(C) Sm (0, 4, 7) (D) Sm (2, 3, 5)

53. A transmission line has conductance of 0.5 μS/km, capacitance of 0.001 μF/km, resistance of 5 Ω/km and inductance of 1.5 mH/km. Then find attenuation constant at 4 kHz frequency.

(A) 2.355×10^{-3} Np/km (B) 0.03 Np/m
(C) 5.32×10^{-3} Np/km (D) 32.4×10^{-3} Np/m

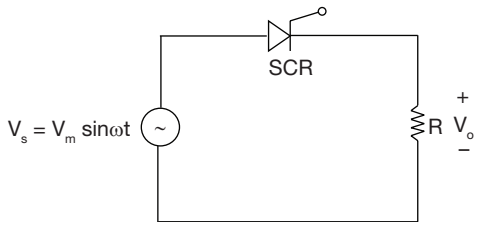
54. For a continuous time signal which is a linear combination of unit impulse functions given as
$x(t) = [\delta(t-2) + \delta(t+2) + \delta(t-1) + \delta(+1)]$.
The fourier transform of $x(t)$ is _____

(A) 2 cos2 ω + 2 sin2ω
(B) 2 cos2 ω + 2 cosω
(C) cosω + cos2 ω
(D) 2 cos2 ω + sin2 ω

55. A 230V, 1000 rpm and 100A separately excited dc motor has an armature resistance of 0.1 Ω. The motor is fed from a chopper which provides both motoring and braking operations. Assuming continuous conduction, if maximum duty ratio of chopper is limited to 0.9 and maximum permissible motor current is twice the rated, calculate maximum permissible motor speed obtainable without field weakening and power fed to the source respectively

(A) 980 rpm, 20.7 kW (B) 850 rpm, 41.4 kW
(C) 980 rpm, 54.5 kW (D) 850 rpm, 75.2 kW

56. A single phase thyristor adjust line spacing converter with a resistive load is shown below:



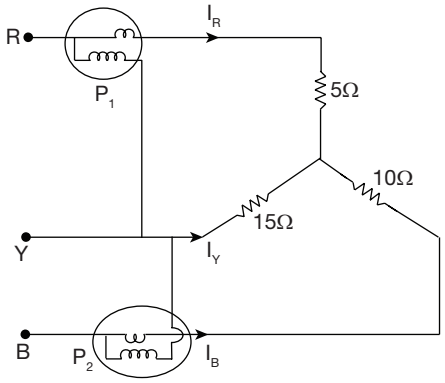
If the supply voltage is 230V (rms) at 50 Hz, calculate ripple factor for firing angle $\alpha = 45^o$ and $R = 100\ \Omega$.

(A) 1 (B) 1.11
(C) 1.21 (D) 1.44

57. What is the reading of 0.4321 on 10V range in $5\frac{1}{2}$ digit voltmeter display?

(A) 0.00043 (B) 0.43210
(C) 0.4321 (D) 0.00432

58. For power measurement in a 3 phase load, two wattmeter methods were used as shown below:



With 3-phase, 440V system of supply and the current coils of two watt meters connected in *R* and *B* phases. What will be the total load power measured by the watt meter P_1 and P_2.

(A) 5.41 kW (B) 10.82 kW
(C) 29.04 kW (D) 41.36 kW

59. A 400 kV transmission line is having per phase line inductance of 1.2 mH/km/phase and line capacitance of 12 nF/km/phase. The power transfer capability of line is _____ MW.

60. A 50 Hz, six pole turbo generator rated 40 MVA, 11 kV has an inertia constant of $H = 8.0$ kW-sec/KVA. Calculate the acceleration, if the input is 20000 Hp and the electrical power developed is 12 MW.

(A) 2.03 rad/sec^2 (B) 1.325 rad/sec^2
(C) 1.5 rad/sec^2 (D) 5.50 rad/sec^2

61. In a short circuit test on a 3-pole, 66 kV circuit breaker the following observations are made: Power factor of fault 0.5, the recovery voltage 0.85 times full line value, the breaking current symmetrical, the frequency of oscillations of restriking voltage 15 kHz. If the neutral is grounded and the fault does not involve ground then calculate the average rate of rise of restriking voltage

(A) 35.69 kV/μsec (B) 3.57 kV/μsec
(C) 59.49 kV/μsec (D) 0.059 kV/μsec

62. A 4 – pole, 400 V wave connected shunt motor has 1000 armature conductors and useful flux per pole of 20 mwb. The armature and field resistance are 0.4 Ω and 250 Ω respectively. Calculate the speed of the motor when it draws 25A from supply mains.

(A) 292 rpm (B) 1500 rpm
(C) 1170 rpm (D) 586 rpm

63. Calculate the reactance voltage for a linear commutation D.C machine has number of commutator segments, Revolutions per minute, Brush width in commutator segement and current per coil are 50, 800, 1.8 and 28 A respectively. (Assume coefficient of self induction = 150 μH)

(A) 3.12 V (B) 6.24 V
(C) 1.56 V (D) 4.68 V

64. The efficiency of a 2000 KVA, 200/400V, 50 Hz single phase transformer is 98% at half full load 0.8 *p.f* leading and 98.5% at full load unity power factor. Then the corresponding full load copper loss _____ kW

65. A 400 KVA, 3 – phase, 50 Hz transformer has a line voltage ratio of 33/11 kV and is delta/star connected. The resistances per phase for high voltage and low voltage are 40Ω and 0.85Ω respectively, if the iron loss is 3000W, calculate the full load efficiency at 0.8 p.f lagging.

(A) 98.50% (B) 97.50%
(C) 98.13% (D) 97.13%

Answer Keys

1. C	**2.** 5	**3.** B	**4.** A	**5.** D	**6.** A	**7.** B	**8.** A	**9.** A	**10.** B
11. C	**12.** 1.615 to 1.625		**13.** D	**14.** C	**15.** –0.44 to –0.39		**16.** D	**17.** 1.8 to 1.9	
18. 4.8 to 4.9		**19.** B	**20.** A	**21.** 1000	**22.** C	**23.** B	**24.** A	**25.** B	**26.** D
27. A	**28.** B	**29.** D	**30.** C	**31.** D	**32.** A	**33.** 625	**35.** D	**36.** B	**37.** D
38. 1	**39.** A	**40.** D	**41.** A	**42.** 0.52 to 0.53		**43.** 0.45 to 0.5		**44.** 3.7 to 3.8	
45. C	**46.** B	**47.** B	**48.** C	**49.** B	**50.** C	**51.** D	**52.** C	**53.** A	**54.** B
55. B	**56.** D	**57.** C	**58.** C	**59.** 505.80 to 506		**60.** B	**61.** B	**62.** D	**63.** A
64. 18.82 to 18.86		**65.** C							

Hints and Explanations

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

2. Let the weight of *A* be *a* kg and that of *B* be *b* kg.
After *A* and *B* join, total number of students in the class is 14.
∴ Before *A* and *B* joined, the strength of the class was 12. If we assume that the average weight of the 12 students is *n*, then after *A* joins, it is $\frac{12n+a}{3}$

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

$\Rightarrow$ $12n + a = 13n + 13$ ——(1)
$\Rightarrow$ $a = n + 13$
After *B* joined, the average increases by 1/2.

$$\therefore \quad \frac{12n+a+b}{14} = n+1+\frac{1}{2},$$

$\Rightarrow$ $12n + a + b = 14n + 14 + 7$ ——(2)
(2) – (1) gives $b = n + 8$ and $a = n + 13$
∴ $a - b = 5$. Ans: 5

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

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

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

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

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

$= 1 + 2x\,(1 + x + x^2 + \ldots\infty)$

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

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

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

$3x^2 - 7x + 2 = 0$
$(3x - 1)(x - 2) = 0$
$\Rightarrow$ $x = \frac{1}{3}$ (or) $x = 2$

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

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

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

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

11. We have $w =$ $\rightarrow$ (1)
Let $w = u + iv \Rightarrow |w| = \sqrt{u^2 + v^2}$

$$\therefore \quad w = \frac{1}{z} \Rightarrow z = \frac{1}{w}$$

The interior of the circle $|z| = 4$ is $|z| < 4\frac{1}{z}$

$$\therefore \quad |z| < 4 \Rightarrow \left|\frac{1}{w}\right| < 4 \Rightarrow \frac{1}{|w|} < 4$$

$\Rightarrow \quad |w| > \frac{1}{4}$

$\Rightarrow \quad \sqrt{u^2+v^2} > \frac{1}{4}$

$\therefore \quad u^2+v^2 > \frac{1}{16}$

Hence the interior points of $|z| = 4$ are mapped to the exterior points of the circle $|W| = \frac{1}{16}$

Choice (C)

12. Standard Result Ans: 1.615 to 1.625

13. Standard Results Choice (D)

14. Given surface is $z = x^2 + y^2 - 25$

i.e., $x^2 + y^2 - z - 25 = 0$

Let $f(x, y, z) = x^2 + y^2 - z - 25 = 0$

The normal to the surface $f(x, y, z) = 0$ is ∇f = grad

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

$\therefore$ The normal to the surface $f(x, y, z) = 0$ at $P(4, 2, -5)$ is

∇f at $P(4, 2, -5) = \left(8\bar{i} + 4\bar{j} - \bar{k}\right)$

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

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

Choice (C)

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

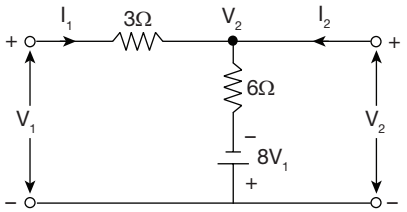
$= \underset{x \to 2}{Lim} \frac{\left(3x^2 - 4x - 9\right)}{\left(4x^3 - 10x\right)}$ (By L Hospital's Rule)

$= \frac{-5}{12} = -0.4167$ Ans: –0.44 to –0.39

16. We know h-parameters are defined in terms of

$V_1 = h_{11} I_1 + h_{12} V_2$

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



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

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

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

$V_1 = 3I_1 + V_2$ → (i)

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

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

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

$6I_2 = 18I_1 + 9V_2$

$I_2 = 3I_1 + 1.5V_2$ → (ii)

From (i) and (ii)

$$[h] = \begin{bmatrix} 3 & 1 \\ 3 & 1.5 \end{bmatrix}$$

$h_{12} \neq -h_{21}$ and $|h| \neq 1$ Choice (D)

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

From the wave from $T = 5$ sec

$0 \le t \le 2$

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

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

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

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

$V(t) = 0$

$$\therefore \quad V_{rms}^2 = \frac{1}{5}\left[\int_0^2 \left(\frac{5}{2}t\right)^2 .dt + \int_2^5 0.dt\right] = \frac{1}{5}\left[\frac{25}{12}.\left[t^3\right]_0^2 + 0\right]$$

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

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

18. From the given data

$P = 150$ W

$P = I^2.R$

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

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

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

$I^2 = 30$

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

$30X^2 = 150$

$X^2 = 5$

$X = 2.236$

Total reactance

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

$12 - 2.236 = 2\,X_m$

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

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

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

$\omega_n = 2$

$2\,z\,\omega_n = 3$

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

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

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

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

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

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

$\omega_r = 0$. Choice (A)

21. We know from the given data

Slope $\Rightarrow$ + 12dB/Oct or + 40dB/dec

So $G.H = KS^2$

$\therefore$ 20 = 20 log K + 40 log ω

Sub ω= 0.1

20 log K = 60

$K = 10^3 = 1000$. Ans: 1000

22. Choice (C)

23. Choice (B)

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

25. Given

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

$(a + b + d)$

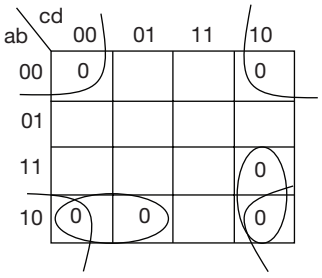
$(b + c^1 + d)$

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

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

(or)

By using K-map



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

Choice (B)

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

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

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

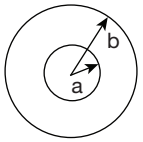
Choice (C) $Q_{n+1} = D = Q_n \odot T$

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

Choice (D)

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

Given that $\frac{a}{b} = 0.25$ Þ $\frac{b}{a} = 4$



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

$\Rightarrow \quad \frac{135\times\ln\left(\frac{9}{3}\right)}{\ln(4)} = C_2 = 106.98$ pF Choice (A)

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

Zeros are at $s = -2$

Poles are a $s = -3$ and 1

One pole at R.H.S of s-plane so non causal.

For Stability:

ROC of the system will be $-3 < R_e(s) < 1$

So ROC includes $j\,\omega$ axis so stable. Choice (B)

29. At high speed the required voltage is high and the wave form will be smooth. Choice (D)

30. Load voltage = $V = \frac{1}{C}\int idt$.

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

Which represents triangular wave form. Choice (C)

31. Schering bridge can be used for measuring dissipation factor, unknown capacitance and loss angle.

Choice (D)

32. Creeping occurring due to over friction compensation.

Choice (A)

33. Surge impedance Loading $= \frac{(KV_L)^2}{Z_o}$ MW

$= \frac{500\times500}{400} = 625$ MW Ans: 625

34. The concept of an electrically short, medium and long lines are based on both physical length of line and wavelength of the line but primarily based on physical length of line only. Choice (B)

35. Choice (D)

36. Given $f(t) = 4\cos^2 3t$

$$\therefore \quad L\left[\frac{f(t)}{t}\right] = L\left[\frac{4\cos^2 3t}{t}\right]$$

$$= L\left[\frac{2(1+\cos 6t)}{t}\right]$$

$$= 2\int_s^\infty L[1+\cos 6t]\,ds$$

$$= 2\int_s^\infty \left(\frac{1}{s}+\frac{s}{s^2+36}\right)ds$$

$$= \int_s^\infty \left(\frac{2}{s}+\frac{2s}{s^2+36}\right)ds$$

$$= 2\ln s + \ln(s^2+36)]_s^\infty$$

$$= \ln s^2 + \ln(s^2+36)]_s^\infty$$

$$= \ln\left(\frac{s^2}{s^2+36}\right)_s^\infty = \ln\left(\frac{1}{1+\frac{36}{s^2}}\right)_s^\infty$$

$$= \ln\left(\frac{1}{1+0}\right) - \ln\left(\frac{1}{1+\frac{36}{s^2}}\right) = 0 - \ln\left(\frac{s^2}{s^2+36}\right)$$

$$= \ln\left(\frac{s^2}{s^2+36}\right)^{-1} = \ln\left(\frac{s^2+36}{s^2}\right)$$ Choice (B)

37. Given differential equation is

$$\frac{d^2x}{dt^2}+4\frac{dx}{dt}+4x = 4\cosh 2t \qquad \rightarrow (1)$$

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

$$= \frac{1}{(D^2+4D+4)}4\cosh 2t$$

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

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

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

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

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

$f^1(x) = 40x^4 - 60x^3 + 20x$

$f^1(x) = 0 \Rightarrow 40x^4 - 60x^3 + 20x = 0$

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

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

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

$f^{11}(x) = 160x^3 - 180x^2 + 20$

At $x = 0;\ f^{11}(x) = 20 > 0$

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

At $x = \frac{-1}{2},\ f^{11}(x) = -45 < 0$

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

At $x = 1;\ f^{11}(x) = 0$

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

At $x = 1;\ f^{111}(x) = 120 \neq 0$

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

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

Ans: 1

39. Given the probability density function of a random variable X is $f(x) = \begin{cases} k(3+2x) & ;\ 2 \le x \le 4 \\ 0 & ;\ \text{otherwise} \end{cases}$

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

$$\int_{-\infty}^{\infty} f(x)dx = 1 \Rightarrow \int_2^4 k(3+2x)dx = 1s$$

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

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

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

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

$$= \int_2^4 x\left(\frac{1}{18}(3+2x)\right)dx = \frac{1}{18}\int_2^4 (3x+2x^2)\,dx$$

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

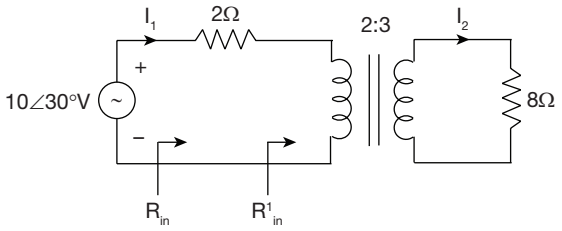
$$\therefore \quad E(X) = \frac{83}{27}$$ Choice (A)

40. Standard Results

Choice (D)

41. We know,

$$\frac{V_2}{I_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2}$$



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

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

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

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

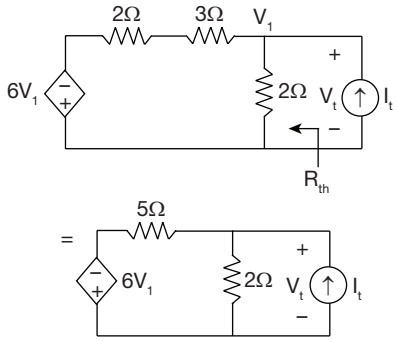
$$\frac{I_1}{I_2} = \frac{3}{2} \Rightarrow I_2 = \frac{2}{3} \times 1.8125\angle 30^o \text{ A} = 1.2\angle 30^o\text{A}$$

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

42. We know $R_N = R_{th} = \dfrac{V_{th}}{I_{SC}}$

Or connect one test source and find the equivalent resistance

The equivalent circuit becomes



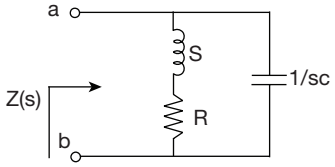
But $V_1 = V_t - I_t + \dfrac{V_t}{2} + \dfrac{V_t + 6V_t}{5} = 0$

$10I_t = 5\ V_t + 14V_t$

$19V_t = 10\ I_t$

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

43.



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

$$f_o = \frac{1}{2\pi\sqrt{LC}} \cdot \sqrt{1 - \frac{R^2C}{L}}\ \text{Hz}$$

Sub R, L, C values

$$f_o = \frac{1}{2\pi\sqrt{4}} \cdot \sqrt{1 - \frac{1}{16}}$$

$$f_o = \frac{0.9682}{4\pi}\text{Hz}$$

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

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

It is type -1 system so

$$e_{ss} = \frac{1}{K_v} = 0.2$$

$K_v = 5.$

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

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

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

45. From the given data

$$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

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

We know the overall transfer function of the system

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

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

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

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

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

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

Given $m(s) = 1$

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

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

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

$A = -1$ and

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

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

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

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

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

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

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

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

The Routh's array is

S^3	$3\,t\,K + 1$
S^2	$3 + t\,K$
S^1	$(K+1) - \dfrac{3\tau K}{3+\tau}$
S^0	K

For stable system

$K > 0$, $t > 0$ and $3 + t > 0$.

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

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

$1 + \dfrac{1}{K} > \dfrac{3\tau}{3+\tau}$ gives

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

$\therefore \quad t > \dfrac{3}{2}$ Choice (B)

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

at $E_C = E_F$

$n = N_C$

$n = N_C \approx N_D$

$N_D = 5 \times 10^{22} \times \dfrac{1}{2.5 \times 10^3}$

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

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

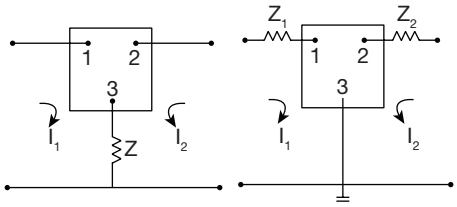
$N_C = 4.82 \times 10^{21} \left(\dfrac{m_e}{m}\right)^{\frac{3}{2}} . T^{3/2}$

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

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

$T = 0.0258^{\circ}$ K Choice (B)

48.



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

$= 19 \times 20 = 19 \times \left(1 + \dfrac{1}{20}\right)$

$= 380\text{W} = 20\text{W}$ Choice (C)

49. $g_m = \dfrac{I_C}{V_T}$ & $V_T = \dfrac{T}{11600}$

$g_m = 0.05$

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

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

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

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

$\dfrac{1}{\sqrt{1 + \left(\dfrac{f_{Ln}}{f}\right)^2}} = 0.89$

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

$f_{Ln} = 15.265$ Hz.

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

$f_L = 7.782$ Hz Choice (C)

51. MVI A, 82 H ® A = 82 H

ADI 7FH ® Add 7FH to A, and store result in A

$A = 82 = 1000\ 0010$

$7F = 7F$	0111 1111
	(1) 0000 0001

So carry flag = 1. A = 01H
JC DSPLAY, – If there is carry in previous instruction, jump to DSPLAY. As there is CY present in previous addition, execution will go to location DSPLAY
SUB $A \rightarrow$ subtract A from A, so A = 00H
OUT Port 1 $\rightarrow$ display contents of Accumulator = 00H. at Port 1. HLT – Stop Choice (D)

52. The output of first decoder
$m_o = \overline{p}\,\overline{q}$, $m_1 = \overline{p}\,q$, $m_2 = p\overline{q}$, $m_3 = pq$
the output of second decoder
$m_o = \overline{r}\,\overline{q}$, $m_1 = \overline{r}\,q$, $m_2 = r\overline{q}$, $m_3 = rq$
output of multiplexer
$= I_0\,\overline{S_2}\,\overline{S_1}\,\overline{S_0} + I_1\,\overline{S_2}\,\overline{S_1}\,S_0 + I_2\,\overline{S_2}\,S_1\,\overline{S_0}$ ……$+ I_7 S_2 S_1 S_0$
$f(p, q, r) = \overline{p}\,\overline{q}\,.\,\overline{p}\,\overline{q}\,\overline{r} + \overline{p}\,q.\,\overline{p}\,\overline{q}\,r + p\overline{q}\,.\,\overline{p}\,q\,\overline{r} + pq.\,\overline{p}\,qr + \overline{r}\,\overline{q}\,.\,p\overline{q}\,\overline{r} + \overline{r}\,q.p\overline{q}\,r + r\overline{q}\,.pq\,\overline{r} + rq\,pqr$
$f(p, q, r) = \overline{p}\,\overline{q}\,\overline{r} + p\,\overline{q}\,\overline{r} + pqr$
$= Sm(0, 4, 7)$ Choice (C)

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

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

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

55. At rated operation, $Eb_1 = V - I_o R = 230 - 100 \times 0.1 = 220$V
Maximum average voltage at
$d = 0.90$, $V_o = \delta V_s = 0.9 \times 230 = 207$V.
Back emf, $E_{b_2} = V_o - IR$
$= 207 - 200 \times 0.1 = 187$V
$N_2 = \frac{E_{b_2}}{E_{b_1}} \times N_1 = \frac{187}{220} \times 1000 = 850$ rpm

Assuming loss less chopper, power fed into the source
$P = V_o I_o = 207 \times 200 = 41.4$ kW Choice (B)

56. Average output voltage, $V_o = \frac{V_m}{2\pi}(1 + \cos a)$

$V_o = \frac{\sqrt{2} \times 230}{2\pi}(1 + \cos 45^\circ)$
$V_o = 88.37$V
RMS output voltage,
$V_{or} = \frac{V_m}{2\sqrt{\pi}}\left\{(\pi - a) + \frac{\sin 2a}{2}\right\}^{1/2}$

$V_{or} = \frac{\sqrt{2} \times 230}{2\sqrt{\pi}}\left[\left(\pi - \frac{\pi}{4}\right) + \frac{1}{2}\sin\left(\frac{\pi}{2}\right)\right]^{1/2}$
$V_{or} = 155.07$
Ripple factor $= \sqrt{\frac{V_o^2 - V_r^2}{V_o^2}} = 1.44$ Choice (D)

57. Resolution on 10V scale $= 10 \times \frac{1}{10^5} = \frac{1}{10^4} = 0.0001$
Hence meter will display upto 4th decimal 0.4321.
Choice (C)

58. Phase voltage $V_R = \frac{440}{\sqrt{3}}\angle 0^\circ = 254.08\angle 0^\circ$ V

$V_Y = \frac{440}{\sqrt{3}}\angle -120^\circ = 254.03\angle -120^\circ$V

$V_B = \frac{440}{\sqrt{3}}\angle -240^\circ = 254.03\angle -240^\circ$ V

Line voltage V_{RY} leads V_R by 30°
$V_{RY} = 440\angle 30^\circ$ and $V_{YB} = 440\angle -90^\circ$
Phase current of star connected load $I_R = \frac{254.03\angle 0^o}{5}$
$R_R = 50.806$ A
$I_B = \frac{254.03}{10}\angle -240^\circ = 25.403\angle -240$
$P_1 = V_{RY} I_R \cos\theta_R = 440 \times 50.806 \times \cos 30$
$= 19.36$ kW
$P_2 = V_{BY} R_B \cos\theta_B = 440 \times 25.403 \times \cos 330$
$= 9.68$ kW
Total power $P = P_1 + P_2 = 29.04$ kW Choice (C)

59. Surge impedance of line $Z_L = \sqrt{\frac{L}{C}}$

$= \sqrt{\frac{1.2 \times 10^{-3}}{12 \times 10^{-9}}} = 316.22\ \Omega$

Power transfer capability in MW $= \frac{V^2}{Z_L}$

$= \frac{400^2}{316.22} = 505.97$ Ans: 505.80 to 506

60. The accelerating power = mechanical power input – electrical power output
$= 20000 \times 0.735 - 12000 = 2.7$ MW
Acceleration $\alpha = \frac{P_a}{M} = \frac{2.7}{M}$

$M = \frac{SH}{\pi f} = \frac{40 \times 8}{\pi \times 50} = 2.03$ MJ-s/radian

$\alpha = \frac{2.7}{2.037} = 1.325$ rad/sec^2

Choice (B)

61. Peak value of voltage $= \frac{66}{\sqrt{3}} \times \sqrt{2} = 53.88$ KV

Instantaneous value of recovery voltage
$V_r = k\, V_m \sin f$
$= 0.85 \times 1.5 \times 53.88 \times 0.866 = 59.49$ kV

$\frac{1}{\pi\sqrt{LC}} = 2 \times 15 \times 10^3 = 30 \times 10^3$

Average RRRV $= \frac{2V_r}{\pi\sqrt{LC}} = 2 \times 59.49 \times 30 \times 10^3$

$= 3.57$ kV/μsec Choice (B)

62. Shunt field current $= \frac{400}{250} = 1.6$A

$I_a = 25 - 1.6 = 23.4$A
$E_b = 400 - 23.4 \times 0.4 = 390.64$V
$E_b = \frac{\varphi ZN}{60} \times \frac{P}{A}$

$390.64 = \frac{20 \times 10^{-3} \times 1000 \times N}{60} \times \frac{4}{2}$

$N = 585.96$ rpm Choice (D)

63. Current per coil = 28A
Self Induction $L = 150$ μH

$T_C = \frac{1.8}{50} \times \frac{60}{800} = 2.7 \times 10^{-3}$ S

Reactance voltage $E = L \times \frac{2I}{T_C} = 150 \times 10^{-6} \times \frac{2 \times 28}{2.7 \times 10^{-3}}$

$= 3.12$V Choice (A)

64. Full load output at unity power factor = 2000 kW

Full load input $= \frac{2000}{0.985} = 2030.45$kW

Full load losses $= W_i + W_{cu} = 2030.45 - 2000$
$W_1 + W_{cu} = 30.45$ kW → (1)

Input at half full load 0.8 p.f $= \frac{1000 \times 0.8}{0.98} = 816.32$ kW

Total losses at Half Full load $= W_i + \frac{W_{cu}}{4} = 816.32 - 800$

$W_i + \frac{W_{cu}}{4} = 16.32$ → (2)

Solving (1) and (2) $W_i = \frac{1161}{100} = 11.61$kW

$W_{cu} = \frac{471}{25} = 18.84$ kW Ans: 18.82 to 18.86

65. Transformation ratio $K = \frac{11000}{\sqrt{3} \times 33,000} = \frac{1}{3\sqrt{3}}$

$R_{02} = 0.85 + \left(\frac{1}{3\sqrt{3}}\right)^2 \times 40 = 2.33\Omega$

Secondary phase current $= \frac{400 \times 10^3}{\sqrt{3} \propto 11000} = 21$A

Iron loss = 3000W

Full load copper loss $= 3 \times \left(\frac{400}{11\sqrt{3}}\right)^2 \times 2.33$

$= 3081$ W.
Total full load losses = 3081 + 3000 = 6081 W
Full load output at 0.8 = 400 × 0.8 = 320 kW

$\therefore$ efficiency $= \frac{320}{320 + 6.08} = 98.13\%$

Choice (C)