GATE 2023

Electrical Engineering

Questions & Solutions

5th Feb Forenoon Session

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GATE 2023
Exam Analysis

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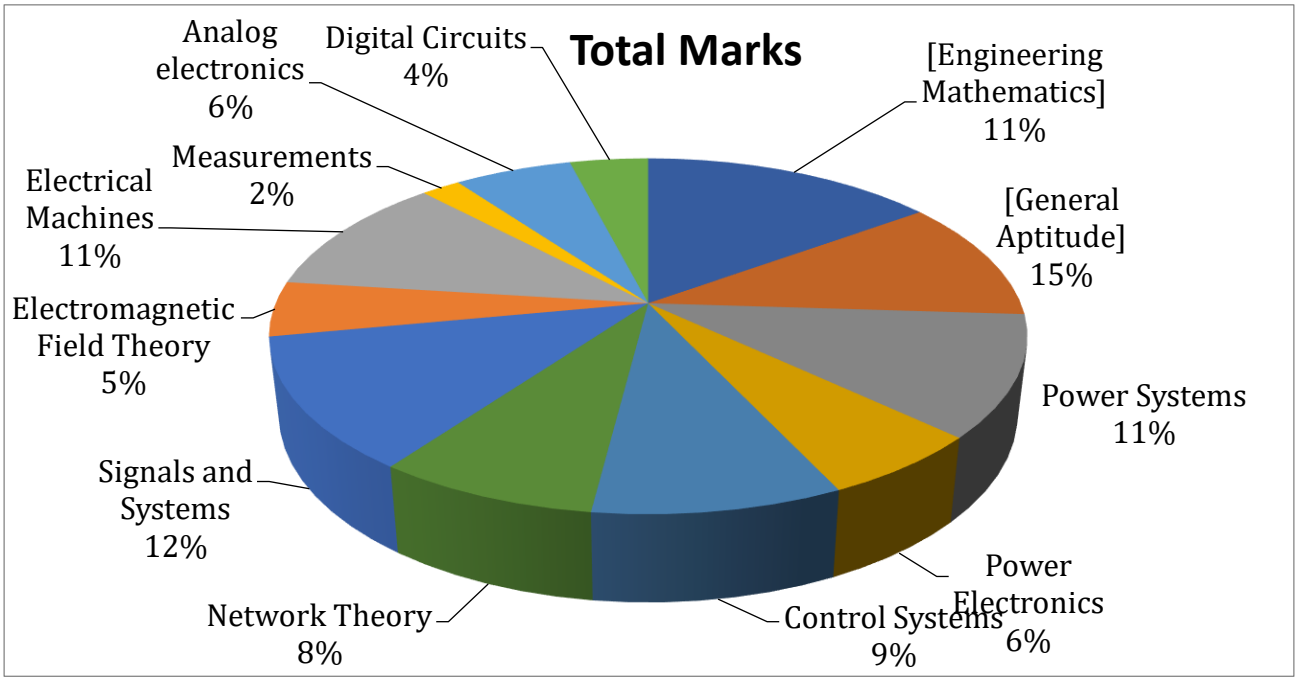
EE

GATE 2023 Paper Analysis

Memory Based



GATE 2023 Paper Analysis

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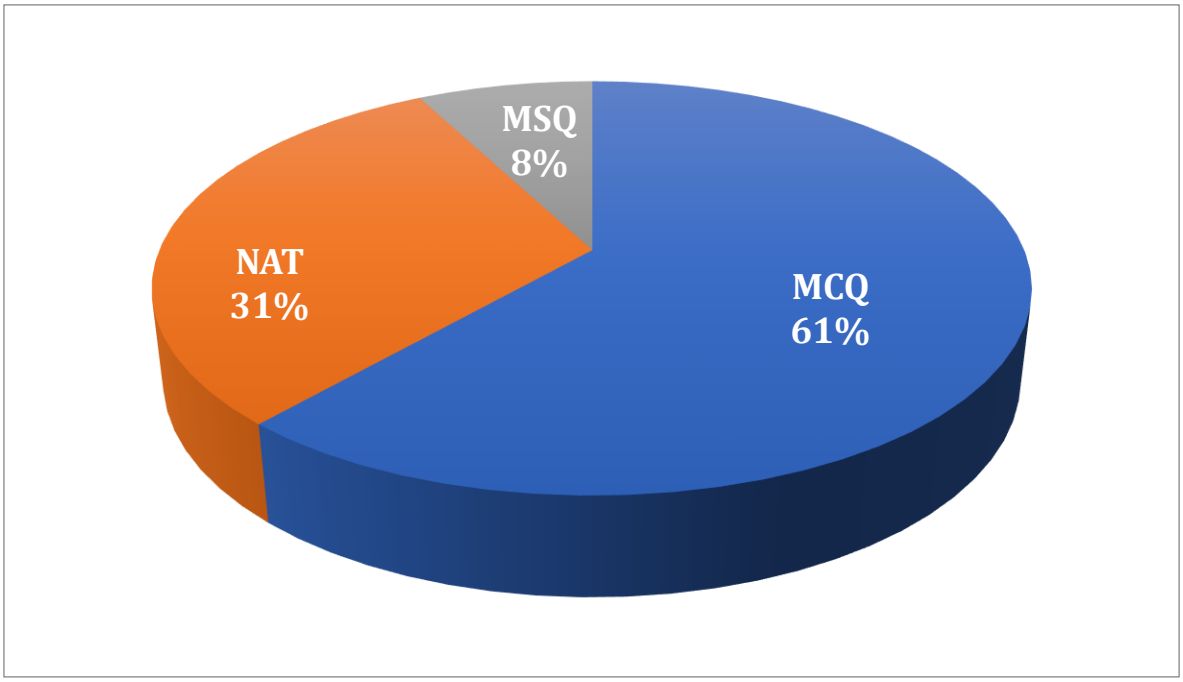
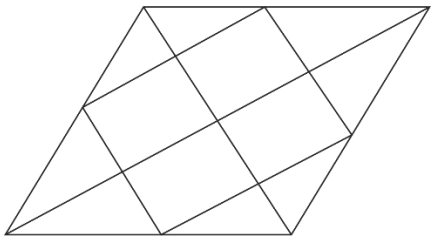


SECTION - A GENERAL APTITUDE

1. How many triangles?



MCQ

(A) 20 (B) 24

(C) 16 (D) 12

Correct Option: A **1 Mark**

2. Rati told Mary, "I am thinking of watching a film this weekend. The following reports the above statement in indirect speech:

Rati told Marry that he _____ of watching a film that weekend

MCQ

(A) is thinking (B) through

(C) was thinking (D) am thinking

Correct Option: A **1 Mark**

3. Students of all the departments of a collegewho have successfully completed the registration process are eligible to vote in the upcoming college elections. However, by the time the due date for registration was over, it was found that surprisingly none of the students from the department of Human Sciences had completed the registration process. Based only on the information provided above, which one of the following sets of statements(s) can be logically interred with certainly?

(i) All the students who would not be eligible to vote in the college elections would certainly belong to the department of Human Sciences.

(ii) None of the students from department other than Human sciences failed to complete the registration process within the due date.

(iii) All the eligible voters would certainly be students who are not from the department of Human Sciences

MCQ

(A) (i) and (iii)
(B) Only (i)
(C) Only (iii)
(D) (i) and (ii)

Correct Option: B

2 Mark

4. Unit place $3^{999} \times 7^{1000}$ is _____

MCQ

(A) 1
(B) 7
(C) 9
(D) 3

Correct Option: B

2 Mark

5. Given a fair six-faced dice where the faces are labeled '1', '2', '3', '4', '5' and '6', what is the probability of getting '1' on the 1st roll of the dice and '4' on the '2nd' roll?

(A) $\frac{5}{6}$ (B) $\frac{1}{6}$

(C) $\frac{1}{36}$ (D) $\frac{1}{3}$

MCQ

Correct Option: C **1 Mark**

6. Permit : _____ : : Enforce : Relax

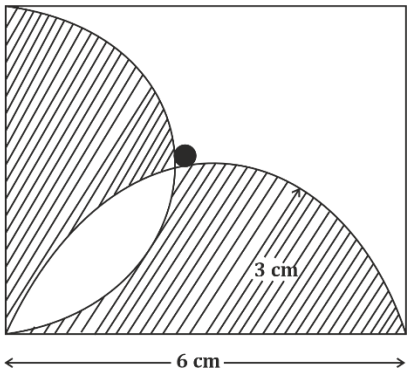
MCQ

(A) All no (B) Forbid

(C) License (D) Reinforce

Correct Option: C **1 Mark**

7. A square with sides of length 6 cm is given. The boundary of the shaded region is defined by the two semi-circles whose diameters are the sides of the square, as shown. The area of the shaded region _____ cm^2



NAT

Answer: 18 **2 Mark**

8. A recent survey shows that 65% of tobacco users were advised to stop consuming tobacco. The survey also shows that 3 out of 10 tobacco users attempted to stop tobacco. Which one is logically inferred with certainly?

(A) A majority of tobacco users who were advised to stop consuming tobacco didn't attempt to do so

(B) Approx 30% of tobacco users successfully stopped consuming tobacco

(C) A majority of tobacco users who were advised to stop consuming tobacco made an attempt to do so

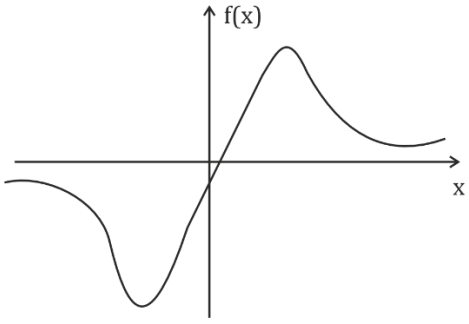
(D) Approx 65% of tobacco users successfully stopped consuming tobacco

MCQ

Correct Option: D

1 Mark

9. Which one of the following options represents the given graph?



MCQ

(A) $f(x) = x2^{-x}$

(B) $f(x) = x2^{-|x|}$

(C) $f(x) = |x|2^{-x}$

(D) $f(x) = x^2 2^{-|x|}$

Correct Option: B

2 Mark

10. Which of the following options does NOT describe the passage below or follow from it?

We tend to think of cancer as a 'modern' illness because its metaphors are so modern. IT is a disease of over production, of sudden growth, a growth that is unstoppable tipped into the abyss of no control. Modern cell biology encourages us to imagine the cell as a Molecular machine. Cancer is that machine unable to quench its initial command (to grow) and thus transform into an indestructible, self-propelled automation.

(A) Modern cell biology encourages metaphors of machinery, and cancer is often imagined as a machine.

(B) If tells us that modern cell biology uses and promotes metaphors of machinery.

(C) It is a reflection of why cancer seems so modern to most of us

(D) Modern cell biology never uses figurative language, such as metaphors, to describe (or) explain anything

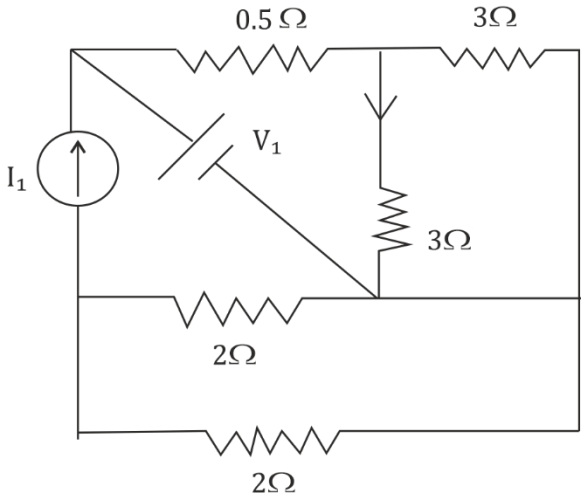
MCQ

Correct Option: C

2 Mark

SECTION - B TECHNICAL

1. $V_1 = 8V$, Find Vab=?

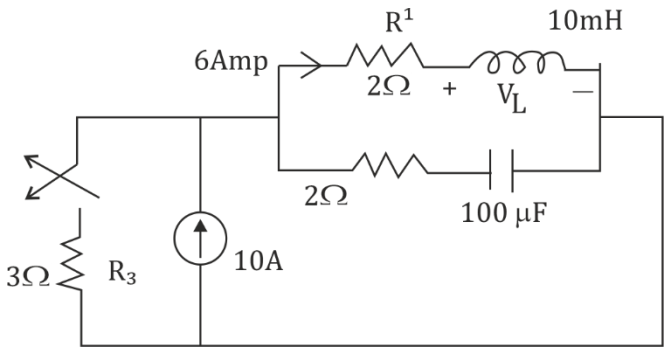


NAT

Answer: 6

1 Mark

2. For t<0, circuit is steady state



T > 0, switch → open, t = O^+, V_L (O^+) = ?

NAT

Answer: 8

1 Mark

3. Consider a unity feedback system consisting of the plant G(S) and P-I controller. Let the $K_P = 3$ & $K_I = 1$. For unit step input, the final value of the controller o/p and the plant o/p are

$G(s) = \frac{1}{S-1}$

(A) ∞, ∞ (B) ?1, 1

(C) 1, 0 (D) 1, ?1

MCQ

Correct Option: B

1 Mark

4. Dice what is the probability of getting '1' on 1st roll &4 on 2nd roll.

(A) $\frac{1}{8}$ (B) $\frac{1}{36}$

(C) $\frac{5}{6}$ (D) $\frac{1}{6}$

MCQ

Correct Option: B **1 Mark**

5. A causal time system is initially at rest is given by $\frac{dy(t)}{dt} + 3y(t) = 2x(t)$. Impulse response is.

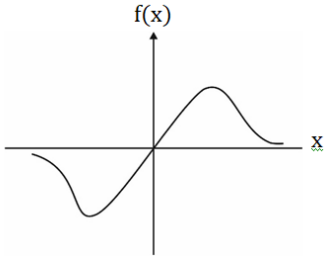
MCQ

(A) $3e^{-2t}$ (B) $2e^{-3t}$

(C) $\frac{1}{3}e^{-2t}u(t)$ (D) $2e^{-3t}u(t)$

Correct Option: D **1 Mark**

6. Which one of the following option represents the given graph?



(A) $f(x) = x\,2^{-x}$ (B) $f(x) = x\,2^{-|x|}$

(C) $f(x) = |x|\,2^{-x}$ (D) $f(x) = x^2\,2^{-|x|}$

MCQ

Correct Option: B **2 Mark**

7. For a given vector $W = [1\ 2\ 3\ ]^T$, the vector normal to plane by $w^Tx = 1$ is

(A) $[3\ 2\ 1]^T$ (B) $[1\ 2\ 3]^T$

(C) $[-2\ -2\ 2]^T$ (D) $[3\ 0\ -1]^T$

MCQ

Correct Option: B **1 Mark**

8. 3 points in xy plane are (–1, 0, 8), (0, 2·2) (1, 2·8). The value of slope of best fit straight line in the least square since is _____

NAT

Answer: * **1 Mark**

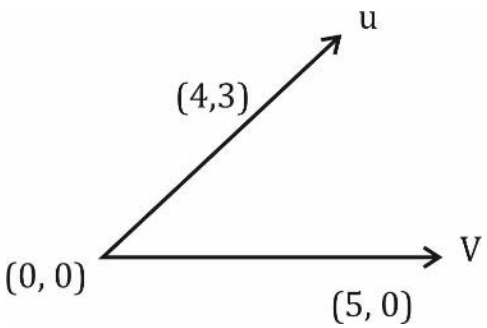
9. The numerically obtained value of 4(t) at t = 1 is_____.

$\frac{dy}{dt} = \frac{e^{-\propto t}}{2+\propto t} \propto = 0.01$ e y(0) = 0

NAT

Answer: * **1 Mark**

10. Au =V by a transformation matrix A [42 v vector] A is



(A) $\begin{bmatrix} 4/3 & -3/5 \\ 3/5 & -4/5 \end{bmatrix}$

(B) $\begin{bmatrix} 4/5 & -3/5 \\ 3/5 & 4/5 \end{bmatrix}$

(C) $\begin{bmatrix} 4/5 & 3/5 \\ -3/5 & 4/5 \end{bmatrix}$

(D) $\begin{bmatrix} 4/5 & 3/5 \\ 3/5 & 4/5 \end{bmatrix}$

MCQ

Correct Option: B

1 Mark

11. $X(z) = \frac{4z}{\left(\frac{z-1}{5}\right)\left(\frac{z-2}{3}\right)(z-3)}$ ROC = R

(A) DFT converges of x(n) converges if R is such x(n)is left sided.

(B) DFT converges of x(n) converges if R is $\frac{2}{3} < |2| < 3$

(C) DFT converges of x(n) converges if R is $|2| > 3$

(D) DFT converges of x(n) converges if R is is such x(n)is right sided seg.

MCQ

Correct Option: B

1 Mark

12. $X(w) = 1 \quad |w|<w_0$

$0 \quad |w|>w_0$

Which one is true?

(A) At $= t = \frac{\pi}{2w_0}$, $x(t) = \frac{1}{\pi}$

(B) x(o) decreases as w_0 increases

(C) x(t) tends to an an impulse $w_0 \to \infty$

(D) At $= t = \frac{\pi}{2w_0}$, $x(t) = \frac{-1}{\pi}$

MCQ

Correct Option: C — **1 Mark**

13. Which is true?

(A) If the impulse response $o<|n|n||<1$ for all n, then the LTI s/s is stable.

(B) If n (n) is of finite duration the system is stable.

(C) If LTI s/s is causal, it is stable.

(D) A dT LTI s/s is causal if its step response is o for $n<o$.

MCQ

Correct Option: A — **2 Mark**

14. The DTF T of signal x (n) is $X(\Omega) = (1+\cos\Omega)\, e^{-j\Omega}$. Consider xp[n] is periodic with period N =5 such that $xp[n] = x[n]$, for $n = 0, 1, 2=0$, for $n = 3, 4$

Note: $xp[n] = \sum_{K=0}^{N-1} a_{K} e^{j\frac{2\pi}{N}Kn}$, $\theta s = ?$

NAT

Answer: * — **1 Mark**

15. The period of x[n], N = ?

$$x[n] = 1+3\sin\left(\frac{15\pi}{\theta}n + \frac{3\pi}{4}\right) - 5\sin\left(\frac{\pi}{3}n - \frac{\pi}{4}\right)$$

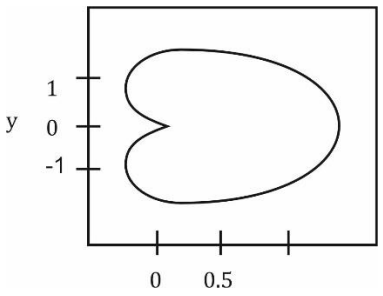
NAT

Answer: *

1 Mark

16. The closed curve in figure in described by r = 1 +cosθ, r=$\sqrt{x^2 + y^2}$

x =r cosθ y = r sinθ. The margin of line integral of vector field F = –y$\hat{\imath}$ + x $\hat{\jmath}$ around the closed curve is _____.



NAT

Answer: 9.42

1 Mark

17. A quadratic function of 2 variables is given as f(x_1, x_2)= $x_1^2 + 2x_2^2 + 3x_1 + 3x_2 + x_1x_2 + 1$

The magnitude of the maximum rate of change of function at point (1, 1) in_____.

NAT

Answer: 10

1 Mark

18. The expected no. of trials for first occurrence of ahead in a biased coin is known to be 4. The probability of first occurrence of head in the descend trial is_____. **NAT**

Answer: 0.1875 **1 Mark**

19. A $3-\phi$, synchronous motor with $z_s = 0.1 + j0.3$ pu/phase has a static stability limit of 2.5 pu. The corresponding excitation voltage in pu is _____ **NAT**

Answer: * **1 Mark**

20. A 10 pole, 50HZ, 24OV, $1-\phi$ IM runs at 540 rpm while driving a rated load. The frequency of induced rotor currents due to backward field is **MCQ**

(A) 100Hz (B) 10Hz

(C) 5Hz (D) 95Hz

Correct Option: D **1 Mark**

21. The 4 stator conductor (AA'BB') of a rotating m/c are carrying DC current of the same value, the direction of which are shown in the fig(i). The rotor coils aa' & bb' are formed by connecting the back ends of conductors a & a' and b & b' resp. as shown in fig(i). The emf, induced in coil aa' & coil bb' are denoted $E_{aa'}$&$E_{bb'}$ resp. If the rotor is rotated uniformly at ω rad/s in clockwise direction, then which one of the following correctly describes the $E_{aa'}$&$E_{bb'}$?

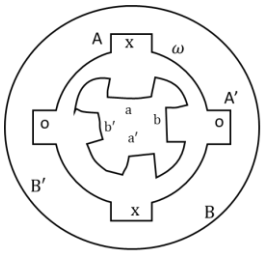
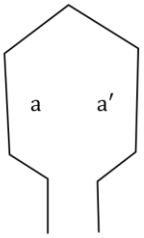


Fig.(i)



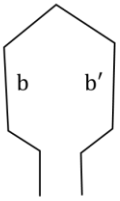


Fig.(ii)

(A) $E_{aa'}$&$E_{bb'}$have finite magnitude with $E_{bb'}$ leading $E_{aa'}$

(B) $E_{aa'} = E_{bb'} = 0$

(C) $E_{aa'}$&$E_{bb'}$ have finite magnitude with $E_{bb'}$ leading $E_{bb'}$

(D) $E_{aa'}$&$E_{bb'}$ have finite magnitude & are in the same phase

MCQ

Correct Option: B

1 Mark

22. The following column presents various modes of induction machine operation and the range of slip.

Mode of Operation	Range of Slip
a. Running in generation mode	p. From 0.0 to 1.0
b. Running in motor mode	q. From 1.0 to 2.0
c. Plugging in motor mode	r. From -1.0 to 0.0

(A) a-p, b-r, c-q (B) a-r, b-q, c-p

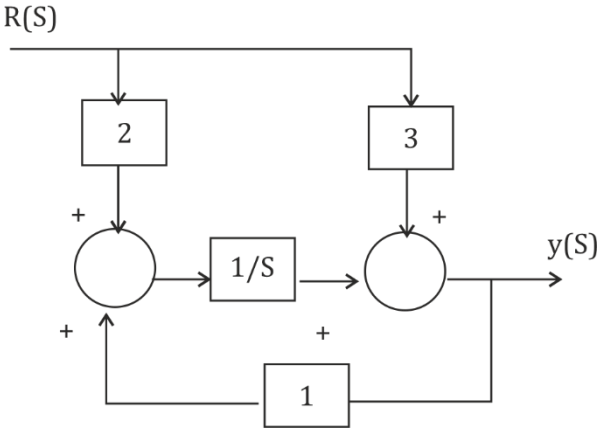
(C) a-q, b-p, c-r (D) a-r, b-p, c-q

MCQ

Correct Option: D

1 Mark

23. Find the transfer function $\frac{y(S)}{R(S)}$



(A) $\frac{S+1}{3S+2}$ (B) $\frac{3S+2}{S+1}$

(C) $\frac{3S+2}{S-1}$ (D) $\frac{2S+3}{S+1}$

MCQ

Correct Option: C

1 Mark

24. The frequency at which this compensator produces maximum phase lead is 4 rad/s. At this Frequency, the gain amplification provided by the controller, assuming asymptotic Bode-magnitude Plot of K(S), is 6 dB. The values of a, β are:

MCQ

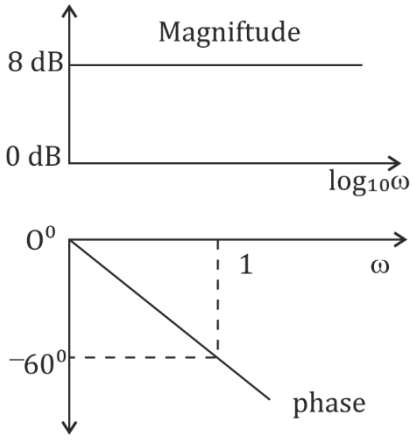
(A) 1, 16 (B) 2.66, 2.25

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

Correct Option: D

2 Mark

25. The transfer function of the system is:



MCQ

(A) $1.04e^{-2.514S}$ (B) $2.51e^{-1.047S}$

(C) $2.51e^{-0.032S}$ (D) $\frac{e^{-2.514eS}}{S+1}$

Correct Option: B

2 Mark

26. Consider the state-space description of an LTI system with matrices

$A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = [3, \square 2]$, $D = 1$

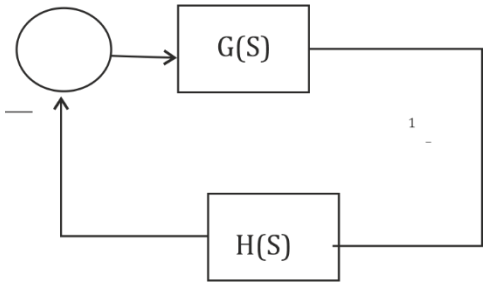
For the input, sin (wt), $w > 0$. The value of w for which the steady-state output of the system will be zero is _____ (nearest integer)

NAT

Answer: 2

2 Mark

27. In the Nyquist plot of OLTF $= \frac{3S+5}{S-1}$ corresponding to the f/b cop shown in the figure, the infinite semi-circular arc of the Nyquist contour in S-plane is mapped into a point at



(A) $G(S)\,H(S) = 0$

(B) $G(S)\,H(S) = \infty$

(C) $G(S)\,H(S) = \square 5$

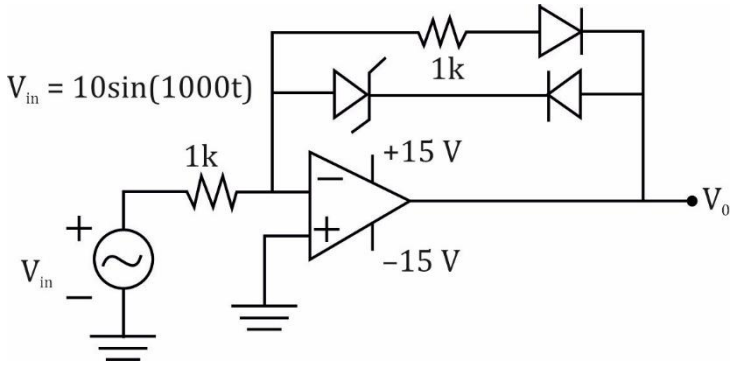
(D) $G(S)\,H(S) = 3$

MCQ

Correct Option: D

1 Mark

28. Consider OP-Amp. Ignore conduction drops of D_1 and D_2. All components are ideal and breakdown voltage of Zener is 5V. Which of the following statements is true?



(A) $V_{O_{max}} = 5V, V_{O_{min}} = -15V$

(B) $V_{O_{max}} = 10V, V_{O_{min}} = -5V$

(C) $V_{O_{max}} = 15V, V_{O_{min}} = -10V$

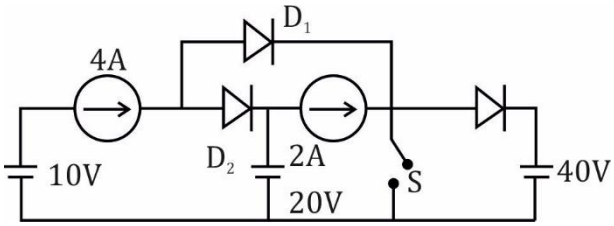
(D) $V_{O_{max}} = 5V, V_{O_{min}} = -10V$

MCQ

Correct Option: B

2 Mark

29. All the elements in the circuit shown in the following figure are ideal. Which of the following statements is/are true?



(A) When S OFF, D_1 and D_3 conducts, D_2 reverse biased

(B) When S ON, D_1 and D_2 conducts, D_3 is reverse biased

(C) When S ON, D_1 conduct D_2 and D_3 are reverse biased

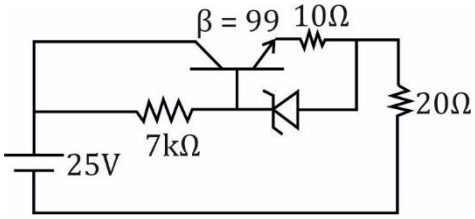
(D) When S OFF, D_1 is reversed biased and D_2 and D_3 conduct

MSQ

Correct Option: A, C

2 Mark

30. The Zener diode in circuit has break down voltage of 5V. The current gain β of X^{tor} in the active region is 99. Ignore V_{BE}. The current through 20Ω is _____ mA.

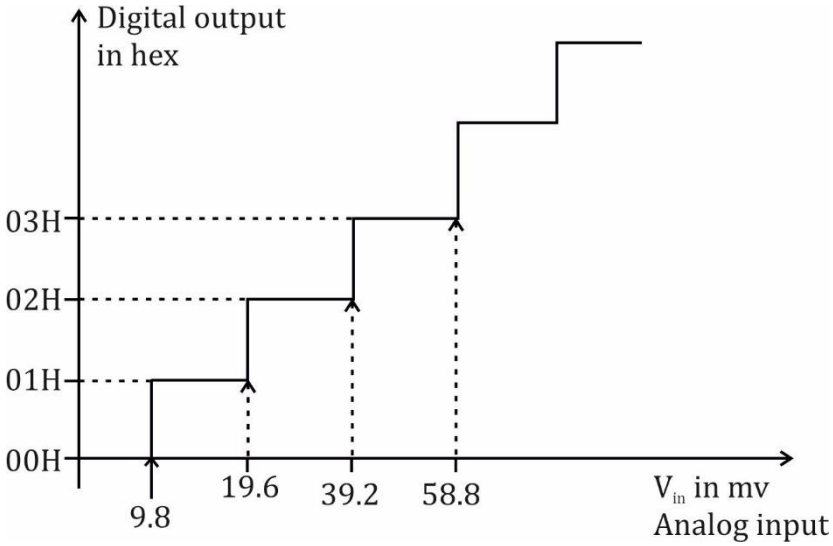


NAT

Answer: *

2 Mark

31. An 3-bit ADC converts analog voltage in the range of 0 to +5V to the corresponding digital code as per the conversion characteristics shown in the figure. For V_{in} = 1.9922 V, which of the following digital output, given in hex decimal is true?



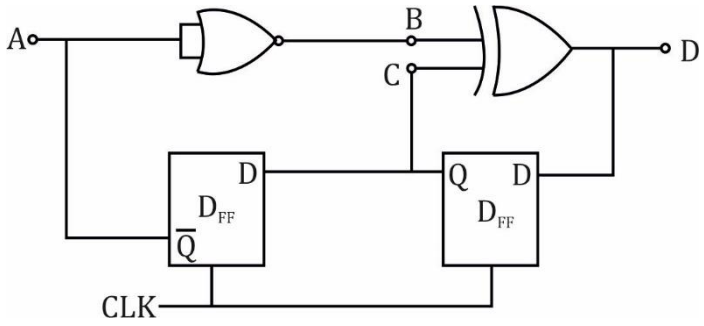
(A) 66 H
(B) 67 H
(C) 65 H
(D) 64 H

MCQ

Correct Option: A

2 Mark

32. Decimal equation of binary segment [ABCD] of initial logic gates which will not change with clock is _____

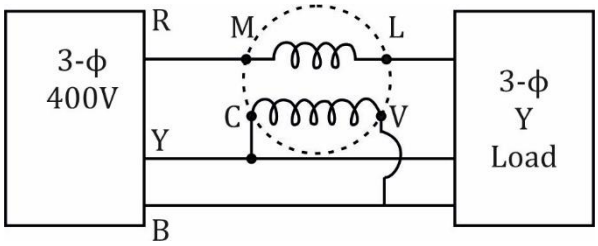


NAT

Answer: *

1 Mark

33. A 3-phase, star-connected, balanced load is supplied from 3-phase, 400 V(rms), balanced voltage source with wattmeter reading is –400W and the line current is I_R = 2A (rms), then power factor of the load per phase is



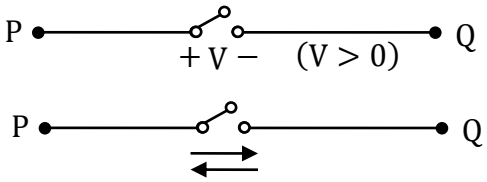
MCQ

(A) 0.5 lead
(B) 1
(C) 0.866 lead
(D) 0.707 lead

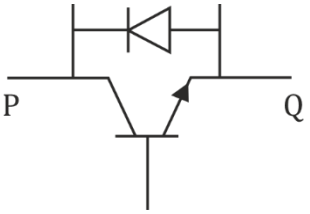
Correct Option: C

2 Mark

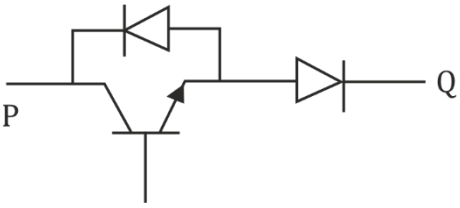
34. A semiconductor switch need to block the voltage V of only one polarity (V > 0) during off state as shown in fig (i) and carry current in both directions during on state shown in fig (ii) which of the following switch combination will realize the same



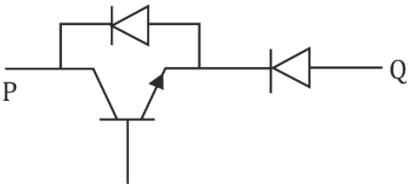
(A)



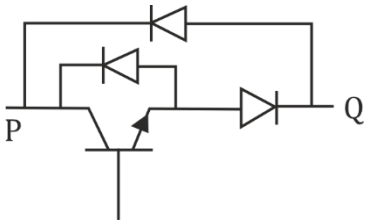
(B)



(C)



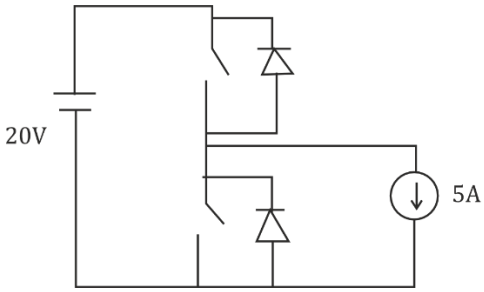
(D)

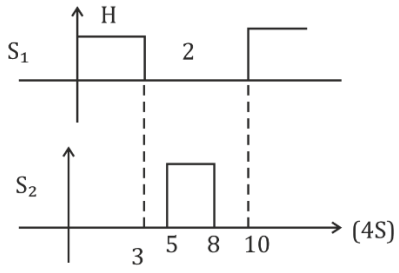


MSQ

Correct Option: A, D — **2 Mark**

35. A DC source is feeding a constant current load of 5 Amp through semiconductor power Switches. The gate signal switches S1 and S2 are shown in figure, the switching frequency is 100 kHz, what will be the average voltage across 5A source in



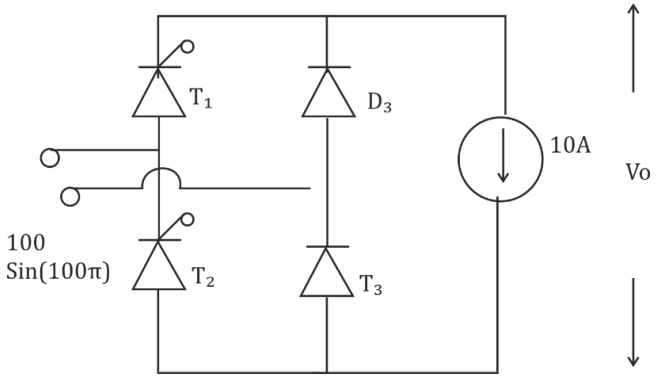


MCQ

(A) 12 V
(B) 6 V
(C) 20 V
(D) 10 V

Correct Option: B — **1 Mark**

36. A sinusoidal AC source of $100 \sin 100\pi t$ is feeding a constant load of 10 Amp. T1 and T2 are fired at $\alpha = 60°$ *and* $T3$ is fired at $\alpha = 240°$. What will be the average output voltage across the load?

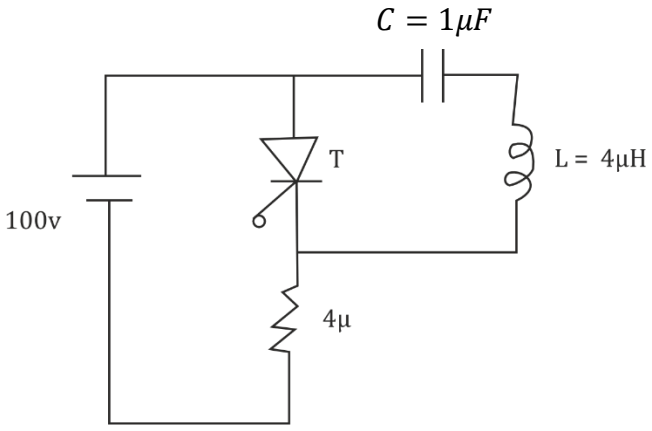


NAT

Answer: 47.77

2 Mark

37. Assume latching and holding currents are zero. T is turned at t = 0. The duration in μ sec for which T will conduct is _____.

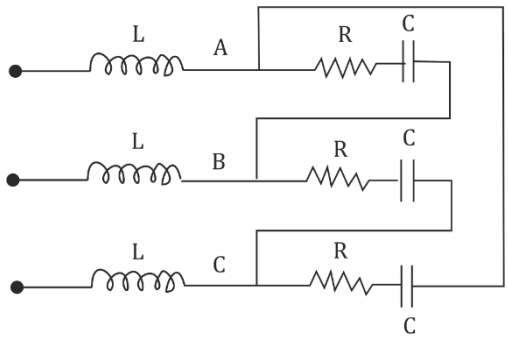


NAT

Answer: 6.28

2 Mark

38. A balanced delta connected load consisting of the series connection of one resistor ($R = 15\Omega$) and ($C = 212.21\mu F$) in each phase is connected to $3\varphi, 50Hz, 415V$ Supply terminals through a line having on inductance of $L = 31.83mH$ per phase shown in the figure. Considering the charge in the supply terminal voltage with loading to be negligible, the magnitude of the voltage across the terminals VAB in volts.



NAT

Answer: *

1 Mark

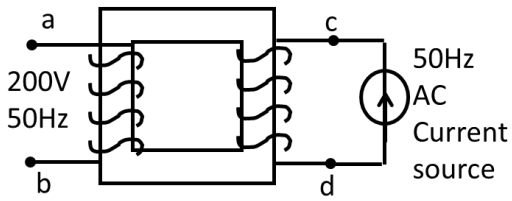
39. A $3-\phi$, 415 V, 50Hz, 6-pole, 960rpm 4HP, SCIM drives a constant torque load at rated speed operating from rated supply & delivering rated output. If the supply voltage and frequency are reduced by 20% the resultant speed of the motor in rpm is _____ (integer)

NAT

Answer: 760

2 Mark

40. When the winding c – d of $1-\phi$ 50 Hz, two winding X^{max} is supplied from an current source of frequency 50Hz, the rated voltage of 200V, 50Hz is obtained at the open circuited terminals. The cross-sectioned area is 5000 mm^2 and average core length travelled by the mutual flux is 500mm. the $B_{max} = 1T, \mu = 5000$ The leakage impedance of wdg ab & cd are $(5 + j100\pi \times 1.6)\Omega \& (11.25 + j100\pi \times 0.36)\Omega$ at 50Hz Considering magnetizing characteristic to be linear & neglect core loss, the self inductance of the wdg. ab is _____ mH.



NAT

Answer: *

2 Mark

41. 50Hz, 275kV, 400 km line has R = 0.035Ω/km, L = mn/km C = 0.01μF/km. Nominal ↑ model $V_R = V_S = 2.75$kV. ϕ b/w v_se for maximum possible active power at receiving end in degree _____

NAT

Answer: 83.63

2 Mark

42. Consider Ybus

$$\begin{matrix}1\\2\\3\end{matrix}\begin{bmatrix}-j15 & j10 & j5\\ j10 & -j13.5 & j4\\ j5 & j4 & -j8\end{bmatrix}$$

Which of following is not true?

(A) line charging capacitor is in all 3 lines

(B) line charging capacitor is in line 2-3 only & shunt capacitor is in b us 3

(C) line charging capacitor is in line 2-3 only

(D) line charging capacitor is in line 2-3 only & shunt capacitor is in I only

MSQ

Correct Option: A, B, D

1 Mark

43. The expression of fuel cost of two thermal generating units as a function of the respective power generation P_{G1}&$F_1\{P_{G1}\} = 0.1\ a\ P^2{}_{G1} + 40\ P_{G1} + 120$ Rs/hr

$OMW \leq P_{G1} \leq 350MW$

$F_2(P_{G2}) = 0.2\ P^2{}_{G2} + 30\ P_{G2} + 100$ Rs/hr

$OMW \leq P_{G2} \leq 350MW$, where a is a constant, for given value of a optimal as $P_{G1} = 175MW$ &$P_{G2} = 115MW$. With the load remaining dispatch is carried out. Then changes in P_{G1}& the total cost of generation $F(= F_1 + F_2)$ in Rs/hr will be as follows.

(A) Both P_{G1}& F will increase

(B) P_{G1}will decrease & F will increase

(C) P_{G1}will increase & F will decrease

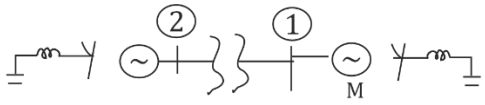
(D) Both P_{G1}& F will decrease

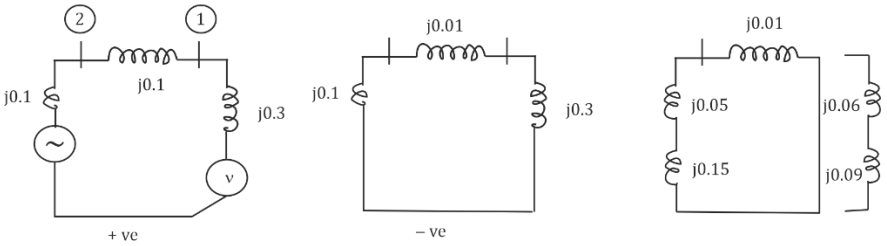
MCQ

Correct Option: B

1 Mark

44. For the single line diagram shown bolted line to line fault takes place at bus 1. The positive and Negative zero sequence reactance diagram are as shown in the figure. What will be the line to line current in per unit?





NAT

L – L fault at (1) If =?

Answer: 7.21

2 Mark