

Answer Key

of

Electronics Engineering GATE-2015

Forenoon Session

31st Jan, 2015



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Section - I (General Aptitude)

Q.1 Choose the appropriate word/phrase, out of the four options given below, to complete the following sentence :

Frogs _____

- (a) croak (b) roar
(c) hiss (d) patter

Ans. (a)

• • • **End of Solution**

Q.2 If $\log_x (5/7) = -1/3$, then the value of x is

- (a) 343/125 (b) 125/343
(c) -25/49 (d) -49/25

Ans. (a)

• • • **End of Solution**

Q.3 Operates \square , \diamond and \rightarrow are defined by: $a \square b = \frac{a-b}{a+b}$; $a \diamond b = \frac{a+b}{a-b}$; $a \rightarrow b = ab$.

Find the value of $(66 \square 6) \rightarrow (66 \diamond 6)$

- (a) -2 (b) -1
(c) 1 (d) 2

Ans. (c)

• • • **End of Solution**

Q.4 Choose the word most similar meaning to the given word:

Educe

- (a) Exert (b) Educate
(c) Extract (d) Extend

Ans. (c)

• • • **End of Solution**

Q.5 Choose the most appropriate word from the options given below to complete the following sentence.

The principal presented the chief guest with a _____, as token of appreciation.

- (a) momento (b) memento
(c) momentum (d) moment

Ans. (b)

• • • **End of Solution**

- Q.6** The following question presents a sentence, part of which is underlined. Beneath the sentence you find four ways of phrasing the underlined part. Following the requirements of the standard written English, select the answer that produces the most effective sentence.

Tuberculosis, together with its effects, ranks one of the leading causes of death in India.

- (a) ranks as one of the leading causes of death
- (b) rank as one of the leading causes of death
- (c) has the rank of one of the leading causes of death
- (d) are one of the leading causes of death

Ans. (a)

• • • **End of Solution**

- Q.7** Humpty Dumpty sits on a wall every day while having lunch. The wall sometimes breaks. A person sitting on the wall falls if the wall breaks.

Which one of the statements below is logically valid and can be inferred from the above sentences?

- (a) Humpty Dumpty always falls while having lunch
- (b) Humpty Dumpty does not fall sometimes while having lunch
- (c) Humpty Dumpty never falls during dinner
- (d) When Humpty Dumpty does not sit on the wall, the wall does not break

Ans. (b)

• • • **End of Solution**

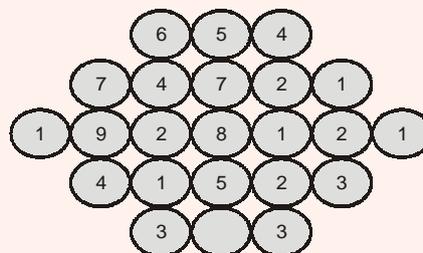
- Q.8** A cube side 3 units is formed using a set of smaller cubes of side 1 unit. Find the proportion of the number of faces of the smaller cubes visible to those which are NOT visible.

- (a) 1 : 4
- (b) 1 : 3
- (c) 1 : 2
- (d) 2 : 3

Ans. (c)

• • • **End of Solution**

- Q.9** Fill in the missing value



Ans. (3)

• • • **End of Solution**

Q.10 Read the following paragraph and choose the correct statement.

Climate change has reduced human security and threatened human well being. An ignored reality of human progress is that human security largely depends upon environmental security. But on the contrary, human progress seems contradictory to environmental security. To keep up both at the required level is a challenge to be addressed by one and all. One of the ways to curb the climate change may be suitable scientific innovations, while the other may be the Gandhian perspective on small scale progress with focus on sustainability.

- (a) Human progress and security are positively associated with environmental security.
- (b) Human progress is contradictory to environmental security.
- (c) Human security is contradictory to environmental security.
- (d) Human progress depends upon environmental security.

Ans. (b)

Section - II (Electronics and Communication Engineering)

Q.1 A silicon sample is uniformly doped with donor type impurities with a concentration of $10^{16}/\text{cm}^3$. The electron and hole mobilities in the sample are $1200 \text{ cm}^2/\text{V}\cdot\text{s}$ and $400 \text{ cm}^2/\text{V}\cdot\text{s}$ respectively. Assume complete ionization of impurities. The charge of an electron is $1.6 \times 10^{-19} \text{ C}$. The resistivity of the sample (in $\Omega\text{-cm}$) is_____.

Ans. (0.520)

• • • **End of Solution**

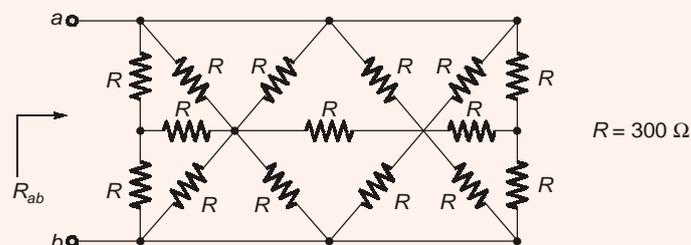
Q.2 Negative feedback in a closed-loop control system **DOES NOT**

- (a) reduce the overall gain
- (b) reduce bandwidth
- (c) improve disturbance rejection
- (d) reduce sensitivity to parameter variation

Ans. (b)

• • • **End of Solution**

Q.3 In the network shown in the figure, all resistors are identical with $R = 300 \Omega$. The resistance R_{ab} (in Ω) of the network is _____.



Ans. (100)

• • • **End of Solution**



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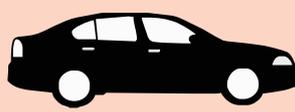


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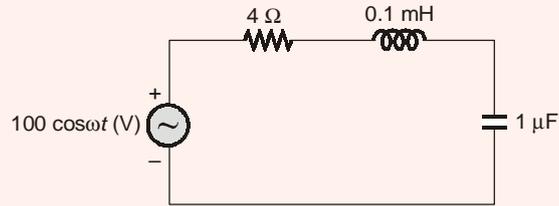
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- Q.4** In the circuit shown, at resonance, the amplitude of the sinusoidal voltage (in Volts) across the capacitor is _____.



Ans. (25)

• • • **End of Solution**

- Q.5** Suppose A and B are two independent events with probabilities $P(A) \neq 0$ and $P(B) \neq 0$. Let \bar{A} and \bar{B} be their complements. Which one of the following statements is FALSE?

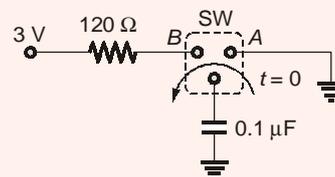
- (a) $P(A \cap B) = P(A) P(B)$ (b) $P(A/B) = P(A)$
 (c) $P(A \cup B) = P(A) + P(B)$ (d) $P(A \cap B) = P(\bar{A})P(\bar{B})$

Ans. (c)

• • • **End of Solution**

- Q.6** In the circuit shown, the switch SW is thrown from position A to position B at time $t = 0$. The energy (in μJ) taken from the 3 V source to charge the $0.1 \mu\text{F}$ capacitor from 0 V to 3 V is

- (a) 0.3
 (b) 0.45
 (c) 0.9
 (d) 3



Ans. (c)

• • • **End of Solution**

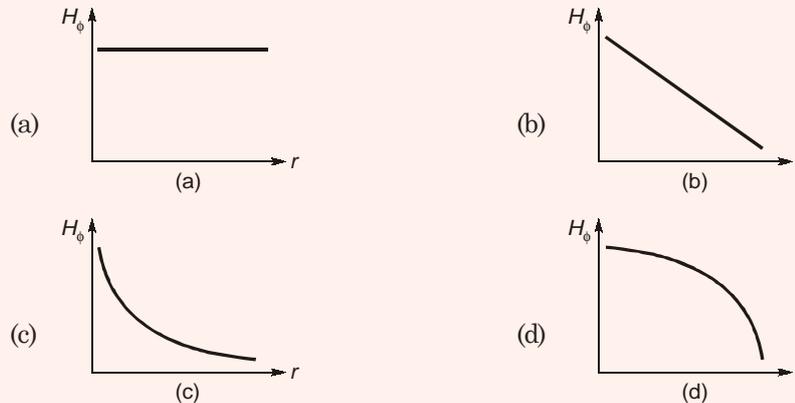
- Q.7** Let $z = x + iy$ be a complex variable. Consider that contour integration is performed along the unit circle in anticlockwise direction. Which one of the following statements is **NOT TRUE**?

- (a) The residue of $\frac{z}{z^2 - 1}$ at $z = 1$ is $1/2$
 (b) $\oint_C z^2 dz = 0$
 (c) $\frac{1}{2\pi i} \oint_C \frac{1}{z} dz = 1$
 (d) \bar{z} (complex conjugate of z) is analytical function

Ans. (d)

• • • **End of Solution**

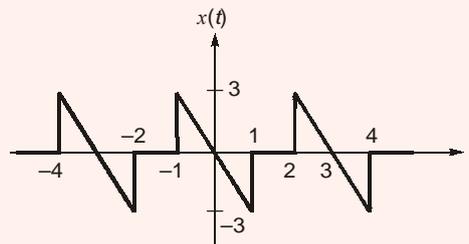
Q.8 Consider a straight, infinitely long, current carrying conductor lying on the z -axis. Which one of the following plots (in linear scale) qualitatively represents the dependence of H_ϕ on r , where H_ϕ is the magnitude of the azimuthal component of magnetic field outside the conductor and r is the radial distance from the conductor?



Ans. (c)

• • • End of Solution

Q.9 The waveform of aperiodic signal $x(t)$ is shown in the figure.



A signal $g(t)$ is defined by $g(t) = x\left(\frac{t-1}{2}\right)$. The average power of $g(t)$ is _____.

Ans. (1.5)

• • • End of Solution

Q.10 Consider a system of linear equations :

$$\begin{aligned} x - 2y + 3z &= -1, \\ x - 3y + 4z &= 1, \text{ and} \\ -2x + 4y - 6z &= k \end{aligned}$$

The value of k for which the system has infinitely many solution is _____.

Ans. (2)

• • • End of Solution



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- Q.11** A function $f(x) = 1 - x^2 + x^3$ is defined in the closed interval $[-1, 1]$. The value of x , in the open interval $(-1, 1)$ for which the mean value theorem is satisfied, is
- (a) $-1/2$ (b) $-1/3$
 (c) $1/3$ (d) $1/2$

Ans. (b)

• • • **End of Solution**

- Q.12** A sinusoidal signal of 2 kHz frequency is applied to a delta modulator. The sampling rate and step-size Δ of the delta modulator are 20,000 samples per second and 0.1 V, respectively. To prevent slope overload, the maximum amplitude of the sinusoidal signal (in Volts) is
- (a) $\frac{1}{2\pi}$ (b) $\frac{1}{\pi}$
 (c) $\frac{2}{\pi}$ (d) π

Ans. (a)

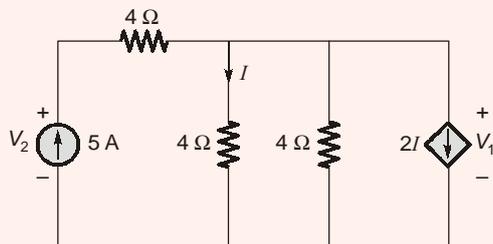
• • • **End of Solution**

- Q.13** The electric field component of a plane wave travelling in a lossless dielectric medium is given by $\vec{E}(z,t) = \hat{a}_y 2 \cos\left(10^8 t - \frac{z}{\sqrt{2}}\right)$ V/m. The wavelength (in m) for the wave is_____.

Ans. (8.89)

• • • **End of Solution**

- Q.14** In the given circuit, the values of V_1 and V_2 respectively are



- (a) 5 V, 25 V (b) 10 V, 30 V
 (c) 15 V, 35 V (d) 0 V, 20 V

Ans. (a)

• • • **End of Solution**

Q.15 Consider a four bit D to A converter. The analog value corresponding to a digital signals of values 0000 and 0001 are 0 V and 0.0625 V respectively. The analog value (in Volts) corresponding to the digital signal 1111 is _____.

Ans. (0.9375)

• • • **End of Solution**

Q.16 In an 8085 microprocessor, the shift registers which store the result of an addition and the overflow bit are, respectively

- (a) B and F (b) A and F
 (c) H and F (d) A and C

Ans. (b)

• • • **End of Solution**

Q.17 A region of negative differential resistance is observed in the current voltage characteristics of a silicon PN junction if

- (a) both the P-region and the N-region are heavily doped
 (b) the N-region is heavily doped compared to the P-region
 (c) the P-region is heavily doped compared to the N-region
 (d) an intrinsic silicon region is inserted between the P-region and the N-region

Ans. (a)

• • • **End of Solution**

Q.18 Consider the signal $s(t) = m(t) \cos(2\pi f_c t) + \hat{m}(t) \sin(2\pi f_c t)$ where $\hat{m}(t)$ denotes the Hilber transform of $m(t)$ and the bandwidth of $m(t)$ is very small compared to f_c . The signal $s(t)$ is a

- (a) high-pass signal
 (b) low-pass signal
 (c) band-pass signal
 (d) double sideband suppressed carrier signal

Ans. (c)

• • • **End of Solution**

Q.19 The polar plot of the transfer function $G(s) = \frac{10(s+1)}{s+10}$ for $\omega \leq \infty$ will be in the

- (a) first quadrant (b) second quadrant
 (c) third quadrant (d) fourth quadrant

Ans. (a)

• • • **End of Solution**

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- Q.20** The result of the convolution $x(-t) * \delta(-t - t_0)$ is
 (a) $x(t + t_0)$ (b) $x(t - t_0)$
 (c) $x(-t + t_0)$ (d) $x(-t - t_0)$

Ans. (d)

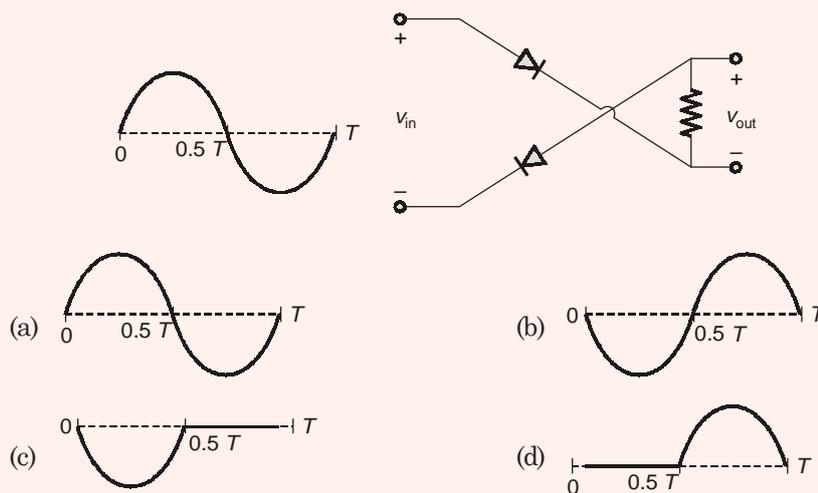
• • • End of Solution

- Q.21** A 16 Kb (=16,384 bit) memory array is designed as a square with an aspect ratio of one (number of rows is equal to the number of columns). The minimum number of address lines needed for the row decoder is _____.

Ans. (7)

• • • End of Solution

- Q.22** For the circuit with ideal diodes shown in the figure, the shape of the output (v_{out}) for the given sine wave input (v_{in}) will be



Ans. (c)

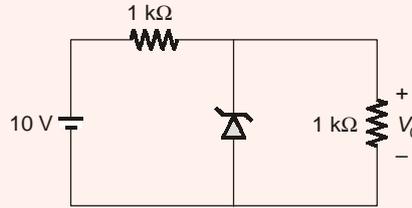
• • • End of Solution

- Q.23** The value of p such that the vector $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ is an eigenvector of the matrix $\begin{bmatrix} 4 & 1 & 2 \\ p & 2 & 1 \\ 14 & -4 & 10 \end{bmatrix}$ is

Ans. (17)

• • • End of Solution

Q.24 In the circuit shown below, the Zener diode is ideal and the Zener voltage is 6 V. The output voltage V_0 (in volts) is _____.



Ans. (5)

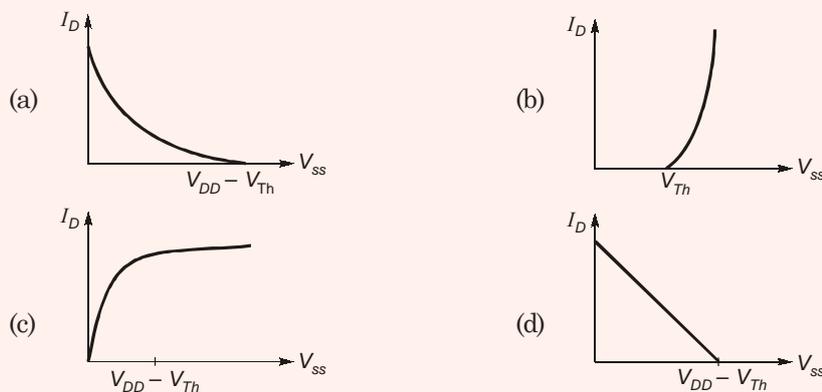
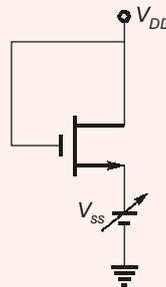
• • • **End of Solution**

Q.25 A unity negative feedback system has the open-loop transfer function $G(s) = \frac{K}{s(s+1)s(+3)}$. The value of the gain $K (>0)$ at which the root locus crosses the imaginary axis is _____.

Ans. (12)

• • • **End of Solution**

Q.26 For the NMOSFET in the circuit shown, the threshold voltage is V_{th} , where $V_{th} > 0$. The source voltage V_{SS} is varied from 0 to V_{DD} . Neglecting the channel length modulation, the drain current I_D as a function of V_{SS} is represented by



Ans. (a)

• • • **End of Solution**



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Q.27 The longitudinal component of the magnetic field inside an air-filled rectangular waveguide made of a perfect electric conductor is given by the following expression

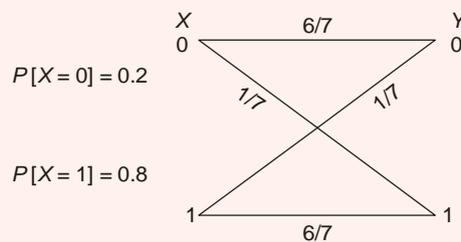
$$H_z(x, y, z, t) = 0.1 \cos(25\pi x) \cos(30.3 \pi y) \cos(12\pi \times 10^9 t - \beta z) \text{ (A/m)}$$

- (a) TM_{12} (b) TM_{21}
 (c) TE_{21} (d) TE_{12}

Ans. (c)

• • • **End of Solution**

Q.28 The input X to Binary Symmetric Channel (BSC) shown in the figure is '1' with probability of 0.8. The cross-over probability is $1/7$. If the received bit $Y = 0$, the conditional probability that '1' was transmitted is _____.



Ans. (0.4)

• • • **End of Solution**

Q.29 The transmitted signal in a GSM system is of 200 kHz bandwidth and 8 users share a common bandwidth using TDMA. If at a given time 12 users are talking in a cell, the total bandwidth of the signal received by the base station of the cell will be at least (in kHz)_____.

Ans. (*)

• • • **End of Solution**

Q.30 A lead compensator network includes a parallel combination of R and C in the feed-forward path. If the transfer function of the compensator is $G_c(s) = \frac{s+2}{s+4}$, the value of RC is_____.

Ans. (0.5)

• • • **End of Solution**



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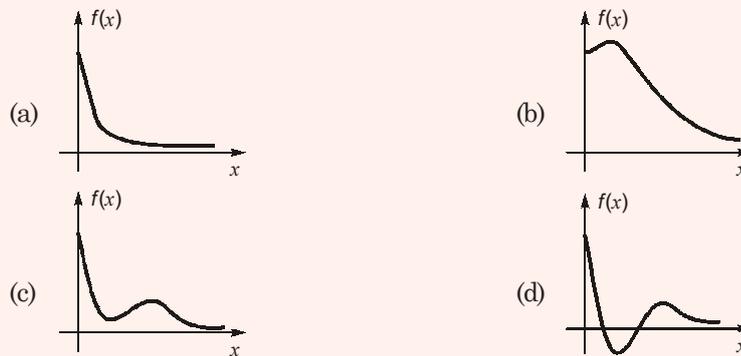
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Q.34 Which one of the following graphs describes the function $f(x) = e^{-x}(x^2 + x + 1)$?



Ans. (b)

• • • **End of Solution**

Q.35 A 3-input majority gate is defined by the logic function $M(a, b, c) = ab + bc + ca$. Which one of the following gate is represented by the function

$$M(\overline{M(a, b, c)}, M(a, b, \overline{c})c)?$$

- (a) 3-input NAND gate
- (b) 3-input XOR gate
- (c) 3-input NOR gate
- (d) 3-input XNOR gate

Ans. (b)

• • • **End of Solution**

Q.36 In the system shown in Figure (a), $m(t)$ is a low-pass signal with bandwidth W Hz. The frequency response of the band-pass filter $H(f)$ is shown in Figure (b). If it is desired that the output signal $z(t) = 10x(t)$, the maximum value of W (in Hz) should be strictly less than _____.

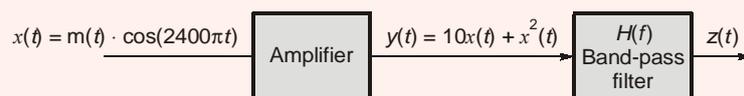


Fig. (a)

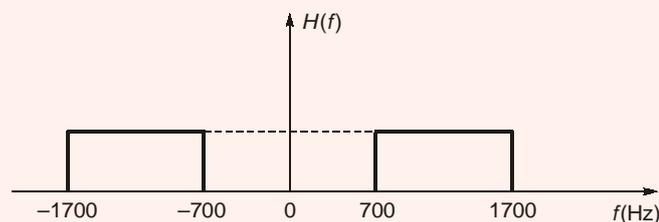


Fig. (b)

Ans. (350)

• • • **End of Solution**

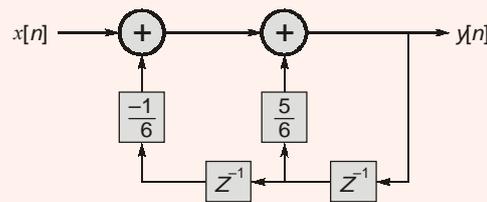
Q.37 A MOSFET in saturation has a drain current of 1 mA for $V_{DS} = 0.5$ V. If the channel length modulation coefficient is 0.05 V^{-1} , the output resistance (in k Ω) of the MOSFET is _____

Ans. (20)

• • • End of Solution

Q.38 For the discrete-time system shown in the figure, the poles of the system transfer function are located at

- (a) 2, 3
- (b) $\frac{1}{2}, 3$
- (c) $\frac{1}{2}, \frac{1}{3}$
- (d) $2, \frac{1}{3}$



Ans. (c)

• • • End of Solution

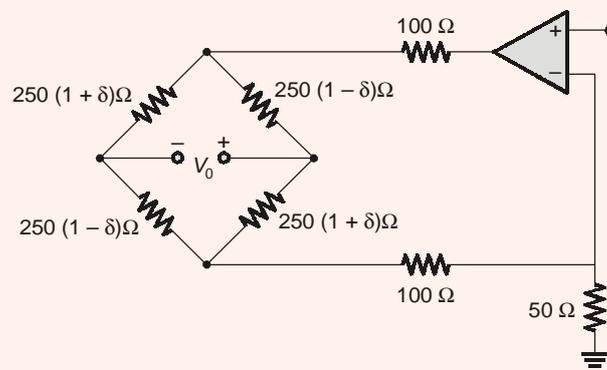
Q.39 A vector \vec{P} is given by $\vec{P} = x^3 y \vec{a}_x - x^2 y^2 \vec{a}_y - x^2 y z \vec{a}_z$. Which of the following statements is **TRUE**?

- (a) \vec{P} is solenoidal, but not irrotational
- (b) \vec{P} is irrotational, but not solenoidal
- (c) \vec{P} is neither solenoidal nor irrotational
- (d) \vec{P} is both solenoidal and irrotational

Ans. (a)

• • • End of Solution

Q.40 In the circuit shown, assume that the opamp is ideal. The bridge output voltage V_0 (in mV) for $\delta = 0.05$ is _____.



Ans. (250)

• • • End of Solution



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Q.49 The Boolean expression $F(X, Y, Z) = \bar{X}\bar{Y}\bar{Z} + X\bar{Y}\bar{Z} + XY\bar{Z} + XYZ$ converted into canonical product of sum (POS) form is

- (a) $(X+Y+Z)(X+Y+\bar{Z})(X+\bar{Y}+\bar{Z})(\bar{X}+Y+\bar{Z})$
 (b) $(X+\bar{Y}+Z)(\bar{X}+Y+\bar{Z})(\bar{X}+\bar{Y}+Z)(\bar{X}+\bar{Y}+\bar{Z})$
 (c) $(X+Y+Z)(\bar{X}+Y+\bar{Z})(X+\bar{Y}+Z)(\bar{X}+\bar{Y}+\bar{Z})$
 (d) $(X+\bar{Y}+\bar{Z})(\bar{X}+Y+Z)(\bar{X}+\bar{Y}+Z)(X+Y+Z)$

Ans. (a)

• • • **End of Solution**

Q.50 The damping ratio of a series RLC circuit can be expressed as

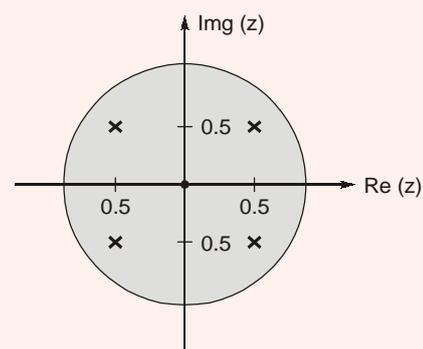
- (a) $\frac{R^2 C}{2L}$ (b) $\frac{2L}{R^2 C}$
 (c) $\frac{R}{2} \sqrt{\frac{C}{L}}$ (d) $\frac{2}{R} \sqrt{\frac{L}{C}}$

Ans. (c)

• • • **End of Solution**

Q.51 The pole-zero diagram of a causal and stable discrete-time system is shown in the figure. The zero at the origin has multiplicity 4. The impulse response of the system is $h[n]$. If $h[0] = 1$, we can conclude

- (a) $h[n]$ is real for all n
 (b) $h[n]$ is purely imaginary for all n
 (c) $h[n]$ is real for only even n
 (d) $h[n]$ is purely imaginary for only odd n



Ans. (c)

• • • **End of Solution**

Q.55 A source emits bit 0 with probability $\frac{1}{3}$ and bit with probability $\frac{2}{3}$. The emitted bits are communicated to the receiver. The receiver decides for either 0 or 1 based on the received value R . It is given that the conditional density functions of R as

$$f_{R|0}(r) = \begin{cases} \frac{1}{4}, & -3 \leq x \leq 1 \\ 0, & \text{otherwise} \end{cases} \quad \text{and} \quad f_{R|1}(r) = \begin{cases} \frac{1}{6}, & -1 \leq x \leq 5 \\ 0, & \text{otherwise} \end{cases}$$

The minimum decision error probability is

- | | |
|-------------------|--------------------|
| (a) 0 | (b) $\frac{1}{12}$ |
| (c) $\frac{1}{9}$ | (d) $\frac{1}{6}$ |

Ans. (*)

• • • **End of Solution**

