

GENERAL APTITUDE

Q. No. 1 - 5 Carry One Mark Each

1. Getting to the top is _____ than staying on top.
(A) much easy (B) more easy (C) easiest (D) easier

Answer: (D)

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2. Four persons P, Q, R and S are to be seated in a row, all facing the same direction, but not necessarily in the same order. P and R cannot sit adjacent to each other. S should be seated to the right of Q. The number of distinct seating arrangements possible is:

(A) 2 (B) 6 (C) 4 (D) 8

Answer: (B)

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3. \oplus and \odot are two operators on numbers p and q such that


$$p \oplus q = \frac{p^2 + q^2}{pq} \text{ and } p \odot q = \frac{p^2}{q};$$

If $x \oplus y = 2 \odot 2$, then x =

(A) $\frac{3y}{2}$ (B) 2y (C) y (D) $\frac{y}{2}$

Answer: (D)

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4. 

The mirror image of the above text about X-axis is

(A) TRIANGLE (B) TRIANGLE
(C) TRIANGLE (D) TRIANGLE

Answer: (D)[Click here to watch video explanation](#)

5. In a company, 35% of the employees drink coffee, 40% of the employees drink tea and 10% of the employees drink both tea and coffee. What % of employees drink neither tea nor coffee?
- (A) 35 (B) 15 (C) 40 (D) 25

Answer: (D)[Click here to watch video explanation](#)

Q. No. 6 - 10 Carry Two Marks Each

6. Statement: Either P marries Q or X marries Y
Among the options below, the logical **NEGATION** of the above statement is:
- (A) Neither P marries Q nor X marries Y (B) X does not marry Y and P marries Q
(C) P does not marry Q and X marries Y (D) P marries Q and X marries Y

Answer: (A)[Click here to watch video explanation](#)

7. A function, λ , is defined by

$$\lambda(p, q) = \begin{cases} (p - q)^2, & \text{if } p \geq q, \\ p + q, & \text{if } p < q. \end{cases}$$

The value of the expression $\frac{\lambda(-(-3+2), (-2+3))}{(-(-2+1))}$ is:

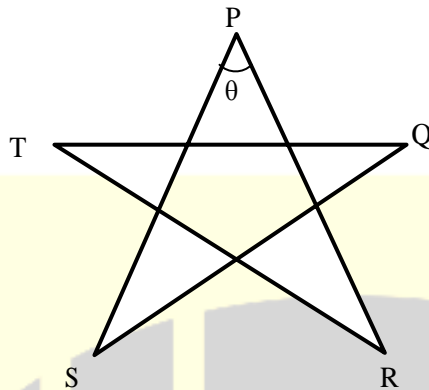
- (A) 16 (B) 0 (C) $\frac{16}{3}$ (D) -1

Answer: (B)[Click here to watch video explanation](#)

8. Consider two rectangular sheets, Sheet M and Sheet N of dimensions $6\text{cm} \times 4\text{cm}$ each
- Folding operation 1:** The sheet is folded into half by joining the short edges of the current shape.
- Folding operation 2:** The sheet is folded into half by joining the long edges of the current shape.
- Folding operation 1 is carried out on Sheet M three times.
- Folding operation 2 is carried out on Sheet N three times.
- The ratio of perimeters of the final folded shape of Sheet N to the final folded shape of Sheet M is _____.
- (A) 3:2 (B) 5:13 (C) 7:5 (D) 13:7

Answer: (650)[Click here to watch video explanation](#)

9.



Five line segments of equal lengths, PR, PS, QS, QT and RT are used to form a star as shown in the figure above.

The value of θ , in degrees, is _____.

- (A) 45 (B) 72 (C) 108 (D) 36

Answer: (D)

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10. Humans have the ability to construct worlds entirely in their minds, which don't exist in the physical world. So far as we know, no other species possesses this ability. This skill is so important that we have different words to refer to its different flavors, such as imagination, invention and innovation.

Based on the above passage, which one of the following is TRUE?

- (A) We do not know of any species other than humans who possess the ability to construct mental worlds
(B) imagination, invention and innovation are unrelated to the ability to construct mental worlds
(C) No species possess the ability to construct worlds in their minds
(D) The terms imagination, invention and innovation refer to unrelated skills

Answer: (D)

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INSTRUMENTATION ENGINEERING

Q. No. 1 - 25 Carry One Mark Each

1. Consider the function $f(x) = -x^2 + 10x + 100$. The minimum value of the function in the interval $[5, 10]$ is _____.

Answer: (100)

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2. A piezoresistive pressure sensor has a sensitivity of 1 (mV/V)/kPa . The sensor is excited with a dc supply of 10V and the output is read using a $3\frac{1}{2}$ digit 200 mV full-scale digital multimeter. The resolution of the measurement set-up, in pascal is _____.

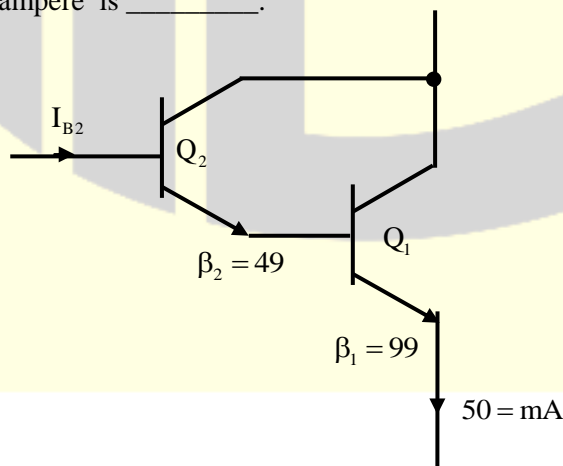
Answer: (10)

3. Let $f(z) = \frac{1}{z^2 + 6z + 9}$ defined in the complex plane. The integral $\oint_c f(z) dz$ over the contour of a circle c with centre at the origin and unit radius is _____.

Answer: (0)

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4. The transistor Q_1 has a current gain $\beta_1 = 99$ and the transistor Q_2 has a current gain $\beta_2 = 49$. The current I_{B2} in microampere is _____.



Answer: (10)

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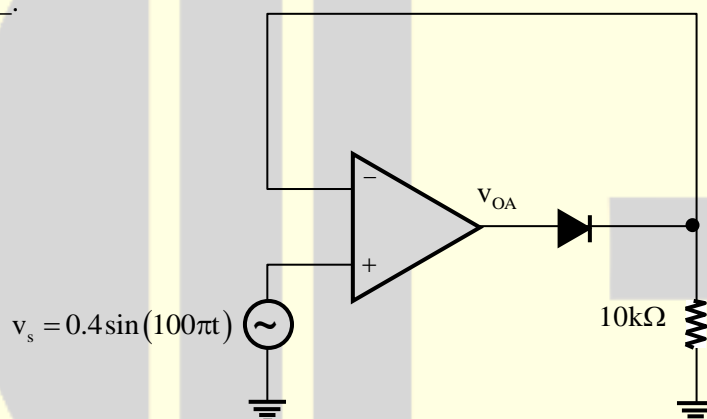
5. Consider the sequence $x_n = 0.5x_{n-1} + 1, n = 1, 2, \dots$ with $x_0 = 0$. Then $\lim_{n \rightarrow \infty} x_n$ is
(A) 2 (B) 1 (C) ∞ (D) 0

Answer: (A)

6. Given: Density of mercury is $13,600 \text{ kg/m}^3$ and acceleration due to gravity is 9.81 m/s^2 . Atmospheric pressure is 101 kPa. In a mercury U-tube manometer, the difference between the heights of the liquid in the U-tube is 1 cm. The differential pressure being measured in pascal is _____ (rounded off to the nearest integer).

Answer: (1334.46)

7. The diode used in the circuit has a fixed voltage drop of 0.6V when forward biased. A signal v_s is given to the ideal OpAmp as shown. When v_s is at its positive peak, the output (v_{OA}) of the OpAmp in volts is _____.



Answer: (1)

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8. When the movable arm of a Michelson interferometer in vacuum ($n = 1$) is moved by $325 \mu\text{m}$, the number of fringe crossings is 1000. The wavelength of the laser used in nanometers is _____.

Answer: (650)

9. A single-phase transformer has a magnetizing inductance of 250 mH and a core loss resistance of 300Ω , referred to primary side. When excited with a 230V, 50Hz sinusoidal supply at the primary, the power factor of the input current drawn, with secondary on open circuit, is _____ (rounded off to two decimal places).

Answer: (0.253)

10. Consider the row vectors $v = (1, 0)$ and $w = (2, 0)$. The rank of the matrix $M = 2v^T v + 3w^T w$, where the superscript T denotes the transpose, is

(A) 4 (B) 2 (C) 3 (D) 1

Answer: (D)

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11. In an ac main, the rms voltage V_{ac} , rms current I_{ac} power W_{ac} are measured as: $V_{ac} = 100V \pm 1\%$, $I_{ac} = 1A \pm 1\%$ and $W_{ac} = 50W \pm 2\%$ (errors are with respect to readings). The percentage error in calculating the power factor using these readings is

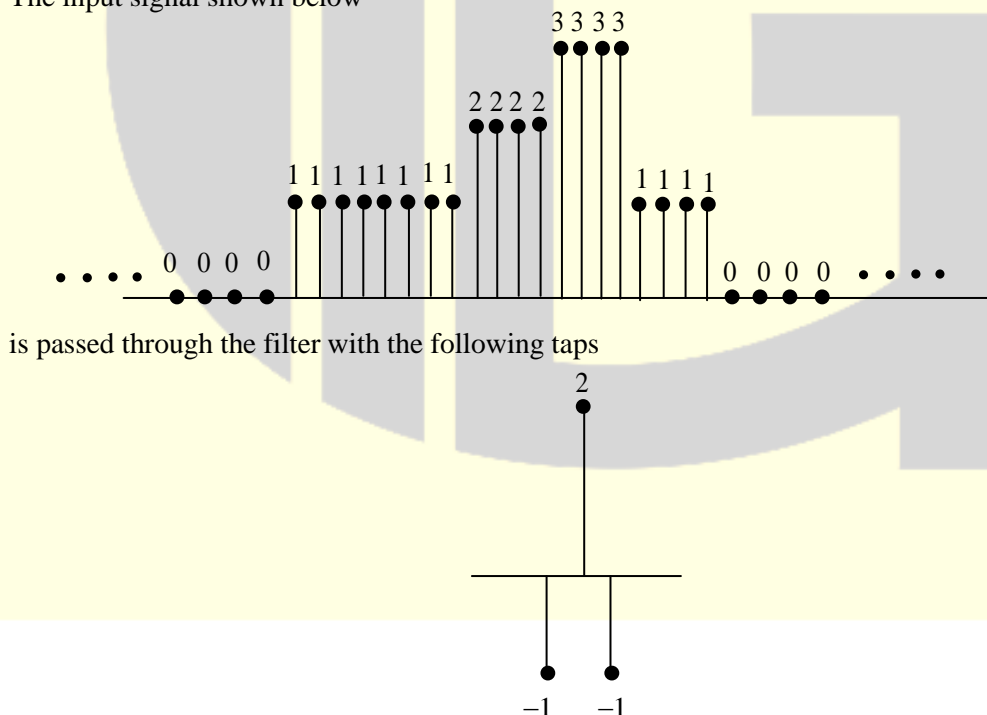
(A) 4% (B) 3% (C) 2% (D) 1%

Answer: (A)

12. A 300V, 5A, LPF wattmeter has a full scale of 300W. The wattmeter can be used for loads supplied by 300V ac mains with a maximum power factor of _____ (rounded off to one decimal place).

Answer: (0.2)

13. The input signal shown below

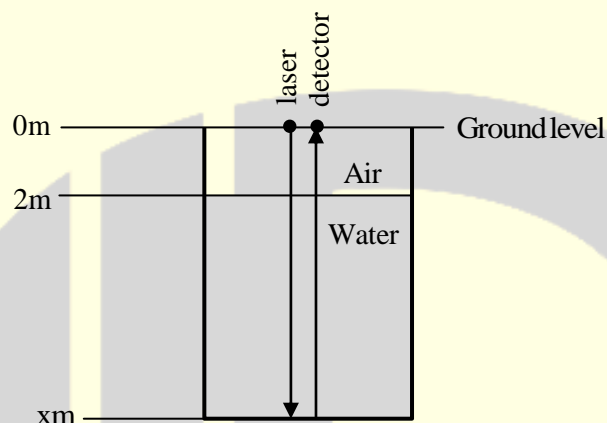


The number of non-zero output samples is _____.

Answer: (10)

14. A laser pulse is sent from ground level to the bottom of a concrete water tank at normal incident. The tank is filled with water up to 2 m below the ground level. The reflected pulse from the bottom of the tank travels back and hits the detector. The round-trip time elapsed between sending the laser pulse, the pulse hitting the bottom of the tank, reflecting back and sensed by the detector is 100 ns. The depth of the tank from ground level marked as x in metre is _____.

(Refractive index of water $n_{\text{water}} = 1.3$ and velocity of light in air $c_{\text{air}} = 3 \times 10^8$ m/s)



- (A) 9 (B) 10 (C) 11 (D) 12

Answer: (D)

15. Taking N as positive for clockwise encirclement, otherwise negative, the number of encirclement N of $(-1, 0)$ in the Nyquist plot of $G(s) = \frac{3}{s-1}$ is _____.

Answer: (-1)

16. A 10 bit ADC has a full-scale of 10.230V, when the digital output is $(11\ 1111\ 1111)_2$. The quantization error of the ADC in millivolts is _____.

Answer: (± 5)

17. The determinant of the matrix M shown below is _____.

$$M = \begin{bmatrix} 1 & 2 & 0 & 0 \\ 3 & 4 & 0 & 0 \\ 0 & 0 & 4 & 3 \\ 0 & 0 & 2 & 1 \end{bmatrix}$$

Answer: (4)

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18. An infinitely long line, with uniform positive charge density, lies along the z-axis. In cylindrical coordinates (r, ϕ, z) , at any point \vec{P} not on the z-axis, the direction of the electric field is

(A) \hat{z} (B) $\frac{(\hat{r} + \hat{z})}{\sqrt{2}}$ (C) \hat{r} (D) $\hat{\phi}$

Answer: (C)

19. An amplitude modulation (AM) scheme uses tone modulation, with modulation index of 0.6. The power efficiency of the AM scheme is _____% (rounded off to one decimal place).

Answer: (15.25)

20. For a 4-bit Flash type Analog to Digital Converter (ADC) with full scale input voltage range “V”, which of the following statement(s) is/are true?

- (A) A change in the input voltage by $\frac{V}{16}$ will always flip the LSB of the output
(B) The ADC requires one 4 to 2 priority encoder and 4 comparators
(C) A change in the input voltage by $\frac{V}{16}$ will always flip MSB of the output
(D) The ADC requires 15 comparators

Answer: (A, D)

21. A strain gage having nominal resistance of $1000\ \Omega$ has a gage factor of 2.5. If the strain applied to the gage is $100\ \mu\text{m/m}$, its resistance in ohm will change to _____ (rounded off to two decimal places).

Answer: (1000.25)

22. Let $u(t)$ denote the unit step function. The bilateral Laplace transform of the function $f(t) = e^t u(-t)$ is _____.

- (A) $\frac{1}{s-1}$ with real part of $s > 1$ (B) $\frac{-1}{s-1}$ with real part of $s > 1$
(C) $\frac{1}{s-1}$ with real part of $s < 1$ (D) $\frac{-1}{s-1}$ with real part of $s < 1$

Answer: (D)

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23. Input-output characteristic of a temperature sensor is exponential for a

- (A) Mercury thermometer (B) Thermistor
(C) Thermocouple (D) Resistive Temperature Device (RTD)

Answer: (B)

24. The signal $\sin(\sqrt{2\pi}t)$ is

- (A) periodic with period $T = 4\pi^2$ (B) periodic with period $T = 2\pi$
(C) periodic with period $T = \sqrt{2\pi}$ (D) not periodic

Answer: (D)

25. The step response of a circuit is seen to have an oscillatory behavior at the output with oscillations dying down after some time. The correct inference (s) regarding the transfer function from input to output is/are

- (A) that it does not have a real pole
(B) that it is first order system
(C) that it is of at least second order
(D) that it has at least one pole-pair that is underdamped

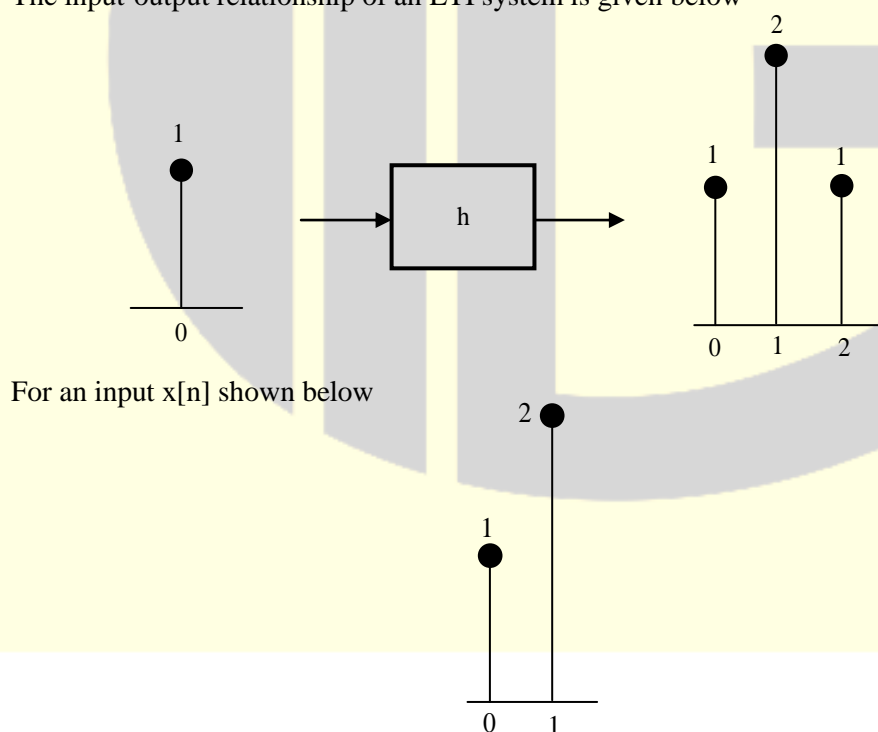
Answer: (C, D)

Q. No. 26 - 55 Carry Two Marks Each

26. A 16-bit microprocessor has twenty address lines (A_0 to A_{19}) and 16 data lines. The higher eight significant lines of the data bus of the processor are tied to the 8-data lines of a 16 Kbyte memory that can store one byte in each of its 16K address locations. The memory chip should map onto contiguous memory locations and occupy only 16 Kbyte of memory space. Which of the following statement(s) is/are correct with respect to the above design?
- (A) If the 16 Kbyte of memory chip is mapped with a starting address of 80000H, then the ending address will be 83FFFH.
- (B) The above chip cannot be interfaced as the width of the data bus of the processor and the memory chip differs.
- (C) The active high chip-select needed to map the 16 Kbyte memory with a starting address at F0000H is given by the logic expression $(A_{19} \cdot A_{18} \cdot A_{17} \cdot A_{16})$.
- (D) The 16 Kbyte memory cannot be mapped with contiguous address locations with a starting address as 0F000H using only A_{19} to A_{14} for generating chip select.

Answer: (A, D)

27. The input-output relationship of an LTI system is given below



The peak value of the output when $x[n]$ passes through h is _____.

- (A) 5 (B) 4 (C) 2 (D) 6

Answer: (A, D)

28. A $3\frac{1}{2}$ digit, rectifier type digital meter is set to read in its 2000V range. A symmetrical square wave of frequency 50Hz and amplitude $\pm 100\text{V}$ is measured using the meter. The meter will read _____.

Answer: (111)

29. A Boolean function F of the three variables X , Y and Z is given as

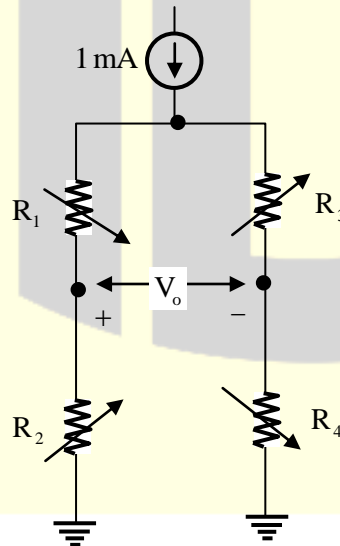
$$F(X, Y, Z) = (X' + Y + Z) \cdot (X + Y' + Z') \cdot (X' + Y + Z') \cdot (X'Y'Z' + X'YZ' + XYZ')$$

Which one of the following is true?

- (A) $F(X, Y, Z) = X'Y'Z + XYZ$ (B) $F(X, Y, Z) = (X' + Y) \cdot (X + Y' + Z')$
(C) $F(X, Y, Z) = X'Z' + YZ'$ (D) $F(X, Y, Z) = (X + Y + Z') \cdot (X' + Y' + Z')$

Answer: (C)

30. For the full bridge made of linear strain gages with gage factor 2 as shown in the diagram, $R_1 = R_2 = R_3 = R_4 = 100\Omega$ at 0°C and strain is 0. The temperature coefficient of resistance of the strain gages used is $0.005 \text{ per } ^\circ\text{C}$. All strain gages are made of same material and exposed to same temperature. While measuring a strain of 0.01 at a temperature of 50°C , the output V_o in millivolt is _____ (rounded off to two decimal places).



Answer: (2.5)

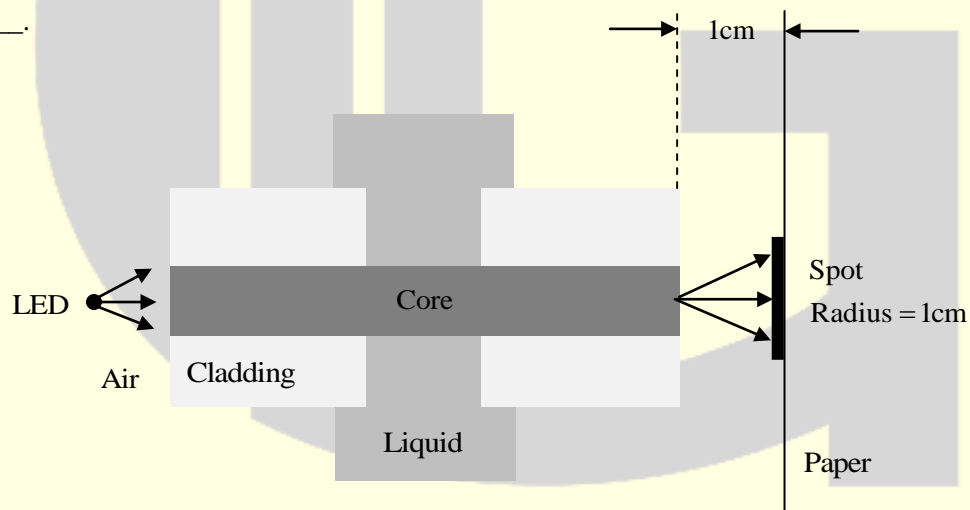
31. A sinusoid $(\sqrt{2} \sin t)\mu(t)$, where $\mu(t)$ is the step input, is applied to a system with transfer-function $G(s) = \frac{1}{s+1}$. The amplitude of the steady state output is _____.

Answer: (1)

32. A bar primary current transfer of rating 1000/1 A, 5VA, UPF has 995 secondary turns. It exhibits zero ratio error and phase error of 30 minutes at 1000A with rated burden. The watt loss component of the primary excitation current in ampere is _____ (rounded off to one decimal place).

Answer: (5)

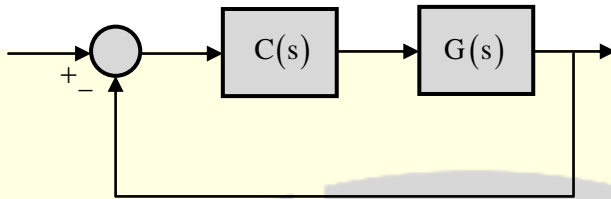
33. In the figure shown, a larger multimode fiber with $n_{\text{core}} = 1.5$ and $n_{\text{load}} = 1.2$ is used for sensing. A portion with the cladding removed passes through a liquid with refractive index n_{liquid} . An LED is used to illuminate the fiber from one end and a paper is placed on the other end, 1 cm from the end of the fiber. The paper shows a spot radius 1 cm. The refractive index n_{liquid} of the liquid (rounded off to two decimal places) is _____.



Answer: (1.32)

34. Consider a unity feedback configuration with a plant and a PID controller as shown in the figure.

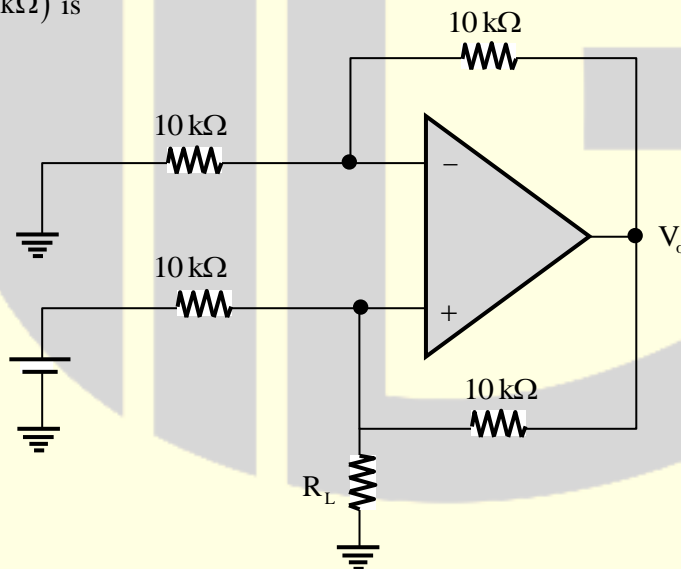
$G(s) = \frac{1}{(s+1)(s+3)}$ and $C(s) = K \frac{(s+3-j)(s+3+j)}{s}$ with K being scalar. The closed loop is



- (A) only stable for $K < 0$ (B) stable for all value of K
(C) only stable for $K > 0$ (D) only stable for K between -1 and $+1$

Answer: (C)

35. The output V_o of the ideal OpAmp used in the circuit shown below is 5V. Then the value of resistor R_L in kilo ohm ($k\Omega$) is



- (A) 25 (B) 5 (C) 2.5 (D) 50

Answer: (A)

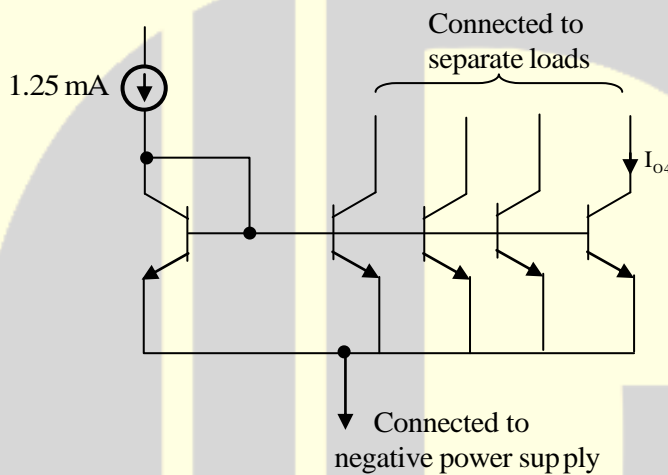
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36. A single-phase transformer has maximum efficiency of 98%. The core losses are 80W and the equivalent winding resistance as seen from the primary side is 0.5Ω . The rated current on the primary side is 25A. The percentage of the rated input current at which the maximum efficiency occurs is
- (A) 100% (B) 50.6% (C) 80.5% (D) 35.7%

Answer: (B)

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37. All the transistors used in the circuit are matched and have a current gain β of 20. Neglecting the Early effect, the current I_{O4} in milliamperes is _____.



Answer: (1)

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38. Given $A = \begin{pmatrix} 2 & 5 \\ 0 & 3 \end{pmatrix}$. The value of the determinant $|A^4 - 5A^3 + 6A^2 + 2I| =$ _____.

Answer: (4)

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39. $f(z) = (z-1)^{-1} - 1 + (z-1) - (z-1)^2 + \dots$ is the series expansion of

- (A) $\frac{-1}{(z-1)}$ for $|z-1| < 1$ (B) $\frac{-1}{z(z-1)}$ for $|z-1| < 1$
- (C) $\frac{1}{z(z-1)}$ for $|z-1| < 1$ (D) $\frac{1}{(z-1)^2}$ for $|z-1| < 1$

Answer: (C)

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40. A signal having a bandwidth of 5 MHz is transmitted using the Pulse code modulation (PCM) scheme as follows. The signal is sampled at a rate of 50% above the Nyquist rate and quantized into 256 levels. The binary pulse rate of the PCM signal in Mbits per second is _____.

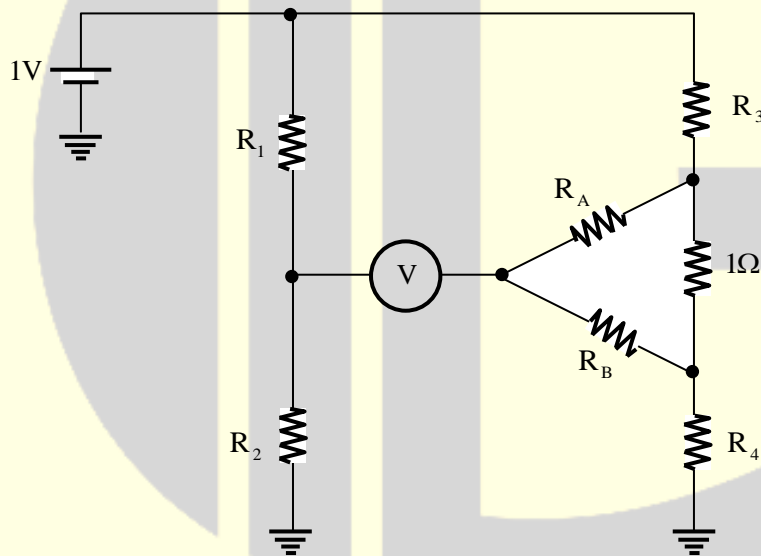
Answer: (120)

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41. Consider a system with transfer-function $G(s) = \frac{2}{s+1}$. A unit step function $\mu(t)$ is applied to the system, which results in an output $y(t)$. If $e(t) = y(t) - \mu(t)$, then $\lim_{t \rightarrow \infty} e(t)$ is _____.

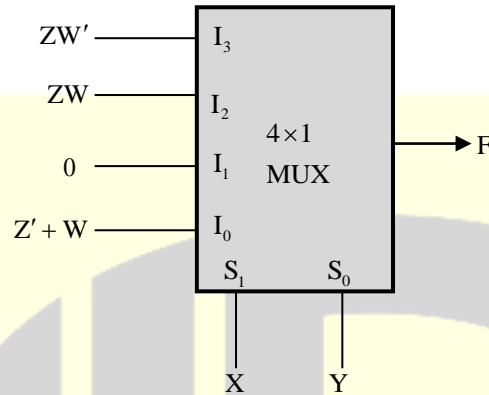
Answer: (1)

42. In the bridge circuit shown, the voltmeter V showed zero when the value of the resistors are: $R_1 = 100\Omega$, $R_2 = 110\Omega$, and $R_3 = 90\Omega$. If $(R_1/R_2) = (R_A/R_B)$, the value of R_4 in ohm is _____.



Answer: (99)

43. A 4×1 multiplexer with two selector lines is used to realize a Boolean function F having four Boolean variables X , Y , Z and W as shown below. S_0 and S_1 denote the least significant bit (LSB) and most significant bit (MSB) of the selector lines of the multiplexer respectively. I_0, I_1, I_2, I_3 are the input lines of the multiplexer.



The canonical sum of product representation of F is

- (A) $F(X, Y, Z, W) = \Sigma m(0, 1, 3, 11, 14)$ (B) $F(X, Y, Z, W) = \Sigma m(0, 1, 3, 14, 15)$
(C) $F(X, Y, Z, W) = \Sigma m(2, 5, 9, 11, 14)$ (D) $F(X, Y, Z, W) = \Sigma m(1, 3, 7, 9, 15)$

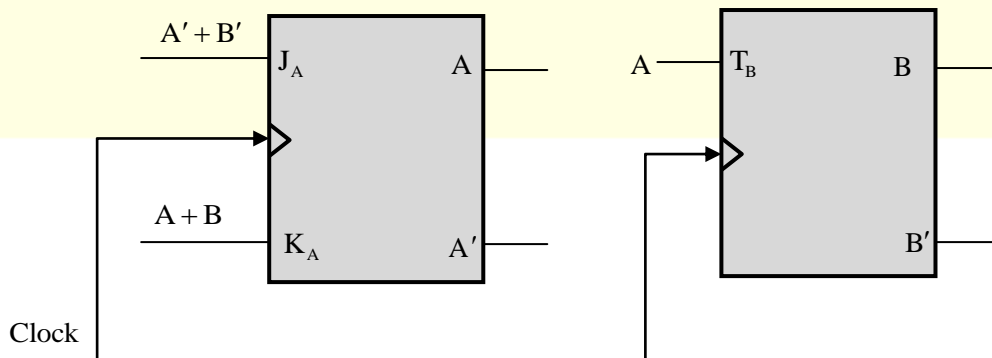
Answer: (A)

44. Consider that X and Y are independent continuous valued random variables with uniform PDF given by $X \sim U(2, 3)$ and $Y \sim U(1, 4)$. Then $P(Y \leq X)$ is equal to _____ (rounded off to two decimal places).

Answer: (0.5)

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45. Given below is the diagram of a synchronous sequential circuit with one J-K flip-flop and one T flip-flop with their outputs denoted as A and B respectively, with $J_A = (A' + B')$, $K_A = (A + B)$, and $T_B = A$.



Starting from the initial state ($AB = 00$), the sequence of states (AB) visited by the circuit is

- (A) $00 \rightarrow 01 \rightarrow 11 \rightarrow 00...$ (B) $00 \rightarrow 10 \rightarrow 11 \rightarrow 01 \rightarrow 00...$
(C) $00 \rightarrow 01 \rightarrow 10 \rightarrow 11 \rightarrow 00...$ (D) $00 \rightarrow 10 \rightarrow 01 \rightarrow 11 \rightarrow 00...$

Answer: (D)

46. A toroid made of CRGO has an inner diameter of 10 cm and an outer diameter of 14cm. The thickness of the toroid is 2cm. 200 turns of copper wire is wound on the core, $\mu_o = 4\pi \times 10^{-7}$ H/m and μ_R of CRGO is 3000. When a current of 5mA flows through the winding, the flux density in the core in millitesla is _____.

Answer: (10)

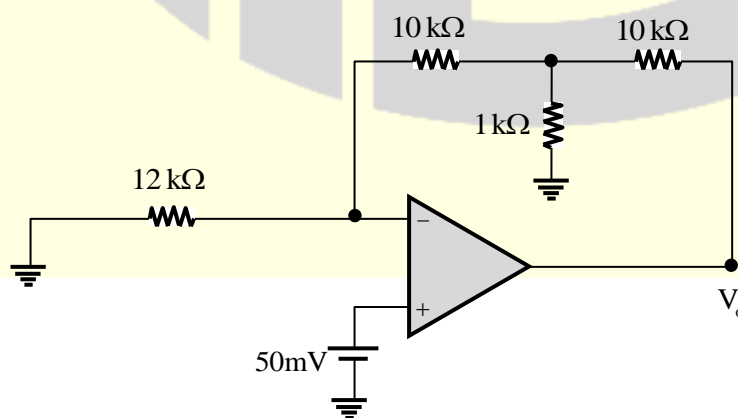
47. A $10\frac{1}{2}$ digit Counter-timer is set in the 'frequency mode' of operation (with $T_s = 1s$). For a specific input, the Counter-timer is changed to operate in the 'Period mode' and the range selected is microseconds (μs , with $f_2 = 1$ MHz). The counter will then display
(A) 0 (B) 1000 (C) 100 (D) 10

Answer: (B)

48. Given $y(t) = e^{-3t}u(t) * u(t+3)$, where $*$ denotes convolution operation. The value of $y(t)$ as $t \rightarrow \infty$ is _____ (rounded off to two decimal places).

Answer: (0.333)

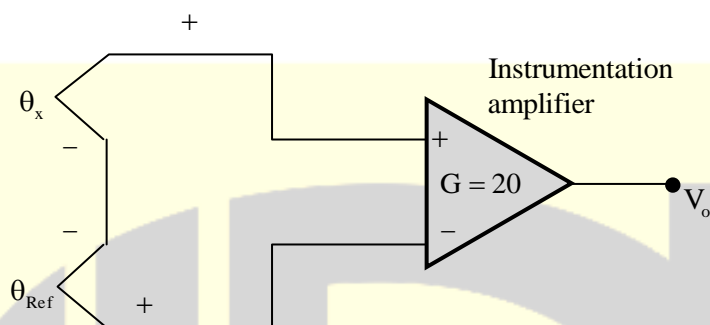
49. The circuit shown below uses an ideal OpAmp. Output V_o in volt is (rounded off to one decimal place).



Answer: (1.05)

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50. A J-type thermocouple has an output voltage $V_0 = (13650 + 50 \theta_x) \mu\text{V}$, where θ_x is the junction temperature in Celsius ($^{\circ}\text{C}$). The thermocouple is used with reference junction compensation, as shown in the figure. The instrumentation amplifier used to gain $G = 20$. If θ_{Ref} is 1°C , for an input θ_x of 100°C , the output V_o if instrumentation amplifier in millivolt is



- (A) 101 mV (B) 98mV (C) 99 mV (D) 100mV

Answer: (C)

51. A slip-ring induction motor is expected to be started by adding extra resistance in the rotor circuit. The benefit that is derived by adding extra resistance in the rotor circuit in comparison to the rotor being shorted is

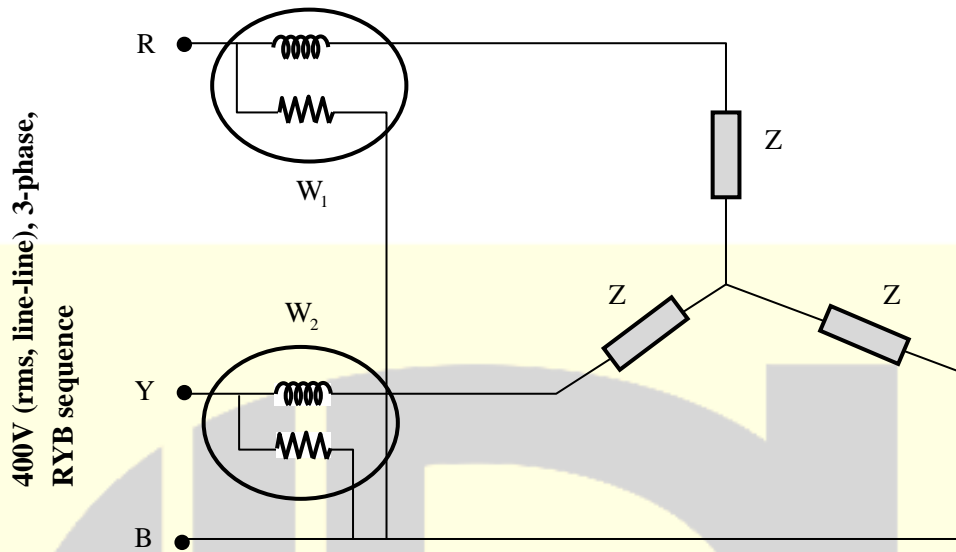
- (A) The losses at starting would be lower (B) The power factor at start will be lower
(C) The starting torque would be higher (D) The starting current is higher

Answer: (C)

52. A household fan consumes 60W and draw a current of 0.3125 A (rms) when connected to a 230V (rms) ac, 50Hz single phase mains. The reactive power drawn by the fan in VAR is _____(rounded off to the nearest integer).

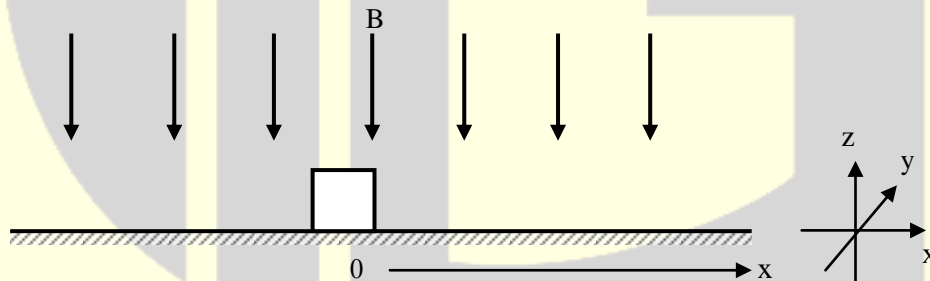
Answer: (39.57)

53. The power in a 400V (rms, line-line) three-phase, three-wire RYB sequence system is measured using the two wattmeters, as shown. The R-line current is $5\angle 60^{\circ}\text{A}$. Wattmeter W_1 in the R-line will read (in watt) _____.



Answer: (0)

54. The figure below shows an electrically conductive bar of square cross-section resting on a plane surface. The bar of mass of 1 kg has depth of 0.5m along the y direction. The coefficient of friction between the bar and the surface is 0.1. Assume the acceleration due to gravity to be 10 m/s^2 . The system faces a uniform flux density $B = 1\hat{z} \text{ T}$. At time $t = 0$, a current of 10A is switched onto the bar and is maintained.



When the bar has moved by 1m, its speed in metre per second is _____ (rounded off to one decimal place).

Answer: (2.8)

55. An air cored coil having a winding resistance of 10Ω is connected in series with a variable capacitor C_x . The series circuit is excited by a 10V sinusoidal voltage source of angular frequency 1000 rad/s. As the value of the capacitor is varied, a maximum voltage of 30V was observed across it. Neglecting skin-effect, the value of the inductance of the coil in millihenry is _____.

Answer: (30)