1. Until Iran come along, India had never been ______ in kabaddi.
   (A) defeated  (B) defeating  (C) defeat  (D) defeatist
   Answer: (A)

2. The fishermen, _______ the flood victims owed their lives, were rewarded by the government
   (A) whom  (B) to which  (C) to whom  (D) that
   Answer: (C)

3. The radius as well as the height of a circular cone is increases by 10%. The percentage increase in its volume is _________.
   (A) 17.1  (B) 21.0  (C) 33.1  (D) 72.8
   Answer: (C)

4. Five numbers 10, 7, 5, 4, 2 are arranged in a sequence from left to right following the directions given below:
   (1) No two odd or even numbers are next to each other.
   (2) The second number from left is exactly half of the left-most number.
   (3) The middle number is exactly twice the right most number.
   Which is the second number from the right?
   (A) 2  (B) 4  (C) 7  (D) 10
   Answer: (C)

5. “Some students were not involved in the strike”. If the above statement is true, which of the following conclusions is/are logically necessary?
1. Some who were involved in strike were students.
2. No student was involved in the strike.
3. At least one student was involved in the strike.
4. Some who were not involved in the strike were students.

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

Answer:  (C)

6. "I read somewhere that in ancient times the prestige of a kingdom depended upon the number of taxes that it was able to levy on its people. It was very much like the prestige of a head-hunter in his own community".

Based on the paragraph above, the prestige of a head-hunter depended upon

(A) the prestige of the kingdom  
(B) the prestige of the heads  
(C) the number of taxes he could levy  
(D) the number of head she could gather

Answer:  (D)

7. Two trains started at 7 AM from the same point. The first train travelled towards north at a speed of 80 km/h and the second train travelled south at a speed of 100 km/h. The time at which they were 540 km apart is _______ AM.

(A) 9  (B) 10  (C) 11  (D) 11:30

Answer:  (B)

8. In a country of 1400 million population, 70% own mobile phones. Among the mobile phone owners only 294 million access the internet. Among these Internet users, only half buy goods from e-commerce portals. What is the percentage of these buyers in the country ?

(A) 10.5  (B) 14.70  (C) 15.00  (D) 50.00

Answer:  (A)
9. The nomenclature of Hindustani music has changed over centuries. Since the medieval period dhrupad styles were identified as baanis. Terms like gayaki and baaj were used to refer to vocal and instrumental styles, respectively. With institutionalization of music education the term gharana became acceptable. 

Gharana originally referred to hereditary musicians from a particular lineage, including disciples and ground disciples. Which one of the following pairings is NOT Correct?

(A) Dhrupad, baani  
(B) Gayaki, Vocal  
(C) Baaj, institution  
(D) Gharana, lineage 

Answer: (C)

10. Since the last one year, after a 125 basis point reduction in repo rate by the Reserve Bank of India, banking institutions have been making a demand to reduce interest rates on small savings schemes. Finally, the government announced yesterday a reduction in interest rates on small saving schemes to bring them on par with fixed deposit interest rates. 

Which one of the following statements can be inferred from the given passage?

(A) Whenever the Reserve Bank of India reduces the repo rate, the interest rates on small saving schemes are also reduced.  
(B) Interest rates on small saving schemes are always maintained on par with fixed deposit interest rates.  
(C) The government sometimes takes into consideration the demands of banking institutions before reducing the interest rates on small saving schemes.  
(D) A reduction in interest rates on small saving schemes follow only after a reduction in repo rate by the Reserve Bank of India. 

Answer: (C)
INSTRUMENTATION ENGINEERING

Q. No. 1 – 25 Carry One Mark Each

1. The figure below shows the $i^{th}$ full-adder block of a binary adder circuit. $C_i$ is the input carry and $C_{i+1}$ is the output carry of the circuit. Assume that each logic gate has a delay of 2 nanosecond, with no additional time delay due to the interconnecting wires.

![Diagram](image)

If the inputs $A_i, B_i$ are available and stable throughout the carry propagation, the maximum time taken for an input $C_i$ to produce a steady-state output $C_{i+1}$ is _______ nanosecond.

Answer: (4)

2. The resistance of a resistor is measured using a voltmeter and an ammeter. The voltage measurements have a mean value of 1V and standard deviation of 0.12V while current measurements have a mean value of 1 mA with standard deviation of 0.05mA. Assuming that the errors in voltage and current measurements are independent, the standard deviation of the calculated resistance value is _______ Ω.

Answer: (130)

3. The circuit shown in the figure below uses ideal positive edge-triggered synchronous J-K flip flops with outputs X and Y. If the initial state of the output is $X = 0$ and $Y = 0$ just before the arrival of the first clock pulse, the state of the output just before the arrival of the second pulse is
4. The input $x[n]$ and output $y[n]$ of discrete-time system are related as $y[n]=\alpha y[n-1]+x[n]$. The condition of $\alpha$ for which the system is Bounded-Input Bounded-Output (BIBO) stable is

(A) $|\alpha|<1$  
(B) $|\alpha|=1$  
(C) $|\alpha|>1$  
(D) $|\alpha|<3/2$

Answer: (A)

5. A box has 8 red balls and 8 green balls. Two balls are drawn randomly in succession from the box without replacement. The probability that the first ball drawn is red and the second ball drawn is green is

(A) 4/15  
(B) 7/16  
(C) 1/2  
(D) 8/15

Answer: (A)

6. Consider a circuit comprising only resistors with constant resistance and ideal independent DC voltage sources. If all the resistances are scaled down by a factor 10, and all source voltages are scaled up by a factor 10, the power dissipated in the circuit scales up by a factor of ________.

Answer: (1000)

7. If each of the values of inductance, capacitance and resistance of a series LCR circuit are doubled, the Q-factor of the circuit would

(A) reduce by a factor $\sqrt{2}$  
(B) reduce by a factor 2

(C) increase by a factor $\sqrt{2}$  
(D) increase by a factor 2

Answer: (B)
8. A signal \( \cos(2\pi f_m t) \) modulates a carrier \( \cos(2\pi f_c t) \) using the double-sideband-with-carrier (DSBWC) scheme to yield a modulated signal \( \cos(2\pi f_c t) + 0.3\cos(2\pi f_m t)\cos(2\pi f_c t) \). The modulation index is \( \boxed{0.3} \). (Rounded off to one decimal place).

Answer: \( 0.3 \)

9. In a single-mode optical fiber, the zero-dispersion wavelength refers to the wavelength at which the
   (A) material dispersion is zero
   (B) waveguide dispersion is zero
   (C) sum of material dispersion and waveguide dispersion is zero
   (D) material dispersion and waveguide dispersion are simultaneously zero.

Answer: \( C \)

10. The total number of Boolean functions with distinct truth-tables that can be defined over 3 Boolean
    variables is \( \boxed{256} \).

Answer: \( 256 \)

11. A 3\( \times \) 3 matrix has eigen values 1, 2 and 5. The determinant of the matrix is \( 10 \).

Answer: \( 10 \)

12. In the circuit shown below, maximum power is transferred to the load resistance \( R_L \), when \( R_L = ____ \Omega \).

[Diagram of a circuit with a 5\( \Omega \) resistor and a 5V source connected to the load resistance \( R_L \).]

Answer: \( 5 \)
13. An 8-bit weighted resistor digital-to-analog converter (DAC) has the smallest resistance of 500 Ω. The largest resistance has a value of __________ kΩ.
Answer: (64)

14. Four strain gauges in a Wheatstone bridge configuration are connected to an instrumentation amplifier as shown in the figure.

From the choices given below, the preferred value for the common mode rejection ratio (CMRR) of the amplifier, in dB, would be
(A) –20  (B) 0  (C) 3  (D) 100
Answer: (D)

15. The correct biasing conditions for typical operation of light emitting diodes, photodiodes, Zener diodes are respectively,
(A) forward bias, reverse bias, reverse bias
(B) reverse bias, reverse bias, forward bias
(C) forward bias, forward bias, reverse bias
(D) reverse bias, forward bias, reverse bias
Answer: (A)

16. The output $y(t)$ of a system is related to its input $x(t)$ as $y(t) = \int_{0}^{t} x(\tau - 2) \, d\tau$. where, $x(t) = 0$ and $y(t) = 0$ for $t \leq 0$. The transfer function of the system is
17. In the circuit shown below, the input voltage $V_{in}$ is positive. The current ($I$) − Voltage ($V$) characteristics of the diode can be assumed to be $I = I_0 e^{V/V_T}$ under the forward bias condition, where $V_T$ is the thermal voltage and $I_0$ is the reverse saturation current. Assuming an ideal op-amp, the output voltage $V_{out}$ of the circuit is proportional to

![Circuit Diagram]

(A) $\log_e \left( \frac{V_{in}}{V_T} \right)$  
(B) $2V_{in}$  
(C) $e^{V_{in}/V_T}$  
(D) $V_{in}^2$

Answer: (C)

18. $\vec{a}$, $\vec{b}$, $\vec{c}$ are three orthogonal vectors. Given that $\vec{a} = \hat{i} + 2\hat{j} + 5\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$, the vector $\vec{c}$ is parallel to

(A) $\hat{i} + 2\hat{j} + 3\hat{k}$  
(B) $2\hat{i} + \hat{j}$  
(C) $2\hat{i} - \hat{j}$  
(D) $4\hat{k}$

Answer: (C)

19. The vector function $\vec{A}$ is given by $\vec{A} = \vec{V}u$, where $u(x,y)$ is a scalar function. Then $|\vec{V} \times \vec{A}|$ is

(A) $-1$  
(B) $0$  
(C) $1$  
(D) $\infty$

Answer: (B)
20. In the circuit shown below, initially the switch $S_1$ is open, the capacitor $C_1$ has a charge of 6 coulomb, and the capacitor $C_2$ has 0 coulomb. After $S_1$ is closed, the charge on $C_2$ in steady state is __________ coulomb.

\[ S_1 \quad \begin{array}{c} \uparrow \\downarrow \hline \end{array} \quad 1k\Omega \quad C_1=1F \quad C_2=2F \]

Answer: (4)

21. A pitot-static tube is used to estimate the velocity of an incompressible fluid of density $1\text{kg/m}^3$. If the pressure difference measured by the tube is $200\text{N/m}^2$, the velocity of the fluid, assuming the pitot-tube coefficient to be 1.0, is __________m/s.

Answer: (20)

22. In the figures (a) and (b) shown below, the transformers are identical and ideal, except that the transformer in figure (b) is centre-tapped. Assuming ideal diodes, the ratio of the root-mean-square (RMS) voltage across the resistor $R$ in figure (a) to that in figure (b) is

\[ V_0\sin(\omega t) \quad \begin{array}{c} \uparrow \downarrow \hline \end{array} \quad R \quad \text{Figure (a)} \]

\[ V_0\sin(\omega t) \quad \begin{array}{c} \uparrow \downarrow \hline \end{array} \quad R \quad \text{Figure (b)} \]

(A) $\sqrt{2}:1$  (B) $2:1$  (C) $2\sqrt{2}:1$  (D) $4:1$

Answer: (B)
23. In a cascade control system, the closed loop transfer function of the inner loop may be assumed to have a single time-constant $\tau_1$. Similarly, the closed loop transfer function of the outer loop may be assumed to have a single time-constant $\tau_2$. The desired relationship between $\tau_1$ and $\tau_2$ in a well-designed control system is

(A) $\tau_1$ is much less than $\tau_2$

(B) $\tau_1$ is equal to $\tau_2$

(C) $\tau_1$ is much greater than $\tau_2$

(D) $\tau_1$ is independent less than $\tau_2$

Answer: (A)

24. The loop-gain function $L(s)$ of a control system with unity feedback is given to be

$$L(s)=\frac{k}{(s+1)(s+2)(s+3)}$$

where $k>0$. If the gain cross-over frequency of the loop-gain function is less than its phase cross-over frequency, the closed-loop system is

(A) unstable

(B) marginally stable

(C) conditionally stable

(D) stable

Answer: (D)

25. Thermocouples measure temperature based on

(A) Photoelectric effect

(B) Seebeck effect

(C) Hall effect

(D) Thermal expansion

Answer: (B)
Q. No. 26 – 55 Carry Two Marks Each

26. The parallel resistance-capacitance bridge shown below has a standard capacitance value of $C_0 = 0.1 \mu F$ and a resistance value of $R_0 = 10 k\Omega$. The bridge is balanced at a supply frequency of 100Hz for $R_1 = 375 k\Omega$, $R_2 = 10 k\Omega$ and $R_3 = 14.7 k\Omega$.

![Parallel Resistance-Capacitance Bridge](image)

The value of the dissipation factor $D = 1/(\omega R_p C_p)$ of the parallel combination of $C_p$ and $R_p$ is ________. (Rounded off to three decimal places).

Answer: (0.042)

27. The curve $y = f(x)$ is such that the tangent to the curve at every point $(x, y)$ has a Y-axis intercept $c$, given by $c = -y$. Then, $f(x)$ is proportional to

(A) $x^{-1}$  (B) $x^2$  (C) $x^3$  (D) $x^4$

Answer: (B)

28. A differential capacitive sensor with a distance between the extreme plates 100mm is shown in figure below.

![Differential Capacitive Sensor](image)

$V_{rms} = 10V$
The difference voltage \( \Delta V = V_1 - V_2 \), where \( V_1 \) and \( V_2 \) are the rms values, for a downward displacement of 10mm of the intermediate plate from the central position, in volts, is

(A) 0.9   (B) 1.0   (C) 1.1   (D) 2

Answer:  (D)

29. In the circuit shown below, the angular frequency \( \omega \) at which the current is in phase with the voltage is \__________\ rad/s.

\[
\begin{align*}
&I_0 \sin(\omega t) \\
&V_0 \sin(\omega t) \\
&5 \text{mH} \\
&50 \Omega \\
&500 \text{nF}
\end{align*}
\]

Answer:  (20000)

30. The forward path transfer function \( L(s) \) of the control system shown in figure (a) has the asymptotic Bode plot shown in Figure (b). If the disturbance \( d(t) \) is given by \( d(t) = 0.1 \sin(\omega t) \) where \( \omega = 5 \text{rad/s} \), the steady-state amplitude of the output \( y(t) \) is

(A) \( 1.00 \times 10^{-3} \)  (B) \( 2.50 \times 10^{-3} \)  (C) \( 5.00 \times 10^{-3} \)  (D) \( 10.00 \times 10^{-3} \)

Answer:  (A)
31. The function \( p(x) \) is given by \( p(x) = A / x^\mu \) where \( A \) and \( \mu \) are constants with \( \mu > 1 \) and \( 1 \leq x < \infty \) and \( p(x) = 0 \) for \( -\infty < x < 1 \). For \( p(x) \) to be probability density function, the value of \( A \) should be equal to

(A) \( \mu - 1 \)  
(B) \( \mu + 1 \)  
(C) \( 1 / (\mu - 1) \)  
(D) \( 1 / (\mu + 1) \)

Answer: (A)

32. A piezoelectric transducer with sensitivity of 30mV/kPa is intended to be used in the range of 0 kPa to 100 kPa. The readout circuit has a peak noise amplitude of 0.3mV and measured signals over the full pressure range are encoded with 10 bits. The smallest pressure that produces a non-zero output, in units of Pa, is approximately

(A) 10  
(B) 100  
(C) 240  
(D) 300

Answer: (B)

33. A 100W light source emits uniformly in all directions. A photo detector having a circular active area whose diameter is 2cm is placed 1m away from the source, normal to the incident light. If the responsivity of the photo detector is 0.4A/W, the photo-current generated in the detector, in units of mA, is 

(A) 1  
(B) 4  
(C) 100  
(D) 400

Answer: (A)

34. \( X = X_1X_0 \) and \( Y = Y_1Y_0 \) are 2-bit binary numbers. The Boolean function \( S \) that satisfies the condition "If \( X > Y \), then \( S=1 \)" in its minimized form, is

(A) \( X_1Y_1 + X_0Y_0 \)  
(B) \( X_1\bar{Y}_1 + X_0\bar{Y}_0 \bar{Y}_1 + X_0\bar{Y}_0 X_1 \)  
(C) \( X_1\bar{Y}_1 X_0\bar{Y}_0 \)  
(D) \( X_1Y_1 + X_0\bar{Y}_0 Y_1 + X_0\bar{Y}_0 \bar{Y}_1 \)

Answer: (B)
35. Four identical resistive strain gauges with gauge factor of 2.0 are used in a Wheatstone bridge as shown in the figure below.

Only one of the strain gauges $R_{\text{SENSE}}$ changes its resistance due to strain. If the output voltage $V_{\text{OUT}}$ measure to be 1 mV, the magnitude of strain, in units of micro strain, is

(A) 1  (B) 10  (C) 100  (D) 1000

Answer: (D)

36. A signal $x(t)$ has a bandwidth $2B$ about a carrier frequency of $f_c = 2\text{GHz}$ as shown in figure (a) below.

In order to demodulate this signal, it is first mixed (multiplied) with a local oscillator of frequency $f_{\text{LO}} = 1.5\text{GHz}$, and then passed through an ideal low-pass filter (LPF) with a cut-off frequency of 2.8GHz. The output of the LPF is sent to a digitizer ADC with a sampling rate of 1.6 GHz as shown in figure (b) below.
The maximum value of B so that the signal x(t) can be reconstructed from its sample according to the Nyquist sampling theorem is __________ MHz.

Answer: (300)

37. A resistance-meter has five measurement range-settings between 200Ω and 2 MΩ in multiplies of 10. The meter measures resistance of a device by measuring a full-range voltage of 2V across the device by passing an appropriate constant current for each range-setting. If a device having a resistance value in the range 8kΩ to 12kΩ and a maximum power rating of 100μW is to be measured safely with this meter, the choice for range-setting on the meter for best resolution in measurement, in kΩ is (A) 2 (B) 20 (C) 200 (D) 2000

Answer: (C)

38. In the circuit shown below, assume that the comparators are ideal and all components have zero propagation delay. In one period of the input signal \( V_{in} = 6\sin(\omega t) \), the fraction of the time for which the output \( OUT \) is in logic state HIGH is (A) 1/12 (B) 1/2 (C) 2/3 (D) 5/6

Answer: (D)
39. In the circuit shown below, a step input voltage of magnitude 5V is applied at node A at time t=0.

If the capacitor has no charge for \( t \leq 0 \), the voltage at node P at \( t=6\mu s \) is ________V. (Rounded off to two decimal places)

Answer: (1.89)

40. The frequency response of a digital filter \( H(\omega) \) has the following characteristics

Passband: \( 0.95 \leq |H(\omega)| \leq 1.05 \) for \( 0 \leq \omega \leq 0.3\pi \) and

Stopband: \( 0 \leq |H(\omega)| \leq 0.005 \) for \( 0.4\pi \leq \omega \leq \pi \),

Where \( \omega \) is the normalized angular frequency in rad/sample. If the analog upper cut off frequency for the passband of the above digital filter is to be 1.2 kHz, then the sampling frequency should be ________kHz.

Answer: (8)

41. Consider a Michelson interferometer as shown in the figure below.
When the wavelength of the laser light source is switched from 400 nanometer to 500 nanometer, it is observed that the intensity measured at the output P goes from a minimum to a maximum. This observation is possible when the smallest path difference between the two arms of the interferometer is _______ nanometer.

Answer: (500 or 1000)

42. In the circuit shown below, all transistors are n-channel enhancement mode MOSFETs. They are identical and are biased to operate in saturation mode.

![Circuit Diagram](image)

Ignoring channel length modulation, the output voltage $V_{out}$ is __________ V.

Answer: (4)

43. In a control system with unity gain feedback, the transfer function of the loop-gain function is $L(s) = 9e^{-0.1s} / s$. The phase margin of the loop-gain function $L(S)$ is _____ degree.

Answer: (38.44)

44. In the control system shown in the figure below, a reference signal $r(t) = t^2$ is applied at time $t = 0$. The control system employs a PID controller $C(s) = K_p + K_i / s + K_ds$ and the plant has a transfer function $P(s) = 3 / s$. If $K_p = 10$, $K_i = 1$ and $K_D = 2$, the steady state value of $e$ is
45. In the circuit shown below, all OPAMPS are ideal.

The current I = 0A when the resistance R = ____ kΩ.

Answer: (9)

46. In a microprocessor with a 16bit address bus, the most significant address line A15 to A12 are used to select a 4096 word memory unit, while line A0 to A11 are used to address a particular word in the memory unit. If the 3 least significant lines of the address bus A0 to A2 are short-circuited to ground, the addressable number of words in the memory unit is ________.

Answer: (512)
47. A discrete-time signal \[ x[n] = e^{j \frac{2\pi n}{5}} + e^{j \frac{4\pi n}{5}} \] is down-sampled to the signal \( x_d[n] \) such that 
\[ x_d[n] = x[4n] \]. The fundamental period of the down-sampled signal \( x_d[n] \) is _________.

Answer: (6)

48. A pulsed laser emits rectangular pulses of width 1 nanosecond at a repetition rate of 1 kHz. If the average power output is 1mW, the average power over a single pulse duration, in watts, is

(A) 1  (B) 10  (C) 100  (D) 1000

Answer: (D)

49. The dynamics of the state \[ \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \] of a system is governed by the differential equation

\[
\begin{bmatrix}
\dot{x}_1 \\
\dot{x}_2
\end{bmatrix} = \begin{bmatrix} 1 & 2 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 20 \\ 10 \end{bmatrix}
\]

Given that the initial state is \[ \begin{bmatrix} 0 \\ 0 \end{bmatrix} \], the steady state value of \[ \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \] is

(A) \[ \begin{bmatrix} -30 \\ -40 \end{bmatrix} \]  (B) \[ \begin{bmatrix} -20 \\ -10 \end{bmatrix} \]  (C) \[ \begin{bmatrix} 5 \\ -15 \end{bmatrix} \]  (D) \[ \begin{bmatrix} 50 \\ -35 \end{bmatrix} \]

Answer: (D)

50. A Voltage amplifier is constructed using enhancement mode MOSFETs labeled M1, M2, M3 and M4 in the figure below. M1, M2 and M4 are n-channel MOSFETs and M3 is a p-channel MOSFET. All MOSFETs operate in saturation mode and channel length modulation can be ignored. The low frequency, small signal input and output voltages are \( V_{in} \) and \( V_{out} \) respectively and the dc power supply voltage is \( V_{dd} \). All n-channel MOSFETs have identical transconductance \( g_{mn} \) while the p-channel MOSFET has transconductance \( g_{mp} \).
The expressions for the low frequency small signal voltage gain \( \frac{V_{\text{out}}}{V_{\text{in}}} \) is

(A) \( -\frac{g_{mn}}{g_{mp}} \)
(B) \( -\frac{g_{mn}}{g_{mn} + g_{mp}} \)^{-1}
(C) \( +\frac{g_{mn}}{g_{mp}} \)
(D) \( \frac{g_{mn}}{g_{mn} + g_{mp}} \)^{-1}

Answer: (C)

51. The transfer function relating the input \( x(t) \) to the output \( y(t) \) of a system is given by \( G(s) = \frac{1}{s + 3} \). A unit-step input is applied to the system at time \( t=0 \). Assuming that \( y(0) = 3 \), the value of \( y(t) \) at time \( t = 1 \) is \( \ldots \). (Rounded off to two decimal places).

Answer: (0.46)

52. In a control system with unit gain feedback, the plant has the transfer function \( P(s) = \frac{3}{s} \). Assuming that a controller of the form \( C(s) = \frac{K}{s + 9} \) is used, where \( K \) is a positive constant, the value of \( p \) for which the root-locus of the closed-loop system passes through the points \( -3 \pm 3\sqrt{3} \) where \( j = \sqrt{-1} \), is

(A) 3 \hspace{1cm} (B) 3\sqrt{3} \hspace{1cm} (C) 6 \hspace{1cm} (D) 9

Answer: (C)
53. In the circuit below, the light dependent resistor (LDR) receives light from the LED. The LDR has resistances of 5kΩ and 500Ω under dark and illuminated conditions, respectively. The LED is OFF at time \( t < 0 \). At time \( t=0s \), the switch \( S_1 \) is closed for 1ms and then kept open thereafter. Assuming zero propagation delay in the devices, the LED

(A) turns ON when \( S_1 \) is closed and remains ON after \( S_1 \) is opened.
(B) turns ON when \( S_1 \) is closed and turns OFF after \( S_1 \) is opened.
(C) turns ON when \( S_1 \) is closed and toggles periodically from ON to OFF after \( S_1 \) is opened.
(D) remains OFF when \( S_1 \) is closed and continues to remain OFF after \( S_1 \) is opened.

Answer: (A)

54. A complex function \( f(z) = u(x,y) + iv(x,y) \) and its complex conjugate \( f'(z) = u(x,y) - iv(x,y) \) are both analytic in the entire complex plane, where \( z = x + iy \) and \( i = \sqrt{-1} \). The function \( f \) is then given by

(A) \( f(z) = x + iy \)
(B) \( f(z) = x^2 - y^2 + i 2xy \)
(C) \( f(z) = \text{constant} \)
(D) \( f(z) = x^2 + y^2 \)

Answer: (C)

55. The output of a continuous-time system \( y(t) \) is related to its input \( x(t) \) as \( y(t) = x(t) + \frac{1}{2} x(t-1) \). If the Fourier transforms of \( x(t) \) and \( y(t) \) are \( X(\omega) \) and \( Y(\omega) \) respectively, and \( |X(0)|^2 = 4 \). The value of \( |Y(0)|^2 \) is __________.

Answer: (9)