1.5. Of the four networks, $N_1$, $N_2$, $N_3$ and $N_4$ of the given figure, the networks having identical driving point functions are

(a) $N_1$ and $N_3$  
(b) $N_2$ and $N_4$  
(c) $N_1$ and $N_4$  
(d) $N_1$ and $N_4$

1.6. A linear time-invariant system is described by the state variable model

$$
\begin{bmatrix}
    x_1 \\
    x_2
\end{bmatrix} =
\begin{bmatrix}
    -1 & 0 \\
    0 & -2
\end{bmatrix}
\begin{bmatrix}
    x_1 \\
    x_2
\end{bmatrix} +
\begin{bmatrix}
    0 \\
    1
\end{bmatrix} u =
\begin{bmatrix}
    1 \\
    2
\end{bmatrix}
\begin{bmatrix}
    x_1 \\
    x_2
\end{bmatrix}
$$

(a) The system is completely controllable  
(b) The system is not completely controllable  
(c) The system is completely observable  
(d) The system is not completely observable.

1.7. A process with open-loop model $G(s) = \frac{k e^{-T_s}}{t s + 1}$ is controlled by a PID controller. For this process

(a) the integral mode improves transient performance  
(b) the integral mode improves steady-state performance  
(c) the derivative mode improves transient performance  
(d) the derivative mode improves steady-state performance.
1.8. A linear discrete-time system has the characteristic equation, \( z^2 - 0.81z = 0 \). The system
(a) is stable
(b) is marginally stable
(c) is unstable
(d) stability cannot be assessed from the given information.

1.9. Bode plot of a stable system is shown in the given figure. The transfer function of the system is

![Bode Plot Diagram]

1.10. Given a unity feedback system with open-loop transfer function, \( G(s) = \frac{K}{s(s + 1)(s + 2)} \). The root locus plot of the system is of the form.

![Root Locus Diagram]

1.11. A semiconductor is irradiated with light such that carriers are uniformly generated throughout its volume. The semiconductor is n-type with \( N_B = 10^{19} \) per cm\(^3\). If the excess electron concentration in the steady state is \( \Delta n = 10^{15} \) per cm\(^3\) and if \( \tau_p = 10\mu \text{sec} \) [minority carrier lifetime] the generation rate due to irradiation
(a) is \( 10^{30} \text{e-h pairs/cm}^3/\text{s} \)
(b) is \( 10^{24} \text{e-h pairs/cm}^3/\text{s} \)
(c) is \( 10^{10} \text{e-h pairs/cm}^3/\text{s} \)
(d) cannot be determined as the given data is insufficient.

1.12. A P-N junction diode series with a 100 ohms resistor is forward biased so that a current of 100 mA flows. If the voltage across this combination is instantaneously reversed to 10 V at \( t = 0 \), the reverse current that flows through the diode at \( t = 0 \) is approximately given by
(a) 0 mA         (b) 100 mA         (c) 200 mA         (d) 50 mA

1.13. An infrared LED is usually fabricated from
(a) Ge         (b) Si         (c) Ga As         (d) Ga As P.

1.14. In a transistor having finite B, the forward bias across the base emitter junction is kept constant and the reverse bias across the collector-base junction is increased. Neglecting the leakage across the collector-base junction and the depletion region generating current, the base current will ________ (increase/decrease/remain constant).

1.15. An n-channel JFET has a pinch-off voltage of \( V_p = -5 \text{ V} \), \( V_{DS} \) (max) = 20 V, and \( \delta_n = 2\text{mA/V} \). The minimum 'ON' resistance is achieved in the JFET for
(a) \( V_{GS} = -7 \text{ V} \) and \( V_{DS} = 0 \text{ V} \)
(b) \( V_{GS} = 7 \text{ V} \) and \( V_{DS} = 0 \text{ V} \)
(c) \( V_{GS} = 0 \text{ V} \) and \( V_{DS} = 20 \text{ V} \)
(d) \( V_{GS} = -7 \text{ V} \) and \( V_{DS} = 20 \text{ V} \)

1.16. The JFET in the circuit shown in the given figure has an \( I_{DS} = 10 \text{ mA} \) and \( V_p = 5 \text{ V} \). The value of the resistance \( R_s \) for a drain current \( I_{DS} = 6.4 \text{ mA} \) is (select the nearest value)

![Circuit Diagram]

(a) 150 ohms         (b) 470 ohms         (c) 560 ohms         (d) 1 kilo ohm.

1.17. An op-amp has an offset voltage of 1 mV and is ideal in all other respects. If this op-amp is used in the circuit shown in the given figure, the output voltage will be (select the nearest value)

![Op-Amp Circuit Diagram]

(a) 1 mV         (b) 1 V         (c) \( \pm 1 \text{ V} \)         (d) 0 V.
1.18. If the transistors in the given figure have high values of β and a $V_{BE}$ of 0.65 volt, the current I, flowing through the 2 kilo ohms resistance will be . . . .

![Transistor Circuit](image)

1.19. The circuit of given figure, uses an ideal op amp. For small positive values of $V_{in}$, the circuit works as

(a) a halfwave rectifier

(b) a differentiator

(c) a logarithmic amplifier

(d) an exponential amplifier.

1.20. Assume that the operational amplifier in given figure is ideal. The current, I, through the 1 K ohm resistor is . . . . . .

![Op Amp Circuit](image)

1.21. The 6 V Zener diode shown in given figure has zero zener resistance and a knee current of 5 mA. The minimum value of R so that the voltage across it does not fall below 6 V is

(a) 1.2K ohms  
(b) 80 ohms  
(c) 50 ohms  
(d) 0 ohms

1.22. The logic realized by the circuit shown in given figure is

(a) $F = A \cdot C$  
(b) $F = A + C$  
(c) $F = B \cdot C$  
(d) $F = B + C$

1.23. Choose the correct statement(s) for the following

(a) PROM contains a programmable AND array and a fixed OR array

(b) PLA contains a fixed AND array and a programmable OR array

(c) PROM contains a fixed AND array and a programmable OR array

(d) PLA contains a programmable AND array and a programmable OR array.

1.24. Given figure shows the circuit of a gate in the Resistor Transistor Logic (RTL) family. The circuit represents a

![Gate Circuit](image)

(a) NAND  
(b) AND  
(c) NOR  
(d) OR

1.25. The initial contents of the 4-bit serial-in-parallel-out, right-shift, Shift Register shown in given figure is 0110. After three clock pulses are applied, the contents of the Shift Register will be

![Shift Register](image)

(a) 0110  
(b) 0101  
(c) 1010  
(d) 1111.

1.26. In an 8085 microprocessor system with memory mapped I/O,

(a) I/O devices have 16-bit addresses

(b) I/O devices are accessed using IN and OUT instructions

(c) there can be a maximum of 256 input devices and 256 output devices

(d) arithmetic and logic operations can be directly performed with the I/O data.
1.27. The following program is run on 8085 microprocessor:

<table>
<thead>
<tr>
<th>Memory Address in hex</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>LXI SP, 1000</td>
</tr>
<tr>
<td>2003</td>
<td>PUSH H</td>
</tr>
<tr>
<td>2004</td>
<td>PUSH D</td>
</tr>
<tr>
<td>2005</td>
<td>CALL 2050</td>
</tr>
<tr>
<td>2008</td>
<td>POP H</td>
</tr>
<tr>
<td>2009</td>
<td>HLT</td>
</tr>
</tbody>
</table>

At the completion of the execution of the program, the program Counter of the 8085 contains _________ and the Stack Pointer contains _________.

1.28. Dual-slope integration type Analog-to-digital converters provide

(a) higher speeds compared to all other types of A/D converters
(b) very good accuracy without putting extreme requirements on component stability
(c) good rejection of power supply hum
(d) better resolution compared to all other types of A/D converters for the same number of bits.

1.29. Which of the following signals is/are periodic?

(a) \( S(t) = \cos 2t + \cos 3t + \cos 5t \)
(b) \( S(t) = \exp(j2\pi t) \)
(c) \( S(t) = \exp(-7t) \sin 10t \)
(d) \( S(t) = \cos 2t \cos 4t \)

1.30. If \( G(f) \) represents the Fourier transform of a signal \( g(t) \) which is real and odd symmetric in time, then

(a) \( G(f) \) is complex
(b) \( G(f) \) is imaginary
(c) \( G(f) \) is real
(d) \( G(f) \) is real and non-negative.

1.31. The maximum power efficiency of an AM modulator is

(a) 25 %
(b) 50 %
(c) 75 %
(d) 100 %

1.32. For a random variable \( x \) following the probability density function, \( p(x) \), shown in given figure the mean and the variance are, respectively,

\[
\begin{array}{c}
\text{(a) } 1/2 \text{ and } 2/3 \\
\text{(b) } 1 \text{ and } 4/3 \\
\text{(c) } 1 \text{ and } 2/3 \\
\text{(d) } 2 \text{ and } 4/3
\end{array}
\]

1.33. The bit stream 01001 is differentially encoded using 'Delay and Ex OR' scheme for DPSK transmission. Assuming the reference bit as a '1' and assigning phases of '0' and \( \pi \) for '1's and '0's respectively, in the encoded sequence, the transmitted phase sequence becomes

\[
\begin{array}{ccc}
(a) & 0 \pi 0 & 0 \\
(b) & 0 \pi 00 & 0 \\
(c) & 0 \pi 0 & 00 \\
(d) & 0 \pi 00 & \pi
\end{array}
\]

1.34. Coherent demodulation of FSK signal can be effected using

(a) correlation receiver
(b) Bandpass filters and envelope detectors
(c) matched filter
(d) discriminator detection.

1.35. Source encoding in a data communication system is done is order to

(a) enhance the information transmission rate
(b) reduce the transmission errors
(c) conserve the transmitted power
(d) facilitate clock recovery in the receiver.

1.36. A transmission line whose characteristic impedance is a pure resistance

(a) must be a lossless line
(b) must be a distortionless line
(c) may not be a lossless line
(d) may not be a distortionless line.

1.37. Which of the following statements is/are correct?

(a) All the resonant frequencies of a microwave cavity are harmonics of a single frequency
(b) No two of the resonant frequencies of a microwave cavity are harmonics of a single frequency
(c) Resonant frequencies of a microwave cavity form distinct sets of harmonically related frequency
(d) None of the above, because a microwave cavity does not resonate at a number of frequencies.

1.38. Two dissimilar antennas having their maximum directivities equal,

(a) must have their beamwidths also equal
(b) cannot have their beamwidths equal because they are dissimilar antennas
(c) may not necessarily have their maximum power gains equal
(d) must have their effective aperture areas (capture areas) also equal.
1.39. The beamwidth-between-first null of uniform linear array of N equally-spaced (element spacing = d), equally-excited antennas is determined by
(a) N alone and not by d
(b) d alone and not by N
(c) the ratio, (N/d)
(d) the product, (Nd)

1.40. In a multicavity magnetron, strapping is employed primarily
(a) to prevent mode jumping
(b) to increase the separation between the resonant frequencies in the π-mode and in the adjacent modes
(c) to reduce the back heating of the cathode
(d) to increase the output of the magnetron.

ANSWERS

1. 1 (a,d) 1. 2 (b,c) 1. 3 (b,d) 1. 4 (b) 1. 5 (c) 1. 6 (b,c) 1. 7 (b,c) 1. 8 (a) 1. 9 (*) 1. 10 (a)
1. 11 (a) 1. 12 (b) 1. 13 (c) 1. 14 (*) 1. 15 (b) 1. 16 (a) 1. 17 (c) 1. 18 (*) 1. 19 (c) 1.20 (*)
1. 21 (a) 1. 22 (b) 1. 23 (c,d) 1. 24 (d) 1. 25 (c) 1. 26 (b,d) 1. 27 (*) 1. 28 (b,c) 1. 29 (a,b) 1.30 (b)
1. 31 (b) 1. 32 (b) 1. 33 (a,d) 1. 34 (a,c) 1. 35 (b,c) 1. 36 (a,b) 1. 37 (c) 1. 38 (c) 1. 39 (d) 1.40 (b)