IES MASTER

Institute for Engineers (IES/GATE/PSUs)

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Prelims Exam
Detailed Solution

ELECTRONICS & TELECOMMUNICATION (SET–C)

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Explanation of Electronics Engg. Prelims Paper (ESE - 2017)

SET - C

1. Consider the following statements:

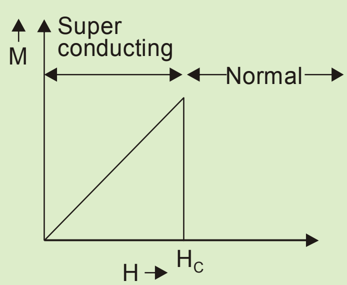
1. Type-I superconductors undergo abrupt transition to the normal state above a critical magnetic field.
2. Type-II superconductors are highly technologically useful super-conductors because the incidence of a second critical field in them is useful in the preparation of high field electromagnets.

Which of the above statements is/are correct?

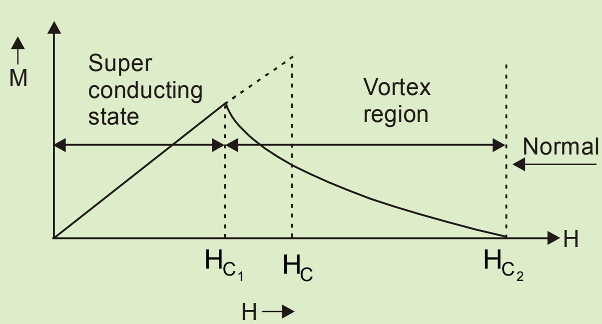
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Sol. (c)

Type-I superconductor undergo to the normal state above critical magnetic field.



Type-II superconductor



Type-II superconductors are known as hard superconductors because they loose their superconductivity gradually. Besides being mechanically harder than type I superconductors they exhibit higher critical magnetic fields, so these are used in the construction of high field superconducting magnets.

2. Consider the following statements:

1. Metal conductors have more R at higher temperatures.
2. Tungsten can be used as a resistance wire.
3. A superconductive material is one which has practically zero resistance.

Which of the above statements are correct?

(a) 1 and 2only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Sol. (b)

1. Metal conductors have more R at higher temperatures because of increased number of collisions between the free electrons and captive electrons.
2. Tungsten cannot be used as a resistance wire due to large variation of its resistance with increase in temperature.
3. Superconductive materials can conduct electricity or transport electrons from one atom to another with no resistance.

3. Consider the following statements regarding precision in measurements of a quantity:

1. Precision is the measure of the spread of the incident errors.

2. precision is independent of the realizable correctness of the measurement.
3. Precision is usually described in terms of number of digits used in the measurement by a digital instrument.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

Sol. (a)

Precision means agreement among the different mesured values. Precision is the measure of spread of errors relative to each other. It does not gaurantee the accuracy of measurement. Also number of significinat figures in which it is expressed indicates the high precision i.e., more the significant figures, the greater the precision of measurement.

4. Consider the following statements in connection with deflection-type and null-type instruments:

1. Null-type instruments are more accurate than the deflection-type ones.
2. Null-type of instrument can be highly sensitive compared to a deflection-type instrument.
3. Under dynamic conditions, null-type instruments are less preferred to deflection-type instruments.
4. Response is faster in null-type instruments as compared to deflection-type instruments.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1, 2 and 4
(c) 1, 3 and 4 (d) 2, 3 and 4

Sol. (a)

Null-type instruments are more accurate than the deflection-type. It is because the opposing effect is calibrated with the help of standards which have high degree of accuracy. But, in the deflection type instrument, accuracy is dependent upon their calibration which depends upon the instrument constants which have not very high accuracy.

Null-type instrument can be highly sensitive compared to deflection type because in null-type instrument, the detector has to cover a small range around the null point. Further, the detector need not be calibrated since it has only to detect the presence and direction of unbalance and not the magnitude of unbalance.

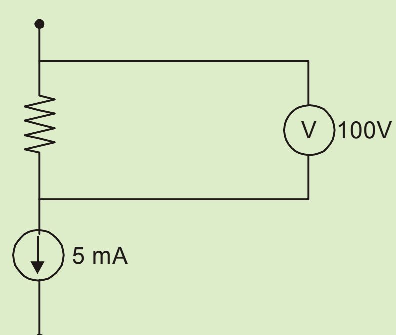
Null-type instruments are less preferred than deflection-type instrument under dynamic condition because null-type instruments require many changes before reaching null-condition. But deflection-type instruments can follow the variations of measurement more rapidly.

5. A voltmeter having a sensitivity of 1000Ω/V reads 100 V on its 150 V scale when connected across at resistor of unidentified specfications in series with a milliammeter. When the milli-ammeter reads 5 mA, the error due to the loading effect of the voltmeter will be nearly

(a) 13% (b) 18%
(c) 23% (d) 33%

Sol. (a)

Given arrangement is shown in figure



Resistance of voltmeter = SV

$$= 1000\frac{\Omega}{V}\times 150V$$

$$= 150K\Omega$$

Given, reading of voltmeter = 100 V

i.e. $5\times 10^{-3}\times\frac{R\times 150K}{R+150K}=100$

$\Rightarrow \quad \frac{150R}{R+150K} = 20$

$\Rightarrow \quad 130R = 3000\ K$

$\Rightarrow \quad R = \frac{3000K}{130}$

$\therefore$ Actual voltage across

$R = 5\times 10^{-3}\times\frac{3000K}{130} = 115.3\,\text{Volt}$

So, percentage error = $\frac{MV-TV}{TV}\times 100\%$

$$= \frac{100-115.3}{115.3}\times 100\%$$

$$= -13.26\%$$

6. Consider the following statements:

Sphere gap method of voltage measurement is used

1. for measuring r.m.s. value of a high voltage
2. for measuring peak value of a high voltage
3. as the standard for calibration purposes

Which of the above statements are correct?

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Sol. (b)

Sphere gap method of voltage measurement is used for measuring peak value of a high voltage.

Sphere gap method for measurement of high voltage can be considered as an approved calibration device with high reliability and simplicity but with limited accuracy.

7. High frequency (in the MHz range) and low amplitude (in the mV range) signals are best measured using

(a) VTVM with a high impedance probe
(b) CRO
(c) moving-iron instrument
(d) digital multimeter

Sol. (b)

The high frequency and low amplitude signals are best measured by using CRO. An economically priced CRO can measure 10 MHz frequency signal having amplitude of 5mV.

8. In scintillation coating applications, shields of which material are generally placed around the photomultiplier tube to overcome interference effects of electrons deflected from their normal path?

(a) Ferromagnetic
(b) Mu-metal magnetic
(c) Electromagnetic
(d) Dielectric

Sol. (b)

The high permeability of Mu-metal provides a low reluctance path for magnetic flux, leading to its use in magnetic shields against static or slowly varying magnetic fields. It not only blocks magnetic field but provides a path for the magnetic field lines around the shielded area.

9. A PMMC instrument if connected directly to measure alternating current, it indicates

(a) the actual value of the subject AC quantity

(b) zero reading

(c) $\frac{1}{\sqrt{2}}$ of the scale value where the pointer rests

(d) $\frac{\sqrt{3}}{2}$ of the scale value where the pointer rests.

Sol. (b)

If an alternating current is applied to the PMMC instrument, the pointer cannot follow the frequent reversals and the deflection corresponds to the mean torque. Hence, for alternating current, PMMC indicates zero reading.

10. Which of the following are measured by using a vector voltmeter?

1. Amplifier gain and phase shift
2. Filler transfer function
3. Complex insertion loss

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Sol. (d)

Vector voltmeter is an instrument which measure amplitude and phase of a signal. It uses two samplers to sample the two signals whose amplitude and relative phase are to be measured. It measures the voltages and phase difference at two different points to measure amplitude and phase difference.

Vector voltmeter is used in the following measurements :

1. Complex insertion losses
2. Amplifier gain and phase shift
3. Filter transfer function
4. Complex impedance of mixers
5. 'S' parameters of transistors
6. Radio frequency distortions
7. Two-port network parameters
8. Amplitude modulation index.

11. In a transistor, the base current and collector current are, respectively, 60 μA and 1.75 mA. The value if α is nearly

(a) 0.91 (b) 0.97
(c) 1.3 (d) 1.7

Sol. (b)

Given, I_0 = 60μA and I_C = 1.75 mA

$$\beta = \frac{\alpha}{1-\alpha} = \frac{I_C}{I_B} = \frac{1.75}{60\times10^{-3}} = \frac{175}{6}$$

or $6\alpha = 175 - 175\alpha$

or $\alpha = \frac{175}{181} = 0.967$

12. A liquid flows through a pipe of 100 mm diameter at a velocity of 1 m/s. If the diameter is guaranteed within ±1% and the velocity is known to be within ±3% of measured value, the limiting error for the rate of flow is

(a) ±1% (b) ±2%
(c) ±3% (d) ±5%

Sol. (d)

Rate of flow = $\frac{\text{Volume}}{\text{Time}} = \frac{\text{Area} \times \text{Length}}{\text{Time}}$

= Area × Velocity

i.e., Q = $\frac{\pi}{4} d^2 \times V$

So, limiting error for the rate of flow.

$$\frac{\partial Q}{Q} = \pm\left(2\frac{\partial d}{d} + \frac{\partial V}{V}\right)$$

= $\pm[(2\times1)+(3)]$

= ± 5%

13. A $3\frac{1}{2}$ digit digital voltmeter is accurate to ±0.5% of reading ±2 digits. What is the percentage error, when the voltmeter reads 0.10 V on its 10V range?

(a) 0.025% (b) 0.25%
(c) 2.05% (d) 20.5%

Sol. (d)

$\pm$ 0.5 % of reading = $\frac{0.5}{100}\times 0.1$ = ± 0.0005V

$\pm$ 2 digit = $\pm$ 0.02V

$\therefore$ Total possible error = $\pm$ 0.0205 V

The % error = $\frac{0.0205}{0.01}\times 100$ = 20.5%

14. The simplest and most common method of reducing any effect of inductive coupling between measurement and power circuits is achieved by using

(a) a screen around the entire measurement circuit
(b) twisted pairs of cable
(c) capacitor(s) to be connected at the power circuit
(d) capacitor(s) to be connected at the measurement circuit

Sol. (b)

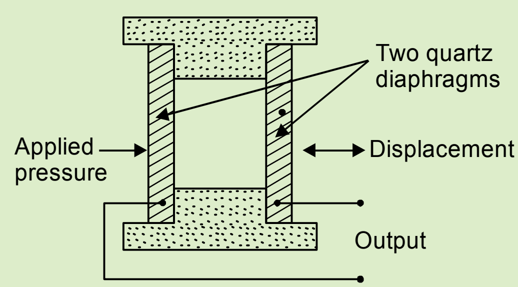
Twisted pairs of cable is the most commonly and simplest method of reducing 'effect of inductive coupling'. In this method, the cable is doubled on itself which results into flow of current in the opposite direction in the cable which is placed side by side. This arrangement produces two equal and oppositve magnetic field and since two cables are very close to each other, the net magnetic field is almost zero. Hence, effect of inductive coupling between measurement and power circuit can be reduced to zero.

15. A capacitance transducer uses two quartz diaphragms of area 750 mm^2 separated by a distance 3.5 mm. The capacitance is 370 pF. When a pressure of 900 kN/m^2 is applied, the deflection is 0-6 mm. The capacitance at this pressure would be

(a) 619 pF (b) 417 pF
(c) 325 pF (d) 275 pF

Sol. (b)

Capacitive transducer using Quartz diaphragms :



When pressure will be applied, the gap between two Quartz diaphragm gets reduced.

Since, capacitance, $C = \frac{\in A}{d}$

$$\Rightarrow \quad \frac{C_1}{C_2} = \frac{\in_1 A_1}{d_1} \times \frac{d_2}{\in_2 A_2}$$

Here, the area of diaphragms and the permittivity between then will remain some. Only change in gap between diaphragm takes place.

$$\text{So,} \quad \frac{370}{C_2} = \frac{(3.5-0.6)}{3.5} = \frac{2.9}{3.5}$$

$$\Rightarrow \quad C_2 = 446.55 \text{ pF} \approx 447 \text{ pF}$$

16. Consider the following statements regarding Time-Division Multiplexing (TDM):

1. The information from different measuring points is transmitted serially on the same communication channel.
2. It involves transmission of data samples rather than continuous data transmission.
3. It is especially useful when telemetering fast-changing, high bendwidth data.

Which of the above statements are valid in respect to TDM?

(a) 1, 2 and 3 (b) 1 and 3 only
(c) 1 and 2 only (d) 2 and 3 only

Sol. (a)

All statements are valid for TDM system.

17. Consider the following regarding essential functional operations of a digital data acquisition system:

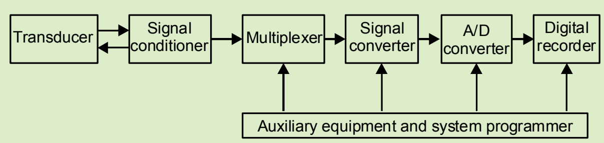
1. Handling of analog signals
2. Converting the data to digital form and handling it
3. Making the measurement
4. Internal programming and telemetry

Which of the above are valid in the stated context?

(a) 1, 2, 3 and 4 (b) 1, 3 and 4 only
(c) 1, 2 and 3 only (d) 2 and 4 only

Sol. (a)

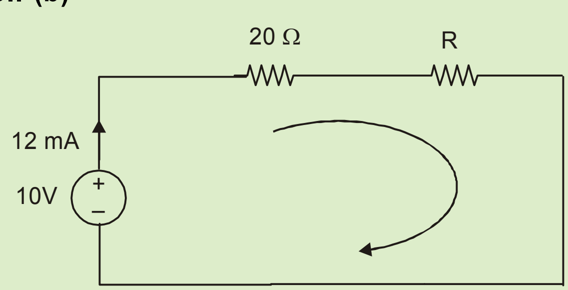
Digital data acquisition system converts analog data to digital form, measures and programmes internally.
Hence, all statements are valid.
The function of the digital data acquisition system consists of handling analog signals, converting the analog data to digital form and handling digital data, measurement of data, internal programming, control and telemetry.



18. A low resistance LDR of 20Ω, operated at a certain intensity of light, is to be protected through a series resistance in such a way that up to 12 mA of current is to flow at a supply voltage of 10 V. What is the nearest value of the protective resistance?

(a) 873 Ω (b) 813 Ω
(c) 273 Ω (d) 81 Ω

Sol. (b)



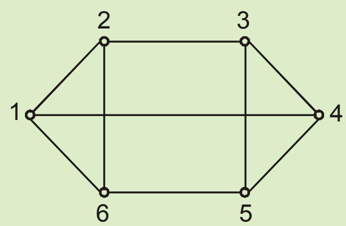
Applying KVL we get

$$10 = (20 + R) \times 12 \times 10^{-3}$$

$$\Rightarrow R = \frac{10}{12 \times 10^{-3}} - 20$$

$$\Rightarrow R = 813\,\Omega$$

19. Consider the following with regards to graph as shown in the figure given below:

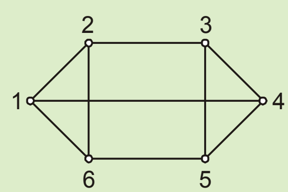


1. Regular graph
2. Connected graph
3. Complete graph
4. Non-regular graph

Which of the above are correct?

(a) 1 and 4 (b) 3 and 4
(c) 2 and 3 (d) 1 and 2

Sol. **(d)**



Regular Graph - A regular graph is a graph where each vertex has the same number of neighbors. Above graph is 3-regular graph.

Connected Graph - A graph is connected when there is a path between every pair of vertices. In a connected graph we can reach every vertices. Above graph is connected graph.

Complete Graph - A complete graph is a undirected graph in which every pair of distinct vertices is connected by a unique edge. In the above graph every pair of distinct vertices are not connected by a unique edge. Therefore above graph is not a complete graph.

20. A network in which all the elements are physically separable is called a

(a) distributed network
(b) lumped network
(c) passive network
(d) reactive network

Sol. **(b)**

Distributed Network - In distributed network resistors, capacitors and inductors can not be electrically separated and individually isolated as separate elements. Ex- Transmission line.

Lumped Network - Lumped network in which physically separate resistors, capacitors and inductors can be represented.

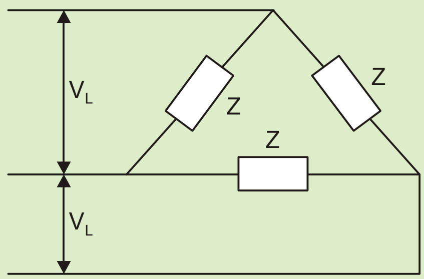
Passive Network - Passive network contains the circuit elements without any energy source.

Reactive Network - Reacitve network contains L and C.

21. Three identical impedances are first connected in delta across a 3-phase balanced supply. If the same impedances are now connected in star across the same supply, then

(a) the phase current will be one-third
(b) the line current will be one-third
(c) the power consumed will be one-third
(d) the power consumed will be halved

Sol. **(c)**



Let impedance value as Z and line voltage as V_L

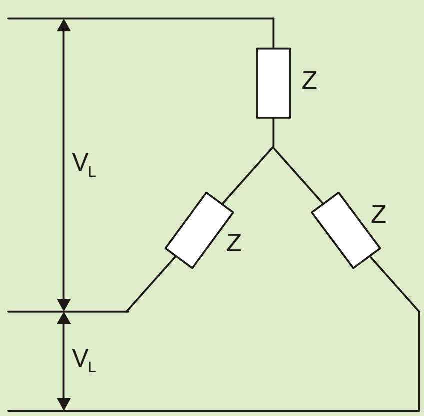
So in delta configuration phase current = $\frac{V_L}{Z}$

Line current = $\frac{\sqrt{3}V_L}{Z} = I_L\,(\text{say})$

So power consumed = $\sqrt{3}V_L I_L = \sqrt{3}V_L \times \frac{\sqrt{3}V_L}{Z}$

$= \frac{3V_L^2}{Z}$ Watts ...(i)

In star configuration



Phase current = $\frac{V_L/\sqrt{3}}{Z} = \text{Line current}\,(I_L)$

Power Consumed = $\sqrt{3}V_L \times \frac{V_L/\sqrt{3}}{Z} = \frac{V_L^2}{Z}$ ...(ii)

From equation (i) and (ii) we can say that power consumed in star connection will be one third of power consumed in delta connection.

22. Consider the following statements regarding trees:

1. A tree contains all the nodes of the graph.
2. A tree shall contain any one of the loops.
3. Every connected graph has at least one tree.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Sol. (b)

Properties of trees.

(i) In a tree there exists one and only one path between any pair of nodes.
(ii) Every connected graph has at least one tree.
(iii) Every tree has at least two number of terminal nodes.
(iv) Every tree has (n–1) branches, where n is the number of nodes of tree.
(v) The rank of tree is (n–1).
(vi) A tree contains all the nodes of graph.

23. A voltage v(t) = 173 sin(314t + 10°) is applied to a circuit. It causes a current flow described by

i(t) = 14.14 sin(314t – 20°)

The average power delivered is nearly

(a) 2500 W (b) 2167 W
(c) 1500 W (d) 1060 W

Sol. (d)

$V(t) = 173 \sin(314+10^\circ)$

$i(t) = 14.14 \sin(314\,t - 20^\circ)$

Average power:

$$P_{avg} = V_{rms} I_{rms} \cos\phi$$

$$P_{avg} = \frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}} \cos\phi$$

$$P_{avg} = \frac{173}{\sqrt{2}} \cdot \frac{1414}{\sqrt{2}} \cos 30^\circ$$

$$P_{avg} = 1059.24 \text{ W} \simeq 1060 \text{ W}$$

24. Consider the following statements respect to a parallel R-L-C circuit:

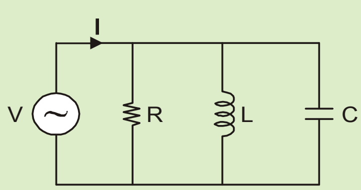
1. The bandwidth of the circuit decreases if R is increased.
2. The bandwidth of the circuit remain same if L is increased.
3. At resonance, input impedance is a real quantity.
4. At resonance, the magnitude of the input impedance attains its minimum value.

Which of the above statements are correct?

(a) 1, 2 and 4 (b) 1, 3 and 4

(c) 2, 3 and 4 (d) 1, 2 and 3

Sol. (d)



$$Y = Y_R + Y_L + Y_C$$

$$Y = \frac{1}{R} + \frac{1}{j\omega L} + j\omega C$$

$$Y = \frac{1}{R} + j\left[\omega C - \frac{1}{\omega L}\right]$$

- At resonance:

$I_m[Y] = 0$

$$\omega C - \frac{1}{\omega L} = 0$$

$$\boxed{\omega = \frac{1}{\sqrt{LC}}}$$

At resonacne

$$Y_0 = \frac{1}{R} \Rightarrow \text{Minimum}$$

$$Z_0 = \frac{1}{Y_0} = R \Rightarrow \text{Maximum}$$

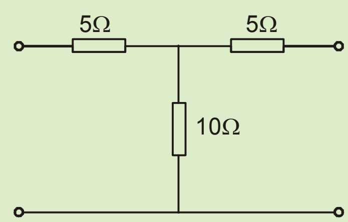
- Bandwidth of parallel RLC network

$$BW = \frac{1}{RC}$$

$R\uparrow, BW\downarrow$

- Bandwidth of parallel RLC network is independent of L.

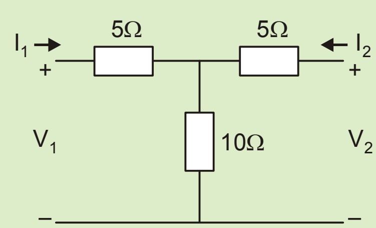
25. What is the admittance matrix for a two-port network shown in the figure given below?



(a) $\begin{bmatrix} 15 & 5 \\ 5 & 15 \end{bmatrix}$ (b) $\begin{bmatrix} 15 & 5 \\ 5 & 15 \end{bmatrix}$

(c) $\begin{bmatrix} 5 & 15 \\ 15 & 5 \end{bmatrix}$ (d) $\frac{1}{200}\begin{bmatrix} 20 & 5 \\ 15 & 20 \end{bmatrix}$

Sol. (None)



Admittance parameter:

$I_1 = y_{11} V_1 + y_{12} V_2$

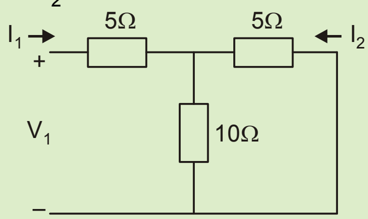
$I_2 = y_{21} V_1 + y_{22} V_2$

Calculation of y_{11} & y_{21}

$$y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0}$$

$$y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2=0}$$

When $V_2 = 0$



$15\ I_1 + 10\ I_2 = V_1$ ...(i)

$10\ I_1 + 15\ I_2 = 0$ ...(ii)

$$I_2 = \frac{-10}{15} I_1$$

From equation (i)

$$15I_1 + 10\left(\frac{-10}{15}I_1\right) = V_1$$

$$\frac{125}{15}I_1 = V_1$$

$$y_{11} = \frac{I_1}{V_1} = \frac{15}{125}$$

From equation (i)

$$15\left(\frac{-15}{10}\right)I_2 + 10I_2 = V_1$$

$$\frac{-125}{10}I_2 = V_1$$

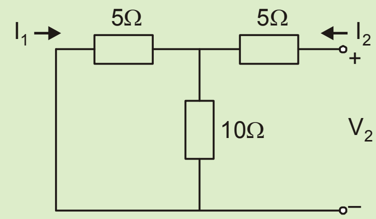
$$y_{21} = \frac{I_2}{V_1} = \frac{-10}{125}$$

Calculation of y_{12} & y_{22}

$$y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0}$$

$$y_{22} = \left.\frac{I_2}{V_2}\right|_{V_1=0}$$

when $V_1 = 0$



$10\ I_1 + 15\ I_2 = V_2$ ...(i)

$15\ I_1 + 10\ I_2 = 0$ ...(ii)

$$I_2 = \frac{-15}{10} I_1$$

From equation (i)

$$10I_1 + 15\left(\frac{-15}{10}I_1\right) = V_2$$

$$\frac{-125}{10}I_1 = V_2$$

$$y_{12} = \frac{I_1}{V_2} = \frac{-10}{125}$$

From equation (ii)

$15\ I_1 + 10\ I_2 = 0$

$$I_1 = \frac{-10}{15} I_2$$

From equation (i)

$$10\left(\frac{-10}{15}I_2\right) + 15I_2 = V_2$$

$$\frac{125}{15}I_2 = V_2$$

$$y_{22} = \frac{I_2}{V_2} = \frac{15}{125}$$

Admittance matrix

$$[y] = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} = \begin{bmatrix} \frac{15}{125} & \frac{-10}{125} \\ \frac{-10}{125} & \frac{15}{125} \end{bmatrix}$$

26. A two-port network is characterized by

$I_1 = 3V_1 + 4V_2$

$6I_2 = 2V_1 + 4V_2$

Its A, B, C and D parameters are, respectively

(a) 2, 3, 6 and 9 (b) 2, –3, 10 and –9

(c) 3, –2, 9 and –6 (d) 3, –2, 9 and –6

Sol. (b)

$I_1 = 3V_1 + 4V_2$ ...(i)

$6I_2 = 2V_1 - 4V_2$

$2V_1 = 4V_2 + 6I_2$

$V_1 = 2V_2 + 3I_2$ ...(ii)

Putting the value of V_1 from equation (ii) to equation (i).

$I_1 = 3(2V_2 + 3I_2) + 4V_2$

$I_1 = 10V_2 + 9I_2$ ...(iii)

$V_1 = 2V_2 + 3I_2$ ...(iii)

$I_1 = 10V_2 + 9I_2$ ...(iii)

ABCD parameters

$V_1 = AV_2 - BI_2$

$I_1 = CV_2 - DI_2$

$$A = \left.\frac{V_1}{V_2}\right|_{I_2=0} = 2$$

$$B = \left.\frac{V_1}{-I_2}\right|_{V_2=0} = -3$$

$$C = \left.\frac{I_1}{V_2}\right|_{I_2=0} = 10$$

$$D = \left.\frac{I_1}{-I_2}\right|_{V_2=0} = -9$$

27. A unit-step voltage is applied at t = 0 to a series R-L circuit with zero initial condition. Then

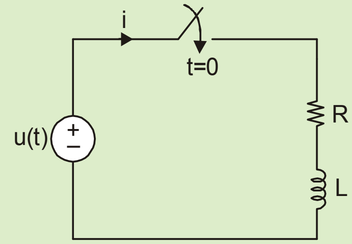
(a) it is possible for the current to be oscillatory

(b) The voltage across the resistor at $t = 0^+$ is zero

(c) the voltage across the resistor at $t = 0^-$ is zero

(d) The resistor current eventually falls to zero

Sol. (b & c)



KVL equation is s-domain

$$\frac{1}{2} = (R + sL)I(s)$$

$$\Rightarrow I(s) = \frac{1}{s(R+sL)} = \frac{1}{R}\left[\frac{1}{s} - \frac{1}{\left(s + R/L\right)}\right]$$

$$\therefore \quad i(t) = \frac{1}{R}\left[1 - e^{-\frac{R}{L}t}\right]$$

At $t = 0^-$ there is no voltage source connected to R and L and all initial conditions are zero so, the voltage across the resistor will be zero.

At $t = 0^+$, $i\ (t = 0^{+)} = 0$

$\therefore$ Voltage across the resistor at $t = 0^+$

$= R \cdot i\ (t = 0^+) = 0\,V$

Hence options (b) and (c) both are correct.

28. One of the basic characteristics of any steady-state sinusodial response of a linear R-L-C circuit with constant R, L and C values is

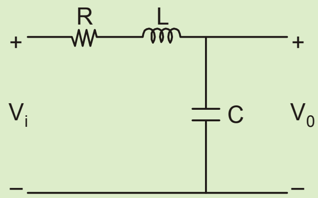
(a) the output remains sinusodial with its frequency being the same as that of the source

(b) the output remains sinusoidal with its frequency differing from that of the source

(c) the output amplitude equals the source amplitude

(d) the phase angle difference between the source and the output is always zero.

Sol. (a)



Transfer function

$$T(s) = \frac{V_0(s)}{V_i(s)} = \frac{1/sC}{R + sL + 1/sC}$$

$$= \frac{1}{s^2LC + sRC + 1}$$

$$T(j\omega) = \frac{1}{(j\omega)^2 LC + j\omega RC + 1}$$

$$T(j\omega) = \frac{1}{1 - \omega^2 LC + j\omega RC}$$

$$|T(j\omega)| = \frac{1}{\sqrt{(1-\omega^2 LC)^2 + \omega^2 R^2 C^2}} = M$$

$$\angle T(j\omega) = -\tan^{-1}\left(\frac{\omega RC}{1-\omega^2 LC}\right) = \phi$$

If $V_i(t) = A\sin(\omega t + \theta)$

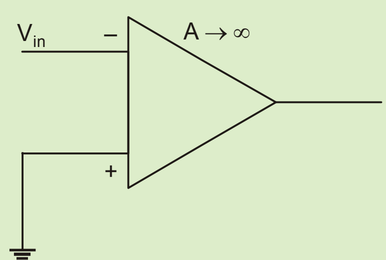
Than $V_0(t) = AM\sin(\omega t + \theta + \phi)$

i.e. $|V_0(j\omega)| = AM$

$\angle V_0(j\omega) = \theta + \phi$

The output of the network is sinusoidal with its output as input frequency will be same.

29. If the input (V_{in}) to the circuit is a sine wave, the output will be



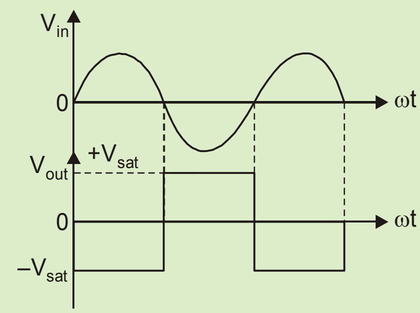
(a) half-wave rectified sine wave
(b) full-wave rectified sine wave
(c) triangular wave
(d) square wave

Sol. (d)

The given circuit is an op-amp inverting comparator circuit.

If $V_{in} > 0$ then $V_{out} = -V_{sat}$

and if $V_{in} < 0$ then $V_{out} = +V_{sat}$



30. Which one of the following Analog-to-Digital Converters (ADC) does not use a DAC?

(a) Digital ramp ADC
(b) Successive approximation ADC
(c) Single-slope ADC
(d) Counting ADC

Sol. (c)

Single-slope ADC (analog to digital converter) does not use DAC (digital to analog converter).

31. Consider that in a system loop transfer function, addition of a pole results in the following:

1. Root locus gets pulled to the right-hand side.
2. Steady-state error is increased.
3. System responses gets slower.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1 and 2 only
(c) 1 and 3 only (d) 2 and 3 only

Sol. (c)

The effect of addition of a pole in a system loop transfer function are:

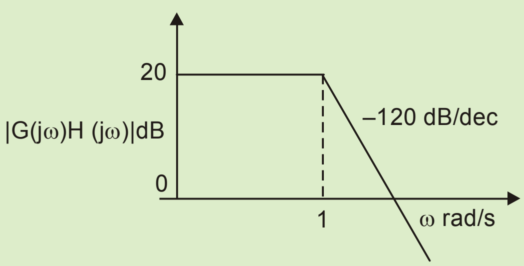
→ Root locus gets pulled to the right-hand side.

→ System response gets slower.

→ System becomes more oscillatory in nature.

→ System stability relatively decreases.

32. The magnitude plot for the open-loop transfer function of a control system is shown in the figure given below:



Its open-loop transfer function, G(s)H(s), is

(a) 10 (s+1)

(b) $\frac{1}{s+1}$

(c) $\frac{10}{s+1}$

(d) 20 (s+1)

Sol. (c)

The initial slope of the plot is 0dB/decade hence the system is type 0.

20 logk = 20

∴ k = 10

At $\omega = 1$ rad/sec., the slope of the plot changes by –20 dB/decode. Hence the corresponding term of the transfer function is

1/(sT+1), where, $T = \frac{1}{\omega} = \frac{1}{1} = 1$ sec.

∴ Open loop transfer function

$$G(s)H(s) = \frac{10}{(1+s)}$$

33. The open-loop transfer function of a unity feedback control system is

$$G(s)H(s) = \frac{10}{s(s+2)(s+K)}$$

Here, K is a variable parameter. The system will be stable for all values of

(a) K > – 2

(b) K > 0

(c) K > 1

(d) K > 1.45

Sol. (d)

The characteristic equation for given feedback control system is

$$1+G(s)H(s) = 0$$

or $$1+\frac{10}{s(s+2)(s+k)} = 0$$

or $$s\left[s^2+(k+2)s+2k\right]+10 = 0$$

or $$s^3+(k+2)s^2+2ks+10 = 0$$

The routh table is formed below:

s^3	1	2k
s^2	$(k+2)$	10
s^1	$2k-\frac{10}{k+2}$	0
s^0	10	

For system to be stable

$$k+2>0 \text{ and } 2k-\frac{10}{k+2}>0$$

or $k>-2$ and $2k^2+4k-10>0$

$$k^2+2k-5>0$$

$$(k+1)^2>6$$

$$k>-1+\sqrt{6}$$

$$k>1.45$$

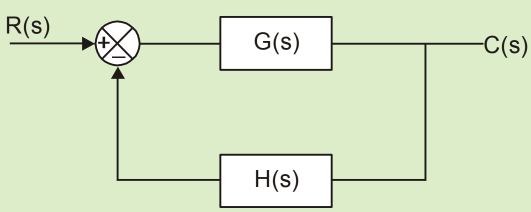
34. A control system has $G(s)=\frac{10}{s(s+5)}$ and H(s) = K. What is the value of K for which the steady-state error for unit-step input is less than 5%?

(a) 0.913 (b) 0.927
(c) 0.953 (d) 1.050

Sol. (d)

$$G(s) = \frac{10}{s(s+5)}$$

$$H(s) = K$$



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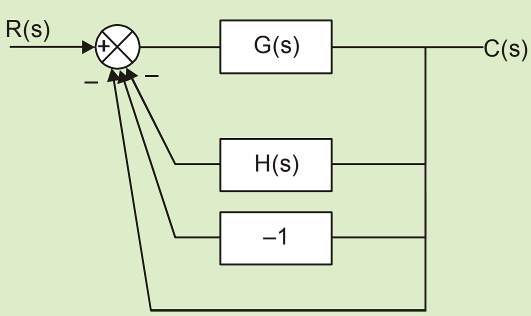

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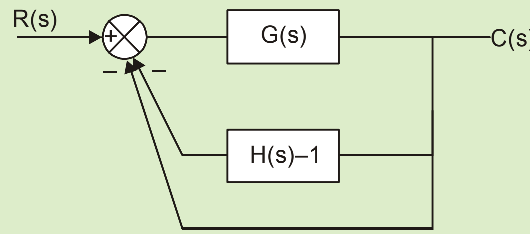

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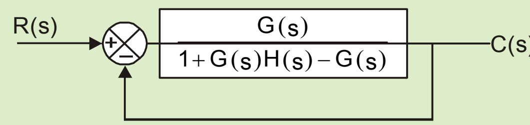

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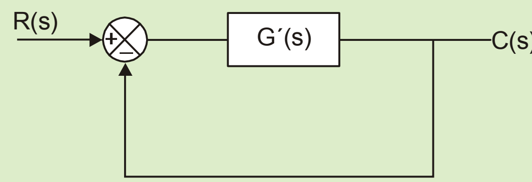


$$G'(s) = \frac{G(s)}{1+G(s)H(s)-G(s)}$$

$$G'(s) = \frac{\frac{10}{s(s+5)}}{1+\frac{10}{s(s+5)}K-\frac{10}{s(s+5)}}$$

$$G'(s) = \frac{10}{s^2+5s+10(K-1)} \equiv$$

Type 'zero' system

$$K_P = \underset{s\to 0}{Lt}\, G'(s) = \underset{s\to 0}{Lt}\, \frac{10}{s^2+5s+10(K-1)} = \frac{1}{K-1}$$

Steady State Error :

$$e_{ss} = \frac{1}{1+K_P} = \frac{1}{1+\frac{1}{K-1}} = \frac{K-1}{K}$$

$$e_{ss} < 0.05$$

$$\frac{K-1}{K} < 0.05$$

$$K-1 < 0.05$$

$$0.95K < 1$$

$$\Rightarrow \quad K < 1.052$$

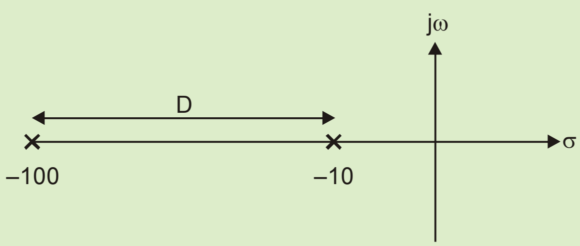
35. What is the time required to reach 2% of steady-state value, for the closed-loop transfer function $\frac{2}{(s+10)(s+100)}$, when the input is u(t)?

(a) 20s (b) 2s
(c) 0.2s (d) 0.02s

Sol. (None)

$$T(s) = \frac{2}{(s+10)(s+100)}$$

$$= \frac{2}{1000\left(1+\frac{s}{10}\right)\left(1+\frac{s}{100}\right)}$$



Using Dominant Pole Concept

$$T(s) = \frac{0.002}{\left(1+\frac{s}{10}\right)} = \frac{K}{(1+sT)}$$

$$T = 0.1s$$

Setting Time = 4T for 2% criterion

= 0.4s

36. If the characteristic equation of a closed-loop system is $2s^2 + 6s + 6 = 0$, then the system is

(a) overdamped (b) critically damped
(c) underdamped (d) undamped

Sol. (c)

Given, Characteristic equation is

$$2s^2 + 6s + 6 = 0$$

or $s^2 + 3s + 3 = 0$

Comparing with $s^2 + 2\xi\omega_n s + \omega_n^2 = 0$

Gives, $\omega_n = \sqrt{3}$, and $2\xi\omega_n = 3$

or $2\xi \times \sqrt{3} = 3$

or $\xi = \frac{\sqrt{3}}{2} = 0.866 < 1$

Hence, system is underdamped.

37. For derivative control action, the actuating signal consists of proportional error signal with addition of

(a) derivative of the error signals
(b) integral of the error signals
(c) steady-state error
(d) a constant which is a function of the system type

Sol. (a)

For a derivative control action, the actuating signal consists of proportional error signal added with derivative of the error signal. Therefor, the actuating signal for derivative control actions given by

$$e_a(t) = e(t) + T_d\frac{de(t)}{dt}$$

where, T_d is a constant.

38. Consider the following statements regarding a PID controller:

1. The error is multiplied by a negative (for reverse action) proportional constant P, and added to the current output.
2. The error is integrated (averaged) over a period of time, and then divided by a constant I, and added to the current control output.
3. The rate of change of the error is calculated with respect to time multiplied by another constant D, and added to the output.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1 and 3 only
(c) 1 and 2 only (d) 2 and 3 only

Sol. (a)

Proportional (Gain)

For a heater, a controller with a proportional band of 10 deg C and a setpoint of 100 deg C would have an output of 100% upto 90 deg C, 50% at 95 Deg C and 10% at 99 deg C. If the temperature overshoots the setpoint value, the heating power would be cut back further. Proportional only control can provide a stable process temperature but there will always be an error between the required setpoint and the actual process temperature.

Integral (Reset)

I represents the steady state error of the system and will remove setpoint / measured value errors. For many applications proportional + Integral control will be satisfactory with good stability and at the desired setpoint.

Derivative (Rate)

The derivative term is use to determine a controller's response to a change or disturbance of the process temperature (e.g. opening an oven door). The larger the derivative term the more rapidly the controller with respond to changes in the process value.

39. A 32 kB RAM is formed by 16 numbers of a particular type of SRAM IC. If each IC needs 14 address bits, what is the IC capacity?

(a) 32 kbits (b) 16 kbits
(c) 8 kbits (d) 4 kbits

Sol. (b)

Given, total capacity = 32 kB
= 32k × 8 bits = 256 k bits
Since, 16 IC's are used.

So each IC provides = $\frac{256}{16}$kbits

14 bits address gives 16 k location. Each chip has 16 k location.
Capacity of each IC = 16 k bits.

40. A cache line has 128 bytes. The main memory has latency 64 ns and bandwidth 1 GB/s. The time required to fetch the entire cache line is

(a) 32 ns (b) 64 ns
(c) 96 s (d) 192 ns

Sol. (d)

Bandwidth 1GB/s means 10^9 bytes can be loaded online in 1 second. To load 128 bytes

$$= 128 \times \frac{1}{10^9} = 128\,\text{nsec.}$$

Main memory latency = 64nsec.
Time required to fetch cacheline
= 128 + 64 = 192nsec.

41. An asynchronous link between two computers uses the start-stop scheme, with one start bit and one stop bit, and a transmission rate of 48.8 kbits/s. What is the effective transmission rate as seen by the two computers?

(a) 480 bytes/s (b) 488 bytes/s
(c) 4880 bytes/s (d) 4800 bytes/s

Sol. (c)

In 8 bit of a single character total bit
= 8 + start bit + stop bit = 8 + 1 + 1 = 10 bit
For every 10 bit wastage of bits = 2
For 48.8×10^3 bit wastage of bits.

$$\frac{2}{10} \times 48.8 \times 10^3 = 9760 \text{ bit}$$

Effective Transmission rate

$$= 48.8 \times 10^3 - 9760$$
$$= 39040 \text{ bits/s}$$
$$= \frac{39040}{8} \text{ bytes/s}$$
$$= 4880 \text{ bytes/s}$$

42. The noise factor of an attenuator pad that has an insertion loss of 6 dB is

(a) 0.25 (b) 0.5
(c) 2 (d) 4

Sol. (d)

Insertion loss= 6dB
Insertion loss (IL) is given by

$$\text{I.L.} = 10 \log \left(\frac{P_T}{P_R}\right),$$

where P_T is the transmitted power
P_R is the power received by the load after insertion

$$10 \log \left(\frac{P_T}{P_R}\right) = 6 \text{ dB}$$

$$\therefore \quad \frac{P_T}{P_R} = 10^{0.6} = 4$$

$$\text{Noise factor} = \frac{P_T}{P_R} = 4$$

43. A weighted complete graph with n vertices has weights 2|i – j| at edges (v_j, v_j). The weight of a minimum spanning tree is

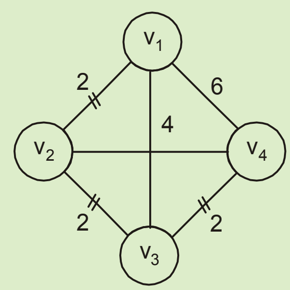
(a) $\frac{n^2}{2}$ (b) $\frac{n}{2}$
(c) 2n – 2 (d) n – 1

Sol. (c)

A complete graph is a connected graph in which exactly one edge connects each pair of vertices.

Given, weight $2|i = j|$ at edges (v_i, v_j)

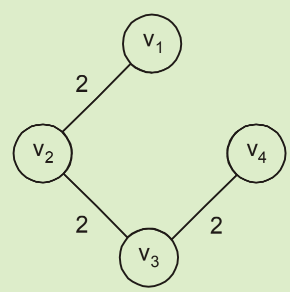
Let us take an example, n = 4



Edge	Cost
$v_1 - v_2$	2
$v_1 - v_3$	2
$v_3 - v_4$	2
$v_1 - v_4$	6
$v_1 - v_3$	4
$v_2 - v_4$	4

Weight of minimum spanning tree = minimum weight of connected edges without constructing circle

Connected edge = $\{v_1 - v_2, v_2 - v_3, v_3 - v_4\}$



weight of minimum spanning tree = 6
2n–2 = 2 × 4 – 2 = 6.

44. Consider the following statements regarding the functions of an operating system in a computer:

1. It controls hardware access
2. It manages files and folders
3. It provides a user interface
4. It manages applications

Which of the above statements are correct?

(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4

Sol. (d)

45. Consider the following processes which arrived in the order P_1, P_2 and P_3:

Process	**Burst Time**
P_1	24 ms
P_2	3 ms
P_3	3 ms

What is the average waiting time by FCFS scheduling?

(a) 17 ms (b) 19 ms
(c) 21 ms (d) 23 ms

Sol. (a)

Process	Burstime
P_1	24 msec.
P_2	3 msec.
P_3	3 msec.

Gantt chart,

P_1	P_2	P_3

0 24 27 30

Waiting time for P_1 = 0 msec.
Wating time for P_2 = 24 msec.
Waiting time for P_3 = 27 msec.

$$\text{Avg. waiting time} = \frac{0+24+27}{3}$$

$$\frac{51}{3} = 17\text{m sec.}$$

46. The cumulative distribution function of a random variable x is the probability that X takes the value

(a) less than or equal to x
(b) equal to x
(c) greater than x
(d) zero

Sol. (a)
If f(x) is p.d.f and F(x) is c.d.f then C.d.f. is defined as

$$F(x) = P[x \le x] = \int_{-\infty}^{x} f(x)dx$$

F(x) = sum of all values less than equal to x.

47. A disk unit has 24 recording surfaces. It has a total of 14000 cylinders. There is an average of 400 sectors per track. Each sector contains 512 bytes of data. What is the data transfer rate at a rotational speed of 7200 r.p.m.?

(a) 68.80×10^6 bytes/s
(b) 24.58×10^6 bytes/s
(c) 68.80×10^3 bytes/s
(d) 24.58×10^3 bytes/s

Sol. (b)

The data transfer rate = (No. of sector/track)×(Bytes in each sector)×(Rotational speed (revolution per sec.))

$$\text{Rotational Speed} = 7200\text{ rpm} \times \frac{1}{60}$$

= 120 rev. per sec.
$400 \times 512 \times 120 = 24.57 \times 10^6$

48. In the demand paging memory, a page table is held in registers. If it takes 1000 ms to service a page fault and if the memory access time is 10 ms, what is the effective access time for a page fault rate of 0.01?

(a) 19.9 ms

(b) 10.9 ms

(c) 9.99 ms

(d) 0.99 ms

Sol. **(a)**

P = 0.01
Effective access time: (1–P)×Ma+P×Page fault service time
= (1–0.01)×10+0.01×1000
0.99 ×10 +10
9.9 +10 = 19.9 ms

49. Consider the following statements regarding database normal forms:

1. Any relation with two attributes is BCNF.
2. Lossless, dependency-preserving decomposition into BCNF is always possible.
3. Lossless, dependency-preserving decomposition into 3NF is always possible.
4. BCNF is stricter than 3NF.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1, 3 and 4
(c) 1, 2 and 4 (d) 2, 3 and 4

Sol. **(b)**

50. Consider the following schedules for transactions T_1, T_2 and T_3:

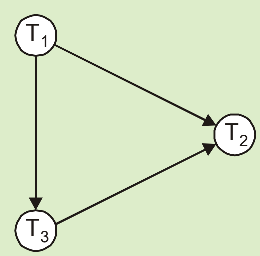
T_1	T_2	T_3
Read (X)		
	Read (Y)	
		Read (Y)
	Write (Y)	
Read (X)		
		Write (X)
	Read (X)	
	Write (X)	

The correct schedule of serialization will be

(a) $T_1 \rightarrow T_2 \rightarrow T_3$
(b) $T_2 \rightarrow T_3 \rightarrow T_1$
(c) $T_3 \rightarrow T_1 \rightarrow T_2$
(d) $T_1 \rightarrow T_3 \rightarrow T_2$

Sol. **(d)**

The precedence graph is an shown below. There is no cycle in this graph.



$T_1 \rightarrow T_3 \rightarrow T_2$

51. A receiver tunes signals from 550 kHz to 1600 kHz with an IF of 455 kHz. The frequency tuning range ratio for the oscillator section of the receiver is nearly.

(a) 2.90 (b) 2.05
(c) 1.65 (d) 1.30

Sol. **(b)**

Minimum signal frequency $f_{s,min}$ = 550KHz
Maximum signal frequency $f_{s,max}$ = 1600 KHz
For osciallator section,
$f_{0min} = f_{s,min} + IF = 550+455 = 1005$ KHz
$f_{0max} = f_{s,max} + IF = 1600+455 = 2055$ KHz

Frequency tuning range ratio = $\frac{f_{0\max}}{f_{0\min}}$ =

$$\frac{2055}{1005} = 2.045$$

52. In a basic transmission line, the voltage at the receiving end without load is 660 V; and it is 420 V with full load. What is the percentage of voltage regulation?

(a) 77% (b) 67%
(c) 57% (d) 47%

Sol. (c)

$$\text{Voltage regulation} = \frac{V_{NL} - V_{FL}}{V_{FL}}$$

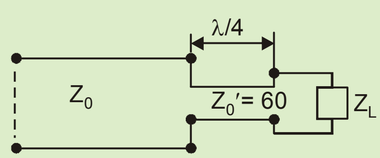
$$= \frac{600 - 420}{420} = 0.57 \text{ or } 57\%$$

53. A quarter-wave transformer of characteristic impedance 60Ω has been used to match a transmission line of characteristic impedance Z_0 with a load of 72Ω. What is the characteristic impedance of the transformer, when the load of 72Ω is replaced by 98Ω?

(a) 98 Ω (b) 80 Ω
(c) 70 Ω (d) 60 Ω

Sol. (c)

For a quarter wave transformer



$$Z_0' = \sqrt{Z_0 \cdot Z_L}$$

$$\Rightarrow 60 = \sqrt{Z_0 \times 72}$$

$$\Rightarrow Z_0 = 50\,\Omega$$

Now, 72Ω is replaced by 98Ω

$$\therefore\ Z''_0 = \sqrt{Z_0 \cdot 98}$$

$$\Rightarrow Z''_0 = \sqrt{50 \times 98}$$

$$\Rightarrow Z''_0 = 70\,\Omega$$

54. Consider the following statements:

Stokes' theorem is valid irrespective of

1. shape of closed curve C
2. type of vector curve A
3. type of coordinate system
4. whether the surface is closed or open

Which of the above statements are correct?

(a) 1, 2 and 4 (b) 1, 3 and 4
(c) 2, 3 and 4 (d) 1, 2 and 3

Sol. (d)

Stoke's theorem states that the circulation of a vector field $\vec{A}$ around a (closed) path L is equal to the surface integral of the curl of A over the open surface S bounded by L, provided $\vec{A}$ and $\nabla \times \vec{A}$ are continuous on S.
Mathematically,

$$\oint_L \vec{A} \cdot dl = \int_S (\nabla \times \vec{A}) \cdot \vec{ds}$$

Thus, Stoke's theorem applies to any vector, any type of coordinate system and any shape of closed curve C.
Stoke's theorem is not applied to closed surface (statement '4' is false).

55. A plane y = 2 carries an infinite sheet of charge 4 nC/m^2. If the medium is free space, what is the force on a point charge of 5 mC located at the origin?

(a) $0.54\pi\overline{a_y}N$ (b) $0.18\pi\overline{a_y}N$

(c) $-0.36\pi\overline{a_y}N$ (d) $-0.18\pi\overline{a_y}N$

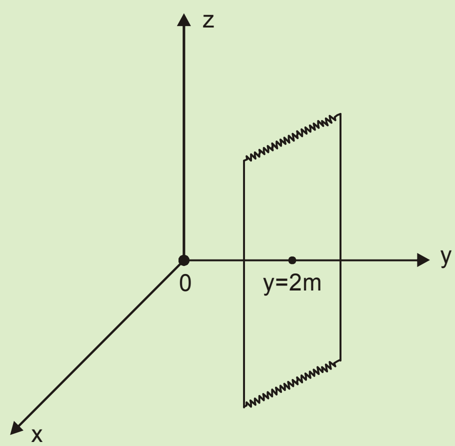
Sol. (c)

Given,

Surface charge density, $\rho_s = 4nC/m^2$

Electric field due to this surface charge at the origin, $\vec{E} = \frac{\rho_s}{2\epsilon_0}\hat{a}_n$

Here, $\hat{a}_n = (-\hat{a}_y)$



∴ Force on a charge of 5mC located at the origin = $5mC \times \vec{E}$

$= 5mC \times \frac{\rho_s}{2\epsilon_0}\hat{a}_n$

$= 5mC \times \frac{4n}{2\epsilon_0}(-\hat{a}_y)$

$= -0.36\pi\ \hat{a}_y$ N

56. A random process X(t) is called 'white noise' if the power spectral density is equal to

(a) $\frac{\pi}{8}$ (b) $\frac{\pi}{2}$

(c) $\frac{3\pi}{4}$ (d) π

Sol. (*)

No option is correct as PSD of white noise is equal to $\frac{N_0}{2}$.

57. What is the reflection coefficient for the line $Z_0 = 300\angle 0°\Omega$ and $Z_L = 150\angle 0°\Omega$?

(a) 0.5 (b) 0.333

(c) –0.333 (d) –0.5

Sol. (c)

Given,

Characteristic impedance,

$Z_L = 300\angle 0° = 300\Omega$

Load impedance, $Z_L = 150\angle 0° = 150\Omega$

Reflection coefficient, $\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$

$= \frac{150-300}{150+300} = \frac{-150}{450} = \frac{-1}{3} = -0.33$

58. An electromagnetic wave is transmitted into a conducting medium of conductivity σ. The depth of penetration is

(a) directly proportional to frequency

(b) directly proportional to squae root of frequency

(c) inversely proportional to frequency

(d) inversely proportional to square root of frequency.

Sol. (d)

For a conducting medium, penetration depth is given by

$$\delta = \sqrt{\frac{2}{\omega\mu\sigma}} = \frac{1}{\sqrt{\pi f \mu\sigma}}$$

i.e. $\delta \propto \frac{1}{\sqrt{f}}$

59. Which of the following are the properties of TEM mode in a lossless medium ?

1. Its cut-off frequency is zero.
2. Its transmission line is a hollow waveguide
3. Its wave impedance is the impedance in a bounded dielectric.
4. Its phase velocity is the velocity of light in an unbounded dielectric.

Select the correct answer using the code given below :

(a) 1, 2 and 3

(b) 1, 3 and 4

(c) 1, 2 and 4

(d) 2, 3 and 4

Sol. (None)

Following are the properties of TEM mode in a lossless medium:

(1) Its cut-off frequency is zero.

(2) Its transmission line is a two-conductor system and not a hollow waveguide.

(3) Its wave impedance is the impedance in an unbounded dielectric.

(4) Its propagation constant is the constant in an unbounded dielectric.

(5) Its phase velocity is the velocity of light in an unbounded dielectric.

Only option (1) & (4) are correct.

60. Consider the following statements :

Plane wave propagation through a circular waveguide results in

1. TE modes
2. TM modes

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) Either 1 or 2

(d) Both 1 and 2

Sol. (c)

A circular waveguide is a tubular, circular conductor. A plane wave propagating through a circular waveguide results in transverse electric (TE) or transverse magnetic (TM) mode.

61. In VLSI n-MOS process, the thinox mask

(a) patterns the ion implantation within the thinox region

(b) deposits polysilicon all over the thinox region

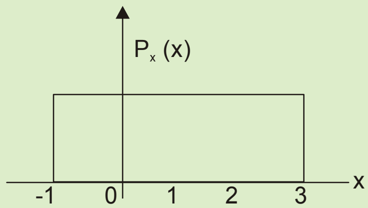
(c) patterns thickox regions to expose silicon where source, drain or gate areas are required

(d) grows thickox over thinox regions in gate areas

Sol. (b)

Thinox mask is used to make the source and drain region through ion implanation.

62. For a random variable x having the PDF shown in the figure given below



the mean and the variance are, respectively

(a) 0.5 and 0.66

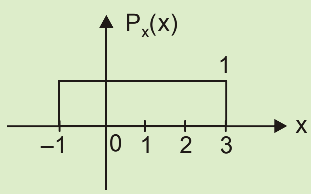
(b) 2.0 and 1.33

(c) 1.0 and 0.66

(d) 1.0 and 1.33

Sol. (d)

Given,



So, $f_x(x) = \frac{1}{4}$

Mean $E[x] = \int_{-\infty}^{\infty} x f_x(x)dx$

$= \int_{-1}^{3} x \cdot \frac{1}{4} dx$

$= \frac{1}{4}\left[\frac{x^2}{2}\right]_{-1}^{3}$

$= \frac{1}{4}\left[\frac{9-1}{2}\right] = \frac{8}{8} = 1$

Variance; $\text{Var}[x] = E[x^2] - \{E[x]\}^2$

$E[x^2] = \int_{-\infty}^{\infty} x^2 f_x(x)dx$

$= \int_{-1}^{3} x^2 \cdot \frac{1}{4} dx = \frac{1}{4}\left[\frac{x^3}{3}\right]_{-1}^{3}$

$= \frac{1}{4}\left[\frac{27-(-1)}{3}\right] = \frac{28}{12} = \frac{7}{3}$

$\therefore$ $\text{Var}[x] = E[x^2] - \{E[x]\}^2$

$= \frac{7}{3} - (1)^2 = \frac{7}{3} - 1 = \frac{4}{3} = 1.33$

63. Consider the following statements with respect to bilinear transformation method of digital filter design :

1. It preserves the number of poles and thereby the order of the filter.
2. It maintains the phase response of the analog filter.
3. The impulse response of the analog filter is not preserved.

Which of the above statements are correct ?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

Sol. (c)

Bilinear transformation is a mapping from the s plane to z plane defined by

$$s = \frac{2}{T_s}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)$$

The bilinear transformation is a rational function that maps the left half s plane inside the unit circle and maps the $j\omega$ axis in a one to one manner onto the unit circle.

Bilinear Transformation only preserve the magnitude response of analog filter.

64. Consider the following statements :

The 8259A Programmable Interrupt Controller an

1. manage eight interrupts
2. vector an interrupt request anywhere in the memory map
3. have 8-bit or 16-bit interval between interrupt vector locations
4. be initialized with operational command words

Which of the above statements are correct ?

(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4

Sol. (b)

The 8259A programmable interrupt controller can manage eight interrupts according to instruction written into its control registers. It can vector an interrupt request any where in the memory map. Interrupts can be spaced at the interval either 4 or 8 locations. It is compatible with 8085 (8 bits) and 8086/88 (16 bits). 8259A requires two types of control words: Initialization commands words (ICWs) and operational command words (OCWs).

65. What are the conditions which are necessary for using a parallel port ?

1. Initializing by placing appropriate bits at the control register
2. Calling on interrupt whenever a status flag sets at the status register
3. Interrupting servicing (device driver) programming

Select the correct answer using the code given below :

(a) 1 and 2 only
(b) 1 and 3 only
(c) 1, 2 and 3
(d) 2 and 3 only

Sol. (b)

Only the control word is required to use the parallel ports and to choose the mode 0, 1 or 2. Control word performs functions similar to that of the status register.

66. Consider a point-to-point communication network represented by a graph. In terms of the graph parameters, the maximum delay (quality of service) experienced by a packet employing Bellman-Ford routing algorithm is/are:

1. diameter of the graph
2. shortest path on the graph
3. sum of all edge weights in te graph

Select the correct using the code given below:

(a) 1 only
(b) 2 only
(c) 3 only
(d) 1, 2 and 3

Sol. (b)

Shortest-path algorithms can be divided into two classes : distance vector and link state. Distance vector algorithms are based on dynamic programming models and can implemented in a distributed asynchronous framework using local cost estimates. The basic distance vector algorithm is known as the Bellman-ford algorithm or the Ford-Fulkerson method.

67. Let RSA prime numbers be p = 3 and q = 11. If the corresponding public key e=3, what is the private key ?

(a) 4 (b) 5
(c) 6 (d) 7

Sol. (d)

$P = 3, \quad q = 11, \quad e = 3$

$n = p \times q = 3 \times 11 = 33$

$\phi(n) = (P-1)(q-1) = (3-1)(11-1) = 20$

$$e.d. = 1 \bmod \phi(n)$$
$$3d = 1 \bmod 20$$
$$3d = 21$$
$$d = 7$$

68. The maximum radiation for an endfire array occurs at

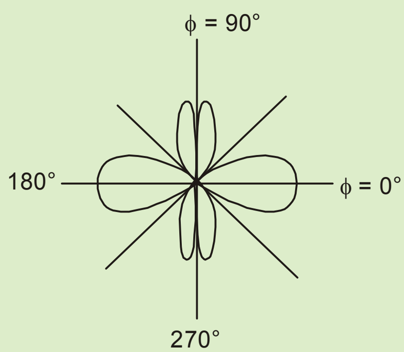
(a) $\phi_0 = 0$

(b) $\phi_0 = \frac{\pi}{2}$

(c) $\phi_0 = -\frac{\pi}{2}$

(d) $\phi_0 = \frac{3\pi}{2}$

Sol. (a)



The radiation pattern of a broad side type of array is shown above. The maximum radiation occurs at $\phi = 0°$ and 180°.

69. Consider the following statements regarding TCP:

1. It enables two hosts to establish a connection and exchange streams of data.
2. It guarantees delivery of data in the same order in which they are sent.
3. TCP segmentation offload is used to reduce the CPU overhead of TCP/IP on fast networks.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Sol. (d)

70. The transmission path loss for a geostationary satellite signal for uplink frequency of 6 GHz is

(a) 60 dB

(b) 92 dB

(c) 184 dB

(d) 200 dB

Sol. (d)

Free space path Loss = $10\log_{10}\left(\frac{4\pi df}{C}\right)^2$

$= 20\log_{10}\left(\frac{4\pi df}{C}\right)$

$= 20\log_{10}(d) + 20\log_{10}(f) + 20\log_{10}\left(\frac{4\pi}{C}\right)$

$= 20\log_{10}(36\times10^6) + 20\log_{10}(6\times10^9) - 147.55$

= 151.12+195.56 − 147.55

= 199.13 dB = 200 dB

71. Consider the following statements :

If the maximum range of radar has to be doubled

1. the peak transmitted power may be increased 16 folds
2. the antenna diameter may be doubled
3. the sensitivity of receiver may be doubled
4. the transmitted pulse width may be doubled

Which of the above statements are correct?

(a) 1 and 2

(b) 2 and 3

(c) 3 and 4

(d) 1 and 4

Sol. (a)

The maximum range in a radar is given by

$$r_{max} = 48\left[\frac{P_t D^4 S}{\delta f \lambda^2 (F-1)}\right]^{1/4}$$

r_{max} = maximum radar range, km
P_t = peak pulse power, W
D = antenna diameter, m
S = effective cross section area of target m^2
δf = receiver bandwidth, Hz
λ = wavelength, m
F = noise figure (expressed as a ratio)

$r_{max} \propto [P_t]^{1/4}$

$r_{max} \propto [D^4]^{1/4}$

$r_{max} \propto D$

Now evaluating the options.
1 and 2 are correct.

72. What is the maximum signal propagation time for a geosynchronous satellite transmission system?

(a) 140 ms

(b) 220 ms

(c) 280 ms

(d) 560 ms

Sol. (c)

Most communication satellites are located in the Geostationary orbit at an altitude of approximately 35,786 km above the equator.

If we are located on the equator and are communicating with a satellite directly overhead then total distance, single hop is nearly 72,000 km so the time delay is 240 ms.

73. The field strength at the receiving antenna location at a distance of 28 km from a half-wave dipole transmitter radiating 0.1 kW is :

(a) 1.5 mV/m

(b) 2.5 mV/m

(c) 3.5 mV/m

(d) 4.5 mV/m

Sol. (c)

For half wave dipole, $R_{rad} = 73\,\Omega$

$$\therefore\ P_{rad} = \frac{1}{2} I_0^2 . R_{rad}.$$

$$\Rightarrow I_0^2 = \frac{2P_{rad}}{R_{rad}} = \frac{2\times 0.1\times 10^3}{73} = 2.74$$

$$\Rightarrow\ I_0 = 1.65\ A$$

Now, for half wave dipole

$$|E_\theta| = \frac{60 I_0}{r}$$

$$\Rightarrow\ |E_\theta| = \frac{60\times 1.65}{28\times 10^3} = 0.0035\ \text{v/m}$$

$$\therefore\ \boxed{E_\theta = 3.5\ \text{mv/m}}$$

74. Consider the following loop :

```
    MOV CX, 8000h
L1: DEC CX
    JNZ L1
```

The processor is running at 14.7456/3 MHz and DEC CX requires 2 clock cycles and JNZ requires 16 clock cycles. The total time taken is nearly

(a) 0.01 s

(b) 0.12 s

(c) 3.66 s

(d) 4.19 s

Sol. (b)

8000H = $8\times16^3+0\times16^2+0\times16^1+0\times16^0$
= 32768
Required T states for loop = 2+16 = 18 T states
$\therefore$ Time taken

$$= 18\times32768\times\frac{1}{(14.7456/3)\times10^6}$$

$$= \frac{18\times32768}{4.9152\times10^6} = 0.12\,\text{sec.}$$

75. A microwave communication link employs two antennas for transmission and reception elevated at 200 m and 80 m, respectively. Considring obliqueness of the Earth, the maximum possible link distance is :

(a) 46 km

(b) 64 km

(c) 96 km

(d) 102 km

Sol. (c)

Link distance = $4.12\left(\sqrt{200}+\sqrt{80}\right)$km
= 95.11 km = 96 km

76. Consider a packet switched network based on a virtual circuit mode of switching. The delay Jitter for the packets of a session from the source node to the destination node is/are

1. always zero
2. non-zero
3. for some networks, zero

Select the correct answer using the code given below.

(a) 1

(b) 2 only

(c) 3 only

(d) 2 and 3

Sol. (b)

In computer networking, packet delay variation (PDV) is the difference in end to end between selected packets in a flow with any lost packets being ignored. The effect is referred to as jitter.

Jitter is the variation in latency as measured in the variability over time of the packet latency across a network. Packet Delay Variation (PDV) is an important quality of service factor in assessment of network performance.

It is non zero and minimized by various methods and devices.

77. Molydenum has a Body-Centered Cubic, (BCC) structure with an atomic radius of 1.36 Å. Then the lattice parameter for BCC molybdenum is:

(a) 2.77Å (b) 3.14Å

(c) 5.12Å (d) 6.28Å

Sol. (b)

For BCC

$$\frac{\sqrt{3}}{4}a = r$$

So $a = \frac{4}{\sqrt{3}} r = \frac{4}{\sqrt{3}} \times 1.36 Å = 3.14 Å$

Directions :

Each of the next thirteen (13) items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the code given below :

Code :

(a) Both Statement(I) and Statement(II) are individually true and Statement (II) is the correct explanation of Statement(I)

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I)

(c) Statement (I) is true but Statement (II) is false.

(d) Statement (I) is false but Statement (II) is true.

78. Statement (I) :

The coupling between two magnetically coupled coils is said to be ideal if the coefficient of coupling is unity.

Statement (II) :

Lower the self-inductance of a coil, more will be the e.m.f. induced.

Sol. (c)

Coefficient of coupling is defined as the fraction of total flux that links the coils.

Coupling between two magnetically coupled coils depends on the distance between the coils and orientation of coils.

Coefficient of coupling, $K = \frac{M}{\sqrt{L_1 L_2}}$

If $K = 1$, ideal coupling

$K < 1$; loose coupling

So, statement-I is correct.

Now, emf induced in a coil,

$$e = L\frac{di}{dt}$$

i.e. emf is directly proportional to the self-inductance. So, lower the self-inductance of a coil, less will be the emf induced.

So, statement-II is false.

79. Statement (I) :

The direction of dynamically induced e.m.f. in a conductor is determined by Fleming's left-hand rule.

Statement (II) :

The mutual inductance between two magnetically isolated coils is zero.

Sol. (d)

The direction of dynamically induced e.m.f. in a conductor is determined by Fleming's right-hand rule. Therefore statement I is false.

80. Statement (I) :

Photodiodes are not used in relay circuits.

Statement (II) :

The current needed to activate photodiodes is very low even at high light intensities.

Sol. (d)

A photo diode is very much used in relay circuits to realise photorelay circuits in which circuit opens and closes the relay contacts according to the light. Hence statement I is false.

The photodiode is connected in reverse biased condition. The only current flowing through it will be due to the minority carrier hence statement II is true.

81. Statement (I) :
An autotransformer is economical in using copper in its manufacture.

Statement (II) :
The section of the winding common to both primary and secondary circuits carries only the difference of primary and secondary currents.

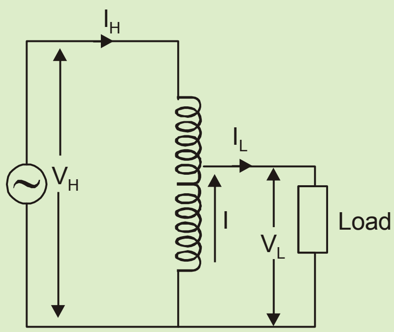
Sol. **(b)**

Let W_{auto} as weight of copper in auto transformer and W_{TW} as weight of copper in two winding transformer.

$$\frac{W_{auto}}{W_{TW}} = 1 - \frac{1}{a_A} \quad \text{where } a_A = \frac{V_H}{V_L} > 1$$

$$\frac{W_{auto}}{W_{TW}} < 1$$

$$W_{Auto} < W_{TW}$$



$I = I_L - I_H$

So, statement (I) and (II) both are correct but statement (II) is not the correct explanation of statement (I).

82. Statement (I) :
FIR filters are always stable.

Statement (II) :
IIR filters require less memory and are less complex.

Sol. **(b)**

FIR filters are inherently stable because all the poles of the FIR filter lies at Z = 0 (i.e. inside the unit circle).

IIR filters are also known as recessive filters. Since IIR filter implementation requires less no. of coefficient multipliers, when implemented recursively. Thus, they require less memory and are less complex.

83. Statement (I) :

Nuclear power plants are suitable only for base load operation.

Statement (II) :
Nuclear power reactor cannot respond to load fluctuation efficiently.

Sol. **(a)**

- Solar insolation is a measure of solar radiation energy received on a given surface area in a given time. It is commonly expressed as average irradiance in watts per square meter (W/m^2) or killowatt-hours per square. Hence, statement I is true.
- Solar photovoltaic system or solar (PV system) is one of the renewable energy system which uses PV module to convert sunlight into electricity and in general solar insolation data are used to achieve this module.

84. Statement (I) :
Solar insolation is a measure of solar irradiance over a specified peiod of time

Statement (II) :
Solar insolation data are commonly used for isolated PV system design.

Sol. (a) 84.

- Solar insolation is a measure of solar radiation energy received on a given surface area in a given time. It is commonly expressed as average irradiance in watts per square meter (W/m^2) or kilowatt-hours per square. Hence, statement I is true.
- Solar photovoltaic system or solar (PV system) is one of the renewable energy system which uses PV module to convert sunlight into electricity and in general solar insolation data are used to achieve this module.

85. Statement (I) :
The smallest change of input detectable at the output is called the resolution of a transducer.

Statement (II) :
A high resolution means high accuracy.

Sol. (b)

Statement-I: Resolution of a transducer means the smallest change in the input that can be detected. Hence it is true.

Statement-II: A high resolution is always required because it will provide high accuracy. Hence it is true.

Both the statements are correct but statement II does not follow from statement I because statement I is defenition whereas statement II is application.

86. Statement (I) :
Constant M and N circles, as also Nichols' charts are graphical techniques to assess closed-loop performance in the frequency domain.

Statement (II) :
While constant M and N circles use Nyquist polar plots data, Nichols' chart uses Bode plots data.

Sol. (b)

The Nichols chart consists of M and N contours super imposed on ordinary graph. Along each M contour the magnitude of closed loop system, M will be a constant. Along each N contour, the phase of closed loop system will be constant.

The Nichols chart is used to find the closed loop frequency response.

The statement II is also correct.

87. Statement (I) :
PID control system performs better than most predictive control methods in the context of measured distrubances.

Sol. (a)

PID controllers are most popular controller and it is an essential part of any control loop in process industry.

The statement II is also correct and correct explanation of statement I.

88. Statement (I) :
Large RAM with MOS circuit technology is used for the main memory in a computer system.

Statement (II)
An important application of ROM is to store system programs, library subroutines, etc.

Sol. (b)

- Large RAM with MOS circuit technology can be used for the main memory because of its high package density and we call it as DRAM. Here speed of operation is lower than SRAM but size is more because of high package density. Hence statement (I) is true.

- Rom is used to store system programs like Bootstrap and library subroutines etc. As it is non volatile memory. Hence statement (II) is true.

But statement (II) is not correct explanation of statement (I).

Therefore option (b) is correct.

89. Statement (I) :

Elements with non-minimum phade transfer functions introduce large phase lags with increasing frequency resulting in complex compensation problems.

Statement (II)

Transportation lag commonly encountered in process control systems is a non-minimum phase element.

Sol. (b)

Transfer functions having at least one pole or zero in the RHS of s-plane are called non-minimum phase transfer functions. The elements with non-minimum phase transfer functions introduce large phase lags with increasing frequency resulting in complex compensation problems.

The transfer function of transportation lag is

$$G(s) = \frac{1-sT_1}{1+sT_2}$$

90. Statement (I) :
Speech enhancement techniques are used to make a processed speech signal sound superior to the unprocessed one.

Statement (II) :
A 'perfect signal' is required as reference for speech enhancement

Sol. (c)

Speech enhancement aim to improve speech quality by using improved algorithms. The objective of enhancement is improvement in intelligibility and overall perceptual quality of degraded speech signal using audio signal processing techniques.

In single channel enhancement of noisy speech no reference signal is available so statement two is false.

91. A 12-bit A/D converter has a full-scale analog input of 5 V. Its resolution is :

(a) 1.22 mV

(b) 2.44 mV

(c) 3.66 mV

(d) 4.88 mV

Sol. (a)

Resolution of 12 bits A/D converter = $\frac{V}{2^n - 1}$

$$= \frac{5}{2^{12}-1} = \frac{5}{4095} = 1.22\text{mV}$$

92. Which of the following circuits converts/convert a binary number on the input to a one-hot encoding at the output ?

1. 3 to 8 binary decoder
2. 8 to 3 binary decoder

3. Comparator

Select the correct answer using the code given below.

(a) 1 only (b) 2 only

(c) 3 only (d) 1, 2 and 3

Sol. (a)

In digital circuit, one-hot refers to a group of bits among which the legal combinations of values are only those with a single high (1) bit and all the other low (0). It is often used for indicating the state of a state machine.

Binary	One – Hot
0 0 0	0 0 0 0 0 0 0 1
0 0 1	0 0 0 0 0 0 1 0
0 1 0	0 0 0 0 0 1 0 0
0 1 1	0 0 0 0 1 0 0 0
1 0 0	0 0 0 1 0 0 0 0
1 0 1	0 0 1 0 0 0 0 0
1 1 0	0 1 0 0 0 0 0 0
1 1 1	1 0 0 0 0 0 0 0

It can be implemented by using a 3 to 8 Decoder.

93. The simiplification in minimal sum of product (SOP) of

$$Y = F(A,B,C,D)$$
$$= \sum_m (0,2,3,6,7) + \sum d\,(8,10,11,15)$$

using K-maps is :

(a) $Y = AC + B\bar{D}$ (b) $Y = A\bar{C} + B\bar{D}$

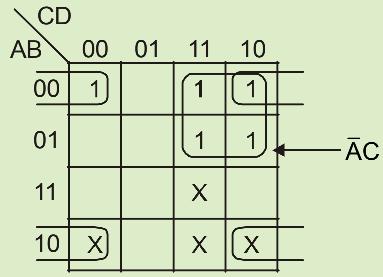
(c) $Y = \bar{A}\bar{C} + \bar{B}D$ (d) $Y = \bar{A}C + \bar{B}\bar{D}$

Sol. (d)

Given, Y = F(A, B, C, D)

$= \Sigma_m (0,2,3,6,7) + \Sigma_d (8,10,11,15)$

Using K-map



$y = \bar{A}C + \bar{B}\bar{D}$

94. A circuit outputs a digit in a the form of 4 bits. 0 is represented by 0000, 1 is represented by 0001,...., 9 by 1001. A combinational circuit is to be designed which takes 4 bits as input and output as 1, if the digit is ≥ 5, and 0 otherwise. If only AND, OR and NOT gates may be used, what is the minimum number of gates required?

(a) 4 (b) 3

(c) 2 (d) 1

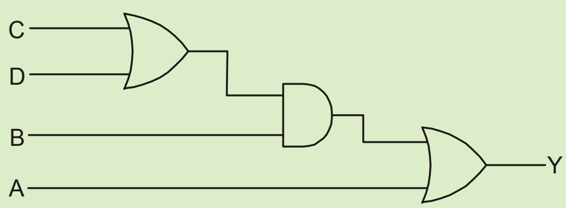
Sol. (b)

Input				Output
A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1

$Y(A,B,C,D) = \sum m(5,6,7,8,9) + \sum d(10,11,12,13,14,15)$

AB \ CD	00	01	11	10
00	0	0	0	0
01	0	1	1	1
11	X	X	X	X
10	1	1	X	X

$$Y = A + BD + BC$$
$$= A + B(C + D)$$



Minimum number of Gate required to implement the output expression = 3

95. How many 3 to 8 line decoders with an enabler input are needed to construct a 6 to 64 line decoder without using any other logic gates ?

(a) 11

(b) 10

(c) 9

(d) 8

Sol. (c)

Expansion of Decoder

$n_1 \times m_1 \rightarrow n_2 \times m_2$
D – 1 D – 2

No. of Deodar D–2 required = $\sum K$

$$\frac{m_2}{m_1} = K_1$$

$$\frac{K_1}{m_1} = K_2$$

$$\frac{K_2}{m_1} = K_3$$

$\vdots$

Till 0 or 1

$$\frac{2}{m_1} = 0, \quad \frac{3,4}{m_1} = 1$$

$3 \times 8 \rightarrow 6 \times 64$
D – 1 D – 2

$$\left.\begin{array}{l} \frac{64}{8} = 8 \\ \frac{8}{8} = 1 \end{array}\right\} = 9$$

No. of 3 to 8 line decoder required to construct a 6 to 64 line decoder = 9

96. The minterm expansion of $F(A,B,C) = AB + B\overline{C} + A\overline{C}$ is

(a) $m_2 + m_4 + m_6 + m_1$

(b) $m_0 + m_1 + m_3 + m_5$

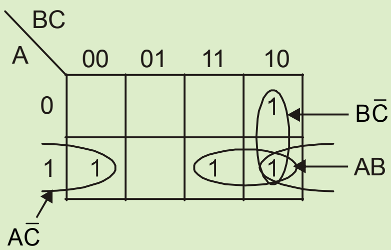
(c) $m_7 + m_6 + m_2 + m_4$

(d) $m_2 + m_3 + m_4 + m_5$

Sol. (c)

Given, $F(A,B,C) = AB + B\overline{C} + A\overline{C}$

Using K-map



Hence, $F(A,B,C) = m_2+m_4+m_6+m_7$

97. The output of a NOR gate is :

(a) high if all of its inputs are high

(b) low if all of its inputs are low

(c) high if all of its inputs are low

(d) high if only one of its inputs is low

Sol. **(c)**

Truth table for NOR is

A	B	O/P
0	0	1
0	1	0
1	0	0
1	1	0

i.e. output is high if all of its inputs are low.

98. If the input to a T flip-flop is a 100 MHz signal, the final output of three T flip-flops in a cascade is :

(a) 1000 MHz

(b) 520 MHz

(c) 333 MHz

(d) 12.5 MHz

Sol. **(d)**

Frequency at output of flip-flop

$$= \frac{\text{Input frequency}}{2^n} = \frac{100\text{MHz}}{2^3} = 12.5 \text{ MHz}$$

99. The addition of the two numbers $(1A8)_{16} + (67B)_{16}$ will be :

(a) $(889)_{16}$

(b) $(832)_{16}$

(c) $(823)_{16}$

(d) $(723)_{16}$

Sol. **(c)**

In hexadecimal system (in which Base is 16) A stand for 10 and B stands for 11

so,

$$\begin{array}{l} \left(1^1A^18\right)_{16} \\ \underline{(6\,7\,B)_{16}} \\ (8\,2\,3)_{16} \end{array} \left[\begin{array}{l} \because 8+11=\dfrac{19}{16} \Rightarrow \text{Rem}-3\;\&\;\text{Carry}=1 \\ \because 1+10+7=\dfrac{18}{16} \Rightarrow \text{Rem}=2\;\&\;\text{Carry}=1 \end{array}\right]$$

100. If the operating frequency of an 8086 microprocessor is 10 MHz and, if for the given instruction, the machine cycle consists of 4 T-states, what will be the time taken by the machine cycle to complete the execution of that same instruction when three wait states are inserted ?

(a) 0.4 μs

(b) 0.7 μs

(c) 7 μs

(d) 70 μs

Sol. **(b)**

Operating frequency = 10 MHz
So each state corresponds to

$$\frac{1}{10MH_2} = 0.1\mu sec$$

So time taken to complete execution

= $4T + 3T$ (wait state)
= 7 T
= 0.7 μsec

101. The probability density function $F(x) = ae^{-b|x|}$, where x is a random variable whose allowable value range is from $x = -\infty$ to $x = +\infty$. The CDF for this function for $x \geq 0$ is

(a) $\frac{a}{b}e^{bx}$

(b) $\frac{a}{b}(2 - e^{-bx})$

(c) $-\frac{a}{b}e^{bx}$

(d) $-\frac{a}{b}(2 + e^{-bx})$

Sol. **(b)**

Given PDF F(x) = $ae^{-b|x|}$

$$\text{CDF} = \int_{-\infty}^{\infty} ae^{-b|x|}dx$$

for $x \geq 0$

$$\text{CDF} = \int_{-x}^{x} f(u)du = \int_{-\infty}^{x} ae^{-b|u|}du$$

$$= \int_{-\infty}^{0} ae^{bu}du + \int_{0}^{x} e^{-bu}du$$

$$= \left[\frac{a}{b}e^{bu}\right]_{-\infty}^{0} + \left[\frac{-a}{b}e^{-bu}\right]_{0}^{x}$$

$$= \frac{a}{b}(1-0) + \left[\frac{-a}{b}\left(e^{-bx} - 1\right)\right]$$

$$= \frac{a}{b}\left(2 - e^{-bx}\right)$$

102. Consider the following statements regarding electrical properties of ceramic materials :

1. They are practically non-conductors at lower temperatures.
2. Ordinary glass and silicates in molten state are dependable as electrical non-conductors.
3. They offer high resistance to current transmission and get heated soon when conducting electric current.

Which of the above statements are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Sol. **(b)**

Ceramic materials are electrically insulator. These materials has high resistance to flow the current at high temperature. These materials and also thermally insulator.

103. If primary and secondary windings of core-type single-phase transformer are wound on non-magnetic core, then the

1. efficiency of the transformer will decrease
2. efficiency of the transformer will increase
3. transformer regulation will increase
4. transformer regulation will decrease

Which of the above possibilities are realized?

(a) 1 and 4

(b) 1 and 3

(c) 2 and 3

(d) 2 and 4

Sol. (b)

In non magnetic core higher magnetization current will be required to establish the same flux due to less permeability. It implies more losses and hence less efficiency. More losses means drop in voltage is more which causes high voltage regulation.

104. In the case of small BJT model with common emitter, the collector current i_c is 1.3 mA, when the collector-emitter voltage is v_{ce} of 2.6 V. The output conductance of the circuit is :

(a) $2.0\,m\Omega$ (b) $2.0\,m℧$

(c) $0.5\,m\Omega$ (d) $0.5\,m℧$

Sol. (d)

The output conductance of the BJT circuit is given as

$$g_m = \frac{i_c}{V_{ce}}$$

$$\Rightarrow \quad g_m = \frac{1.3\times 10^{-3}}{2.6}$$

$$\Rightarrow \quad g_m = 0.5\ m℧.\ \text{Ans}$$

105. An FM broadcasting radio station transmits signals of frequency 100 MHz with a power of 10 kW. The bandwidth of the modulation signal is from 100 Hz to 1.5 kHz. If the maximum deviation set by FCC, (δ), is 75 kHz, the range of the modulation index is :

(a) 100 to 750

(b) 100 to 250

(c) 50 to 750

(d) 50 to 250

Sol. (c)

Here, minimum frequency of message signal
$f_m(\text{min})$ = 100 Hz
maximum frequency of message signal
$f_m(\text{max})$ = 1.5 KHz
Maximum frequency deveation $\delta = 75\text{KHz}$
Minimum modulation index m_f (min)

$$= \frac{\delta}{f_m(\text{max})} = \frac{75}{1.5} = 50$$

Maximum Modulation Index m_f(max) =

$$\frac{\delta}{f_m(\text{min})} = \frac{75\times 10^3}{100} = 750$$

$\therefore$ Range will be 50 to 750

106. An amplitude-modulated amplifier has a radio frequency output of 60 W at 100% modulation. The internal loss in the modulator is 6 W. What is the unmodulated carrier power ?

(a) 33 W

(b) 36 W

(c) 40 W

(d) 44 W

Sol. (d)

Here, Output power P_{out} = 60 W
Internal power loss P_d = 6 W

$\therefore$ Total input power $P_{in} = P_{out} + P_d = 60+6 = 66$ W

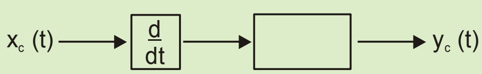
Now, unmodulated carrier power (P_C) is given by:

$$P_{in} = P_c\left(1+\frac{m^2}{2}\right)$$

$$\therefore\ 66 = P_c\left(1+\frac{1}{2}\right) \quad (\because m = 100\%)$$

$$\therefore\ P_c = \frac{66\times 2}{3} = 44 \text{ W}$$

107. The figure shows the block diagram of a frequency discriminator. What does the second block represent ?



(a) Envelope detector

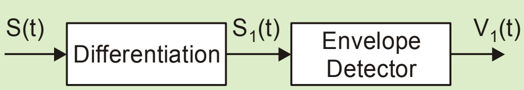
(b) Low-pass filter

(c) Ratio detector

(d) Band-reject filter

Sol. (a)

Frequency discriminator or slope detector method is used for demodulation of F.M. The ideal frequency discriminator block diagram is shown below:



where $s(t) = A_c \cos\left[2\pi f_c t + 2\pi K_f \int_0^t m(\tau)d\tau\right]$ (FM signal)

108. A dominant pole is determined as

(a) the highest frequency pole among all poles

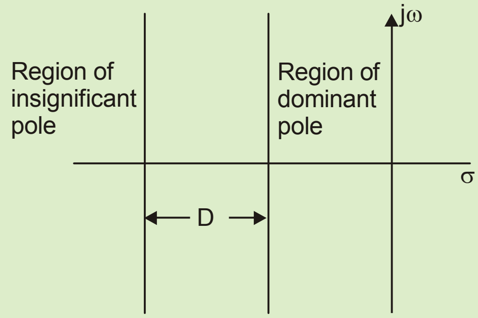
(b) the lowest frequency pole at least two octaves lower than other poles

(c) the lowest frequency pole among all poles

(d) the highest frequency pole at least two octaves higher than other poles

Sol. (b)

Dominant Pole Concept



The pole which are nearer to $j\omega$ axis is dominant pole and the pole which are away from the $j\omega$ axis is known as insignificant pole.

The distance D between dominant pole and insignificant pole is 5 to 10 times of the magnitude of dominant pole or pair of complex dominant pole.

109. if only one multiplexer and one inverter are allowed to be used to implement any Boolean function of n variables, what is the maximum size of the multiplexer needed ?

(a) 2^{n-2} line to 1 line

(b) 2^{n-1} line to 1 line

(c) 2^{n+1} line to 1 line

(d) 2^{n+2} line to 1 line

Sol. (b)

To realize n variables boolean function the MUX required = $2^{n-1}\times 1$.

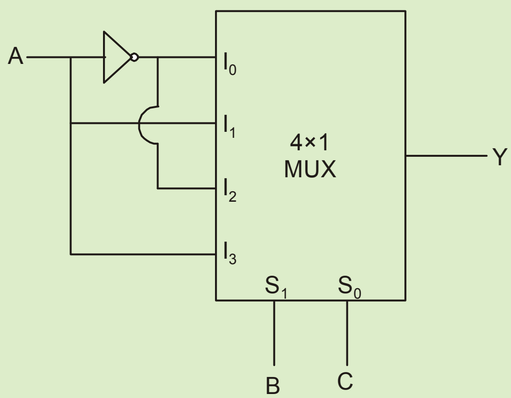
Example : Implement the boolean function using MUX.

$$F(A,B,C) = \sum m(0,2,5,7)$$

MUX required = $2^{n-1} \times 1 = 2^{3-1} \times 1 = 4 \times 1$

Select Line : BC

	I_0	I_1	I_2	I_3
$\bar{A}$	(0)	1	(2)	3
A	4	(5)	6	(7)
	$\bar{A}$	A	$\bar{A}$	A



110. What is the minimum $\frac{E_b}{N_0}$ required to achieve a spectral efficiency of 6 bps/Hz?

(a) 5.2

(b) 5.3

(c) 10.5

(d) 15.8

Sol. (c)

Minimum $\frac{E_b}{N_0}$ required to achieve a spectral efficiency of 6bps/Hz

Given, $\frac{C}{W} = 6$

$$\frac{E_b}{N_0} = \frac{W}{C}\left[2^{C/W} - 1\right]$$

$$\frac{E_b}{N_0} = \frac{1}{6}\left[2^6 - 1\right]$$

$$\frac{E_b}{N_0} = \frac{1}{6} \times 63 = 10.5$$

111. What is the required bandwidth of a PCM system for 256 quantization levels when 48 telephone channels, each band limited to 4 kHz, are to be time-division multiplexed by this PCM?

(a) 6.246 MHz

(b) 3.464 MHz

(c) 3.072 MHz

(d) 1.544 MHz

Sol. (d)

In PCM system, No. of quantization levels (L) = 2^n = 256

$\therefore$ n = 8

Bandwidth of each channel = 4KHz

$\therefore$ Sampling frequency = 4×2 = 8KHz

Required Bandwidth = $mnf_s/2$ where m = no. of channels = $8 \times 8 \times 10^3 \times 48/2$

= 1.536 MHz

112. The modulation scheme used in GSM is :

(a) frequency shift keying

(b) phase shift keying

(c) Gaussian minimum shift keying

(d) amplitude shift keying

Sol. (c)

Guassian minimum shift keying is used in GSM.

113. The basic motivation behind the development of digital modulation techniques is :

(a) to develop a digital communication field

(b) to institute methods for translating digital message from baseband to passband

(c) to develop digitized versions of analog modulation schemes

(d) to improve upon pulse modulation schemes

Sol. (b)
The basic motivation behind the development of digital modulation techniques is to institute methods for translating digital message from baseband to passband.

114. The received signal level for a particular digital system is –151 dBW and the effective noise temperature of the receiver system is 1500 K. The value of $\frac{E_b}{N_0}$ required for a link transmitting 2400 bps is :

(a) –12 dB

(b) –1.2 dB

(c) +1.2 dB

(d) +12 dB

Sol. (d)

$$\frac{C}{N} = -151$$
$$B = 2400$$
$$T = 1500 \text{ K}$$
$$\frac{E_b}{N_0} = \frac{C}{N(KTB)}$$
$$= 10\log_{10}\frac{C}{N} - 10\log_{10}T - 10\log_{10}B - 10\log_{10}K$$
$$= -151 - 10\log_{10}(1500) - 10\log_{10}2400 + 228.6$$
$$= 12.04 \text{ dB}$$

115. The largest error between reference input and output during the transient period is called :

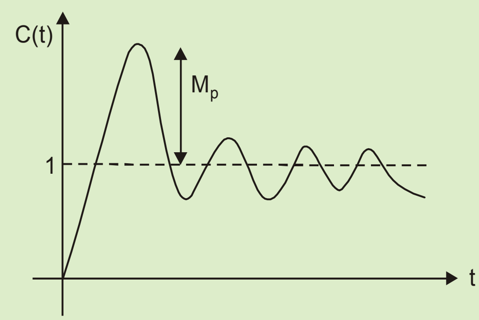
(a) peak error

(b) transient overshoot

(c) peak overshoot

(d) transient deviation

Sol. (c)



The largest Error between reference input and output during transient period is called peak over shoot.

$M_P = C(t_p) - C(\infty)$

$C(t_p) \Rightarrow$ Response at Peak time

$C(\infty) \Rightarrow$ steady state Response

Peak overshoot is maximum overshoot over its steady state value.

116. Consider the follwing statemtns regarding ‘relative stability’:

It is defined

1. in terms of gain margin only
2. in terms of phase margin and certain other parameters
3. In terms of gain margin, phase margin and location of poles in s-plane
4. in relation to another identified system

Which of the above statements are correct ?

(a) 1 and 2

(b) 2 and 3

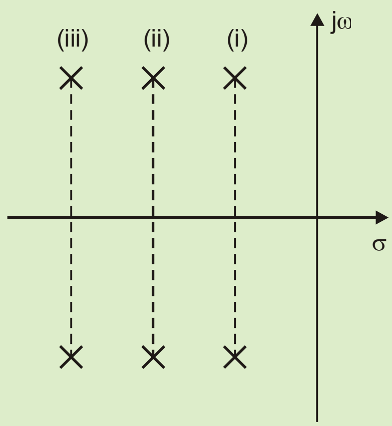
(c) 3 and 4

(d) 1 and 4

Sol. **(c)**

Gain Margin and Phase Margin of the system gives relative stability.

Relative stability is analysis of how fast transient has died out in the system. If we moves away from $j\omega$ axis in left half of s plane then relative stability of system improves.



(III) is relatively more stable to (II)

(II) is relatively more stable to (I).

117. Consider the following statements :

For a type-1 and a unity feedback system, having unity gain in the forward path

1. positional error constant K_p is equal to zero
2. acceleration error constant K_a is equal to zero
3. steady state error e_{ss} per unit-step displacement input is equal to 1

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

Sol. **(None)**

$$G(s) = \frac{1}{s(1+sT)} \rightarrow \text{Type}-1$$

(i) Position Error constant.

$$K_p = \lim_{s\to 0} G(s) = \lim_{s\to 0} \frac{1}{s(1+sT)} = \infty$$

(ii) Acceleration Error constant.

$$K_a = \lim_{s\to 0} s^2 G(s) = \lim_{s\to 0} s^2 \frac{1}{s(1+sT)} = 0$$

(iii) r(t) = u(t)

Steady State Error

$$e_{ss} = \lim_{s\to 0} s \cdot \frac{1/s}{1+\frac{1}{s(1+sT)}} = 0$$

118. Consider a discrete memoryless source with source alphabet $S = \{s_0, s_1, s_2\}$ with probabilities

$$P(s_0) = \frac{1}{4}, P(s_1) = \frac{1}{4} \text{ and } P(s_2) = \frac{1}{2}$$

The entropy of the source is

(a) $\frac{1}{2}$ bit

(b) $\frac{2}{3}$ bit

(c) $\frac{3}{2}$ bit

(d) $\frac{1}{3}$ bit

Sol. **(c)**

Given $P(s_0) = \frac{1}{4}, P(s_1) = \frac{1}{4}, P(s_2) = \frac{1}{2}$

Entropy (H) = $\sum_{K=0}^{2} P_K \log_2\left(\frac{1}{P_K}\right)$

$= \frac{1}{4}\log_2 4 + \frac{1}{4}\log_2 4 + \frac{1}{2}\log_2 2$

$= \frac{2}{4} + \frac{2}{4} + \frac{1}{2} = \frac{3}{2}$ bits

119. For a lead compensator, whose transfer function is given by $K\frac{s+a}{s+b}; a, b \geq 0$

(a) a < b

(b) a > b

(c) $a \geq Kb$

(d) $a = 0$

Sol. (a)

The given transfer function can be re-written as

$$\frac{K(s+a)}{s+b} = \frac{Ka(1+s/a)}{b(1+s/b)}$$

Now, for this to be a transfer function of lead compensator.

$$\frac{\frac{1}{b}}{\frac{1}{a}} < 1 \text{ or } \frac{a}{b} < 1$$

$\therefore$ a < b

120. A unity feedback system has open loop transfer function with two of its poles located at $-0.1, 1$; and two zeroes located at -2 and -1 with a variable gain K. For what value (s) of K would the closed-loop system have one pole in the right half of the s-plane ?

(a) K > 0.3

(b) K < 0.05

(c) 0.05 < K < 0.3

(d) K > 0

Sol. (b)

Given, H(s) = 1 and G(s) = $\frac{k(s+2)(s+1)}{(s+0.1)(s-1)}$

the characteristic equation is

$(s+0.1)(s-1) + k(s+1)(s+2) = 0$

or $s^2(1+k) + s(3k-0.9) + (2k-0.1) = 0$

RH table :

s^2	$(1+k)$	$(2k-0.1)$
s^1	$(3k-0.9)$	
s^0	$(2k-0.1)$	

$2K - 0.1 < 0 \Rightarrow K < 0.05$

For closed loop system to have one pole in the right half of s-plane, only option (b) satisfies.

121. Consider the following statements :

The output of a linear circuit, driven with a sine wave at a frequency f, is itself a sine wave

1. at the same frequency
2. with chance of changed amplitude
3. with chances of changed amplitude and phase

Which of the above statements is/are correct?

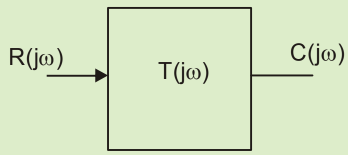
(a) 1 and 2

(b) 1 only

(c) 1 and 3

(d) 2 only

Sol. (c)



$$r(t) = A \sin(\omega t + \theta)$$

$$|R(j\omega)| = A$$

$$\angle R(j\omega) = \theta$$

$$T(j\omega) = M\angle\theta$$

$$|T(j\omega)| = M$$

$$\angle T(j\omega) = \phi$$

$$C(t) = AM \sin(\omega t + \theta + \phi)$$

$$|C(j\omega)| = AM$$
$$\angle C(j\omega) = \phi + \phi$$

Output of a linear circuit with sinusoidal input is sinusoidal. But the Amplitude and phase of the output has been changed.

122. Consider the following statements :

The main contribution to photo conduction is by

1. the generation of electron and hole pair by a photon
2. a donor electron jumping into the conduction band because of a photon's energy
3. a valence electron jumping into an acceptor state because of a photon's energy

Which of the above statements is/are correct?

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

Sol. (d)

If photons of sufficient energies illuminate the semiconductor, photo generation takes place and the following transitions are possible:

- An electron-hole pair can be created by a high energy photon.
- A photon may excite a donor electron into the conduction band.
- Or a valence electron may go into an acceptor state.

The last two transitions are known as impurity excitations.

123. Thermal runaway is not possible in FET because as the temperature of the FET increase

(a) mobility decreases

(b) trans-conductance increases

(c) drain current increases

(d) trans-conductance decreases

Sol. (a)

FET possess a temperature coefficient at high current levels that prevents the thermal runaway phenomena that may occur in BJT. This is because, at all but very low drain currents, the temperature dependence is dominated by the negative temperature coefficient of the threshold voltage. This means that, as the temperature of the FET increases, the mobility of the charge carriers in the channel decreases.

124. For JFET, the drain current I_D is:

(a) $I_{DSS}\left(1-\frac{V_{GS}}{V_p}\right)^{1/2}$

(b) $I_{DSS}\left(1-\frac{V_{GS}}{V_p}\right)$

(c) $I_{DSS}\left(1-\frac{V_{GS}}{V_p}\right)^{3/2}$

(d) $I_{DSS}\left(1-\frac{V_{GS}}{V_p}\right)^{2}$

Sol. (d)

For JFET the drain current,

$$I_0 = I_{DSS}\left(1-\frac{V_{GS}}{V_p}\right)^2 \text{ ...Shockley's equation}$$

125. For n-channel depletion MOSFET, the highest trans-conductance gain for small signal is at

(a) $V_{GS} = 0V$

(b) $V_{GS} = V_p$

(c) $V_{GS} = |V_p|$

(d) $V_{GS} = -V_p$

Sol. (a)

The transconductance, $g_m = g_{m_0}\left(1-\frac{V_{GS}}{V_p}\right)$

Where, g_{mo} is the highest transconductance at V_{GS} = 0V

126. The n-p-n transistor made of silicon has a DC base bias voltage 15 V and an input base resistor $150K\Omega$. Then the value of the base current into the transistor is

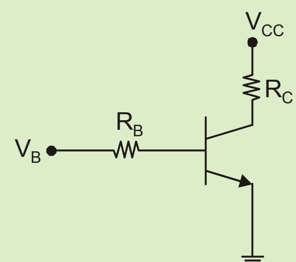
(a) $0.953\mu A$

(b) $9.53\mu A$

(c) $95.3\mu A$

(d) $953\mu A$

Sol. (c)



Given, V_B = 15V and R_B = $150k\Omega$

$$V_B - I_BR_B = 0.7$$

$$I_B = \frac{V_B - 0.7}{R_B} = \frac{15-0.7}{150\times10^3} = 95.33\mu A$$

127. A signal may have frequency components which lie in the range of 0.001 Hz to 10 Hz. Which one of the following types of couplings should be chosen in a multistage amplifier designed to amplify the signal?

(a) Capacitor coupling

(b) Direct coupling

(c) Transformer coupling

(d) Double-tuned transformer coupling

Sol. (b)

To amplify a low frequency (0.001Hz to 10Hz) signals, direct coupling is used in a multistage amplifier.

128. If an input impedance of op-amp is finite, then which one of the following statements related to virtual ground is correct ?

(a) Virtual ground condition may exist.
(b) Virtual ground condition cannot exist
(c) In case of op-amp, virtual ground condition always exists.
(d) Cannot make a valid declaration

Sol. (b)

The virtual ground condition exist only if the input impedance of op-amp is infinite.

129. Hysteresis is desirable in a Schmitt-trigger because

(a) energy is to be stored/discharged in parasitic capacitances
(b) effects of temperature variations would be compensated
(c) devices in the circuit should be allowed time for saturating and de-saturation
(d) it would prevent noise from causing false triggering

Sol. (d)

Hysteresis is desirable in a schmitt trigger because it prevents noise from causing false triggering. If the peak-to-peak noise voltage is less than the hysteresis, the noise cannot produce false triggering.

130. In a photoconductive cell the resistance, of the semiconductor material varies with intensity of incident light.

(a) directly
(b) inversely
(c) exponentially
(d) logarithmically

Sol (b)

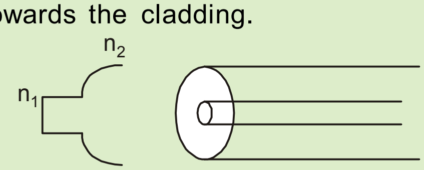
The photoconductive cell is a semiconductor device whose resistance varies inversely with the intensity of light that falls upon its photosensitive material.

131. In graded index multimode optical fiber the refractive index of the core is

(a) uniform across its radial distance except for the cladding
(b) maximum at the fiber axis and decreased stepwise towards the cladding
(c) maximum at the fiber axis and decreases gradually towards the cladding.
(d) maximum at the fiber axis and increases stepwise towards the cladding

Sol. (c)

In a graded multimode optical fiber the refractive index of the core is maximum at the fiber axis and starts decreasing gradually towards the cladding.



132. Consider the following factors :

1. Number of turns of the coil
2. Length of the coil
3. Area of cross-section of the coil
4. Permeability of the core

On which of the above factors does inductance, depend ?

(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 1, 2, 3 and 4
(d) 2 and 4 only

Sol. (c)

Inductance of a coil,

$$L = \frac{N^2}{S}$$

$$= \frac{N^2}{\left(\frac{\ell}{\mu_0\mu_r A}\right)}$$

$$= \frac{\mu_0\mu_r AN^2}{\ell}$$

So, Inductance of a coil depends on

(i) Permeability of the core

(ii) Area of cross-section of the coil

(iii) Number of turns of the coil

(iv) Length of the coil.

133. A mathematical expression for 50 Hz sinusoidal voltage of peak value 80V will be

(a) $v = 50\sin 314t$

(b) $v = 50\sin 80t$

(c) $v = 80\sin 314t$

(d) $v = 80\sin 50t$

Sol. (c)

Mathematical expression of a sinusoidal voltage is,

$$V = V_m \sin\omega t = V_m \sin 2\pi ft$$

Where, V is instantaneous voltage

V_m is peak voltage

ω is angular frequency in rad/s.

f is frequency in Hz.

Given, f = 50 Hz

V_m = 80 V

So, V = 80 sin (2π×50)t

V = 80 sin 314 t.

134. Consider the following statements :

1. Flaming's rule is used where induced e.m.f. is due to flux cutting.
2. Leng'z law is used when the induced e.m.f. is due to change in flux linkages.
3. Lenz's law is direct consequence of the law of conservation of energy.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Sol. (d)

Induce e.m.f. by Fleming's right hand rule.
Lenz's law is a manifestation of conservation of energy.
Also Lenz's law is based on Faraday's law of induction.

135. a conductor of length 1 m moves at right angles to a uniform magnetic field of flux density 2 Wb/m^2 with a velocity of 50 m/s. What is the value of the induced e.m.f. when the conductor moves at an angle of 30° to the direction of the field ?

(a) 75 V (b) 50 V

(c) 25 V (d) 12.5 V

Sol. (b)

Given,

Magnetic flux density, B = 2Wb/m^2

Velocity of the conductor, v = 50m/s

Angle between direction of conductor movement and magnetic field, $\theta = 30°$

Length of the conductor, l = 1m

∴ Induced e.m.f. = $Bl v\sin\theta$

= 2×1×50×sin(30°)

= 50V

136. The total flux at the end of a long bar magnet is $50\mu Wb$. The end of the bar magnet is withdrawn through a 1000-turn coil in 1/10 second. The e.m.f. generated across the terminals of the coil is

(a) 5 V
(b) 10 V
(c) 25 V
(d) 50 V

Sol. (a)

Emf $E = N\dfrac{d\phi}{dt}$

Where

N = Number of turns

$d\phi$ = change in flux

dt = change in time

$$E = 100 \times \frac{500 \times 10^{-6}}{1/10}$$

$$= 5\text{ V}$$

137. The slip of a 400 V, 3-phase, 4-pole, 50 Hz machine running at 1440 r.p.m. is

(a) 6% (b) 5%
(c) 4% (d) 3%

Sol. (c)

Synchronous speed, $N_S = \dfrac{120 \times f}{P}$

where f = frequency

P = Number of poles

Synchronous speed,

$$N_s = \frac{120 \times 50}{4} = 1500\text{r.p.m.}$$

$$\text{Slip; } s = \frac{N_s - N}{N_s} = \frac{1500 - 1440}{1500}$$

$$= 0.04 \text{ or } 4\%$$

138. A 500 HP, 440 V, 3-phase, 50 Hz induction motor runs at 950 r.p.m. when on full load with a synchronous speed of 1000 r.p.m. for this condition, the frequency of the rotor current will be

(a) 4.0 Hz (b) 3.5 Hz
(c) 2.5 Hz (d) 2.0 Hz

Sol. (c)

$$\text{Slip, } s = \frac{N_S - N}{N_S} = \frac{1000 - 950}{1000} = 0.05$$

Frequency of rotor, f_r = sf

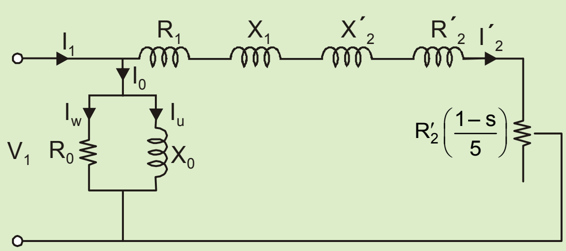
= 0.05 × 50 = 2.5 Hz

139. By adding resistance in the rotor circuit of a slip ring induction motor, the starting current

(a) as well as torque reduce
(b) as well as torque increase
(c) reduces but the starting torque increases
(d) increase but the starting torque decreases

Sol. (c)

Equivalent circuit of induction motor



From above diagram

$$I_1 = I_0 + I_2'$$

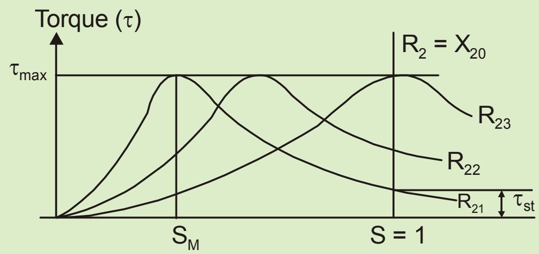
and $$I'_2 = \frac{V_1}{\sqrt{\left(R_1 + \frac{R'_2}{s}\right)^2 + (X_1 + X'_2)^2}}$$

So, if rotor resistance (R_2) increases starting current decreases.

Developed torque

$$\tau_d = \frac{V_1^2\left(\frac{R'_2}{5}\right)}{W_S\left[R_1 + \frac{R'_2}{s}\right] + (X_1 + X'_2)^2}$$

So with variation of rotor resistance the torque-slip curve changes as shown below.



Here $R_{23} > R_{22} > R_{21}$

At starting slip, S = 1

It is clear from figure that as resistance of rotor increases starting torque "increases."

140. Consider the following statements with regards to an induction motor :

1. Maximum torque is independent of rotor resistance.
2. Starting torque is maximum when rotor resistance equals rotor reactance.
3. Torque is very sensitive to any changes in supply voltage.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Sol. (d)

Position or slip at which maximum torque occurs is dependent on rotor resistance. Not the maximum torque.

Starting torque is maximum when $R_2 = X_{20}$

Also Torque $\propto$ (Supply Voltage)^2

141. A transformer has 2% resistance and 5% reactance. What is its voltage regulation at full load with 0.8 p.f. lagging?

(a) 5.3% (b) 4.6%

(c) 0.53% (d) 0.43%

Sol. (b)

Given,

R_{pu} = 2%

X_{pu} = 5%

Voltage regulation of transformer,

V.R. = $R_{pu}\cos\phi + X_{pu}\sin\phi$; for lagging load

= $R_{pu}\cos\phi - X_{pu}\sin\phi$; for leading load

So,

V.R. = [(0.02×0.8) + (0.05×0.6)]

= 0.016 + 0.030

= 0.046 i.e. 4.6%

142. A voltage is generated across a piezoelectric material, 0.5 cm thick, subjected to an impact of 5 N/m^2. The voltage coefficient of the material is 23 kV-m/N. The magnitude of the voltage generated will be

(a) 2300 V (b) 1650 V

(c) 1150 V (d) 575 V

Sol. (d)

Voltage generated across a piezo-electric material,

V = gtP

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Received so far..... [If found any discrepancy please bring it to our notice.]

Where, g = voltage coefficient of material

t = thickness of material

P = Applied pressure

So,

$$V = 23 \times 10^3 \times 0.5 \times 10^{-2} \times 5$$
$$= 57.5 \times 10$$
$$= 575 \text{ volt.}$$

143. The 'residual resistivity' of a metal is

(a) due to lattice vibrations at high temperature
(b) due to photon scattering at high temperature
(c) temperature-dependent
(d) temperature-independent

Sol. (d)

Residual resistivity is temperature independent and it is caused by impurities and structural imperfections.

144. Electrical conductivity, thermal conductivity and magnetic properties of ceramic material are

(a) very high all the time
(b) very low all the time
(c) dependent on the material
(d) ascertainable, instance to instance

Sol. (c)

Electrical conductivity, thermal conductivity and magnetic properties of ceramic materials are dependent on the material, composition, grainsize, manufacturing process etc.

145. Laminated insulation, coated with varnish, is a staple adoption in transformer assemblage in order to

(a) reduce the reluctance of the magnetic path
(b) minimize losses due to eddy currents
(c) increase the reluctance of the magnetic path
(d) increase the defect of eddy current.

Sol. (b)

According to faraday's Law of induction, when conductor is placed in changing magnetic field, loops of electrical current induced in the conductor, called eddy currents. The magnitude of the current in a given loop is proportional to the strength of the magnetic field, the area of the loop, and the rate of change of flux and inversely proportional to the resistivity of the material.

Eddy current loss,

$$P_e = K_e f^2 B m^2 t^2$$

Hence, to reduce the eddy current loss, the thickness of core is reduced by lamination and coated with varnish to insulate from each other.

146. When a ferromagnetic substance is magnetized, there are marginal diminiutions in its linear dimensions. This phenomenon is called

(a) hysteresis
(b) magnetostriction
(c) diamagnetism
(d) dipolar relaxation

Sol. (b)

Magnetostriction is a property of ferromagnetic materials that causes them to change their shape or dimensions.

147. When the working temperature becomes more than the Curie temperature, a ferromagnetic material becomes a

(a) diamagnetic material
(b) paramagnetic material
(c) ferromagnetic material
(d) Mu-material

Sol. (b)

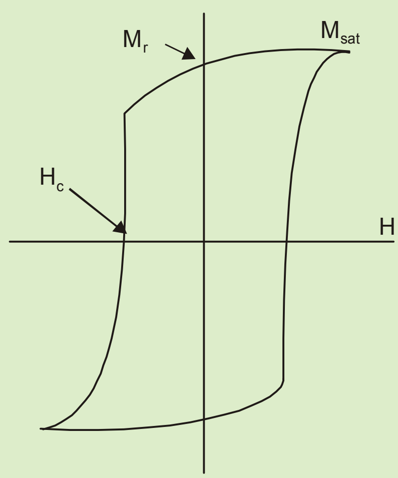
Above curie temperature ferromagnetic material becomes paramagnetic in nature.

148. Compared to other materials, a material with wider hysteresis loop has

(a) lower permeability, higher retentivity and higher coercivity
(b) higher permeability, lower retentivity and higher coercivity
(c) lower permeability, higher retentivity and lower reluctance
(d) lower permeability, lower retentivity and lower residual magnetism

Sol. **(a)**

Hard ferromagnetic materials have wider hysteresis loop. Thus these materials have higher retentivity and higher coercivity and lower permeability.



M_{sat} = Saturation magnetization
M_r = Remanence magnetization
H_c = Coercive field.

149. Which of the following materials is used in light-emitting diodes ?

(a) Gallium arsenide sulphate
(b) Gallium arsenide phosphide
(c) Gallium chromate phosphide
(d) Gallium phosphide sulphate

Sol. **(b)**

Gallium arsenide phosphide is used for manufacturing red, orange and yelloow light emitting diodes.

150. Consider the following methods in nano-particle synthesis :

1. Bottom-up
2. Top-down
3. Side-by-side

Which of these methods is/are slow and does/do not conduce to large-scale production ?

(a) 1 only (b) 2 only
(c) 3 only (d) 1, 2 and 3

Sol. **(b)**

Top - down methods are slow and not suitable for large scale production.