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ACE ENGINEERING ACADEMY
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ESE - 2016

E&T PAPER - 1 (OBJECTIVE)

QUESTIONS WITH DETAILED SOLUTIONS

SET - A

NAME OF THE SUBJECT	NO. OF QUESTIONS	NAME OF THE SUBJECT	NO. OF QUESTIONS
NETWORK THEORY	18	ELECTROMAGNETIC THEORY	23
SIGNALS & SYSTEMS	23	PHYSICAL ELECTRONICS, ELECTRON DEVICES AND ICs	18
ELECTRONIC MEASUREMENTS & INST.	23	MATERIAL AND COMPONENTS	15

ALL QUERIES RELATED TO ESE - 2016 KEY ARE TO BE SENT TO THE FOLLOWING EMAIL ADDRESS

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01. Which one of the following helps experimental confirmation of the Crystalline state of matter?

(a) Shock compression
(b) Photo emission
(c) Conductivity measurements
(d) X-ray diffraction

01. Ans: (d)

Sol: The crystalline state or the crystal structure of any materials is determined only by x-ray diffraction method.

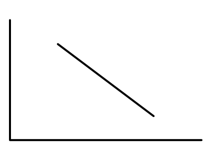
02. The electrical conductivity of pure semiconductor is :

(a) Proportional to temperature
(b) Increases exponentially with temperature
(c)Decreases exponentially with temperature
(d) Not altered with temperature

02. Ans: (b)

Sol: The dependence of the electrical conductivity σ of a pure semiconductor on temperature is given by

$\sigma = Ce^{-E_g/2kT}$



Or

Taking log on both sides,

In σ = –(E_g/2k) (1/T) + constant (*ln* (C)).

Hence a plot of in σ Vs (1/T) must be a straight line.

Hence the dependence of conductivity of an intrinsic semi conductor with temperature is exponential.

03. Consider the following statements pertaining to the resistance of a conductor:

1. Resistance can be simply defined as the ratio of voltage across the conductor to the current through the conductor. This is, in fact, Georg Ohm's law
2. Resistance is a function of voltage and current
3. Resistance is a function of conductor geometry and its conductivity

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

03. Ans: (c)

Sol: When the ends of a conductor are subjected to a potential difference, a current flows through the conductor. The current through the conductor increases linearly on increasing the voltage.

A plot of the voltage against current is a straight line. Thus the current I is directly proportional to the voltage V.

$I \propto V$ or $I = (V/R)$

V = IR. R is called the resistance.

Hence R occurs as a constant of proportionality. It does not depend upon I or V. It depends only upon the dimensions of the conductor and the material of the conductor as R = ($\rho l/A$). Where ρ is called the resistivity of the material of the conductor, l-length of the conductor. A area of cross section of the conductor.

04. The ratio of ionic radii of Cations i.e, r_c and that of Anions i.e. r_A for stable and unstable ceramic crystal structure, is :

(a) Less than unity

(b) Greater than unity

(c) Unity

(d) Either lesser or greater than unity

04. Ans: (a)

Sol: Ceramic crystals are mostly ionic. The ionic bond is formed by the transfer of the electron. The one which loses an electron and becomes positively charged is called the cation. Due to the excess number of protons the attractive force on electrons is more and hence the radius of cation is smaller than the neutral atom. Similarly the one which gains that electron becomes negatively charged and is called the anion. Hence the ratio of the cation radius to that of anion radius is less than unity.

05. Which one of the following statements is correct?

(a) For insulators the band-gap is narrow as compared to semiconductors

(b) For insulators the band-gap is relatively wide whereas for semiconductors it is narrow

(c) The band-gap is narrow in width for both the insulators and conductors

(d) The band-gap is equally wide for both conductors and semiconductors

05. Ans: (b)

Sol: According to the band theory of solids, in the case of conductors the valence band and conduction band overlap in a semiconductor there is a small gap between the valence band and conduction band. In the case of insulators, there is large gap between the two bands.

06. In an extrinsic semiconductor the conductivity significantly depends upon:

(a) Majority charge carriers generated due to impurity doping

(b) Minority charge carriers generated due to thermal agitation

(c) Majority charge carriers generated due to thermal agitation

(d) Minority charge carriers generated due to impurity doping

06. Ans: (a)

Sol: In an extrinsic semiconductor, majority carrier concentration is very large, almost 10^{10} times the minority carrier concentration due to doping. Hence the conductivity is due to the majority carriers only. Charge carriers generated due to thermal agitation is very negligible in comparison to doping.

07. Necessary condition for photo-electric emission is:

(a) $h\nu \geq e\phi$
(b) $h\nu \geq mc$
(c) $h\nu \geq e\phi^2$
(d) $h\nu \geq \frac{1}{2}mc$

07. Ans: (a)

Sol: According to Einstein's photo electric equation, $h\nu = e\phi$ + kinetic energy of electron emitted.

ϕ is called the stopping potential and $e\phi$ is the work function of the conductor. Hence for photo electric emission, $h\nu$ must be greater than or equal to $e\phi$.

08. In some substances when an electric field is applied the substance becomes polarized. The electrons and nucleii assume new geometrical positions and the mechanical dimensions are altered. This phenomenon is called:

(a) Electrostriction
(b) Hall-Effect
(c) Polarization
(d) Magnetization

08. Ans: (a)

Sol: The mechanical deformation produced as a result of electric field in a material is called Electrostriction. It is to be distinguished from piezoelectric effect. In electrostriction, the strain $\varepsilon \propto E^2$. In piezoelectric effect, the strain $\varepsilon \propto E$. Hence reversing the electric field changes compression to elongation in piezoelectric whereas it is not so in electrostriction.

09. In ferromagnetic materials, the net magnetic moment created due to magnetization by an applied field is :

(a) Normal to the applied field
(b) Adds to the applied field
(c) In line with magneto motive force
(d) Substracts from the applied field

09. Ans: (b)

Sol: A ferromagnet contains a large number of domains, with each domain having a large magnetic moment. On the application of magnetic field the domain start aligning in the direction of magnetic field and hence the field due to the magnetization adds to the applied field. This is the reason for the very large susceptibility of ferromagnets.

10. At what temperatures domains lose their ferromagnetic properties?
(a) Above ferromagnetic Curie temperature
(b) Below paramagnetic Curie temperature
(c) Above 4° K
(d) At room temperature

10. Ans: (a)

Sol: On increasing the temperature the domains get into random orientation and magnetization decreases. At a particular temperature called the Curie temperature, the ferromagnet transforms to a paramagnet.

11. Which of the following materials does not have paramagnetic properties?
1. Rare earth elements (with incomplete shell)
2. Transition elements
3. Magnesium oxide
Select the correct answer from the codes given below:
(a) 1 only (b) 2 only
(c) 3 only (d) 1 and 2

11. Ans: (c)

Sol: Paramagnetism is due to the presence of one or two unpaired electrons in the outer most orbital. This can occur in the case of rare earth elements with incomplete shell and in transition elements. Hence Magnesium Oxide cannot be paramagnetic.

12. In a superconducting magnet, wires of superconducting material are embedded in the thick copper matrix, because while the material is in the superconducting state:
(a) The leakage current passes through copper part
(b) Copper part helps in conducting heat away from the superconductor
(c) Copper part helps in overcoming the mechanical stress
(d) Copper acts as an insulating cover for superconductor

12. Ans: (c)

Sol: A typical cable for superconducting magnetic coil consists of a large number of strands of 20μm size incorporated in a copper matrix. This design ensures that the mechanical stability of the coil. Further it can provide current carrying facility in the event of the magnet transform from superconducting to normal state suddenly.

13. The crystal structure of some Ceramic materials may be thought of being composed of electrically charged Cations and Anions, instead of Atoms, and as such:
(a) The Cations are negatively charged, because they have given up their valence electrons to Anions which are positively charged.

(b) The Cations are positively charged, because they have given up their valence electrons to Anions which are negatively charged.

(c) The Cations are positively charged, because they have added one electron to their valence electrons borrowing from Anions which are negatively charged.

(d) The Cations are negatively charged, as they are non-metallic whereas Anions are positively charged being metallic.

13. Ans: (b)

Sol: An atom is always neutral. As explained in the question number 4, a cation is formed by the loss of the electron by one atom and hence positively charged and the anion is formed by accepting that electron and hence negatively charged.

14. Manganin alloy used for making resistors for laboratory instruments contains:

(a) Copper, Aluminimum and Manganese
(b) Copper, Nickel and Manganese
(c) Aluminium, Nickel and Manganese
(d) Chromium, Nickel and Manganese

14. Ans: (b)

Sol: Manganin is an alloy of 86% Cu, 2% Ni, 12% Mn.

15. A rolled-paper capacitor of value 0.02 μF is to be constructed using two strips of aluminium of width 6 cm, and, wax impregnated paper of thickness 0.06 mm whose relative permittivity is 3. The length of foil strips should be:

(a) 0.3765 m (b) 0.4765 m
(c) 0.5765 m (d) 0.7765 m

15. Ans: (a)

Sol: $C = 0.02\ \mu F$

$w = 6$ cm

$d = 0.06$ mm

$\varepsilon_r = 3$

For rolled - paper capacitor

$$C = \frac{2\varepsilon A}{d},\ A = \frac{Cd}{2\varepsilon}$$

$$L \times w = \frac{0.02\times10^{-6}\times0.06\times10^{-3}}{2\times3\times8.854\times10^{-12}}$$

$$L = \frac{0.02\times10^{-6}\times0.06\times10^{-3}}{2\times3\times8.854\times10^{-12}\times6\times10^{-2}}$$

$L = 0.3764$ m

16. A Ge sample at room temperature has intrinsic carrier concentration, $n_i = 1.5\times10^{13}$ cm^{-3} and is uniformly doped with acceptor of 3×10^{16} cm^{-3} and donor of 2.5×10^{15} cm^{-3}. Then, the minority charge carrier concentration is:

(a) 0.918×10^{10} cm^{-3} (b) 0.818×10^{10} cm^{-3}
(c) 0.918×10^{12} cm^{-3} (d) 0.818×10^{12} cm^{-3}

16. Ans: (b)

Sol: Intrinsic carrier concentration ,

$n_i = 1.5\times10^{13}/cm^3$

Acceptor concentration $N_A = 3\times10^{16}/cm^3$

Donor concentration $N_D = 2.5\times10^{15}/cm^3$

$N_A - N_D = 3\times10^{16} - 2.5\times10^{15}$

$= 2.75\times10^{16}$

Hence it is a p-type semiconductor

$$p = \frac{N_A - N_D}{2} + \sqrt{\left(\frac{N_A - N_D}{2}\right)^2 + n_i^2}$$

$p = 2.75\times10^{16}/cm^3$

According to Mass Action Law,

$np = n_i^2$

$$n = \frac{n_i^2}{p}$$

$$n = \frac{(1.5\times10^{13})^2}{2.75\times10^{16}}$$

$n = 0.818\times10^{10}/cm^3$

17. Assume that the values of mobility of holes and that of electrons in an intrinsic semiconductor are equal and the values of conductivity and intrinsic electron density are $2.32/\Omega m$ and $2.5\times10^{19}/m^3$ respectively. Then, the mobility of electron/hole is approximately:

(a) $0.3\ m^2/Vs$ (b) $0.5\ m^2/Vs$
(c) $0.7 m^2/Vs$ (d) $0.9\ m^2/Vs$

17. Ans: (a)

Sol: $\mu_n = \mu_p$

Intrinsic semiconductor conductivity

$\sigma_i = 2.32(\Omega - m)^{-1}$

Intrinsic electron concentration

$n_i = 2.5\times10^{19}/cm^3$

$\sigma_i = n_i q(\mu_n+\mu_p)$

$= n_i q(2\mu_n)$

$2.32 = 2.5\times10^{19}\times1.6\times10^{-19}\times2\times\mu_n$

$$\mu_n = \frac{2.32}{2.5\times10^{19}\times1.6\times10^{-19}\times2}$$

$\mu_n = 0.29\ m^2/V\text{-sec}$

$\therefore\ \mu_n$ or $\mu_p = 0.29\ m^2/V\text{-sec}$

18. A silicon sample A is doped with 10^{18} atom/cm^3 of Boron and another silicon sample B of identical dimensions is doped with 10^{18} atom/cm^3 of Phosphorous. If the ratio of electron to hole mobility is 3, then the ratio of conductivity of the sample A to that B is:

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

18. Ans: (c)

Sol: Sample A Sample B

$N_A=10^{18}$ atoms/cm^3 $N_D= 10^{18}$ atoms/cm^3

$$\frac{\mu_n}{\mu_p} = 3$$

$$\frac{\sigma_A}{\sigma_B} = \frac{N_A q\mu_p}{N_D q\mu_n}$$

$$= \frac{\mu_p}{\mu_n} = \frac{1}{3}$$

$$\frac{\sigma_A}{\sigma_B} = \frac{1}{3}$$

19. The Hall-coefficient of a specimen of doped semiconductor is $3.06\times10^{-4}\ m^3C^{-1}$ and the resistivity of the specimen is $6.93\times10^{-3}\ \Omega m$. The majority carrier mobility will be:

(a) $0.014\ m^2V^{-1}s^{-1}$
(b) $0.024\ m^2V^{-1}s^{-1}$
(c) $0.034\ m^2V^{-1}s^{-1}$
(d) $0.044\ m^2V^{-1}s^{-1}$

19. Ans: (d)

Sol: Hall-coefficient $R_H = 3.06\times10^{-4} m^3c^{-1}$

Resistivity $\rho = \frac{1}{\sigma} = 6.93\times10^{-3}\Omega\text{–m}$

$\mu = \sigma R_H$

$$\mu = \frac{3.06\times10^{-4}}{6.93\times10^{-3}}$$

$\mu = 0.04415\ m^2/V\text{-sec}$

20. Doped silicon has Hall-coefficient of 3.68×10^{-4} m^3C^{-1} and then its carrier concentration value is :

(a) 2.0×10^{22} m^{-3}

(b) 2.0×10^{-22} m^{-3}

(c) 0.2×10^{22} m^{-3}

(d) $0.2 \times 10^{-22} m^{-3}$

20. Ans: (a)

Sol: Hall-coefficient $R_H = 3.68\times10^{-4}$ m^3C^{-1}

$$R_H = \frac{1}{nq} \text{ or } \frac{1}{pq}$$

$$\text{Carrier concentration (n or p)} = \frac{1}{R_H q}$$

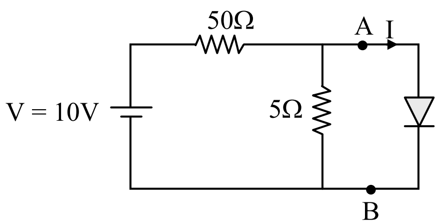
$$= \frac{1}{3.68\times10^{-4}\times1.6\times10^{-19}}$$

$$= 1.698\times10^{22}$$

$$= 1.7\times10^{22}$$

Carrier concentration (n or p) $\simeq$ $2\times10^{22}/cm^3$

21. What is the value of current I through the ideal diode in the circuit ?

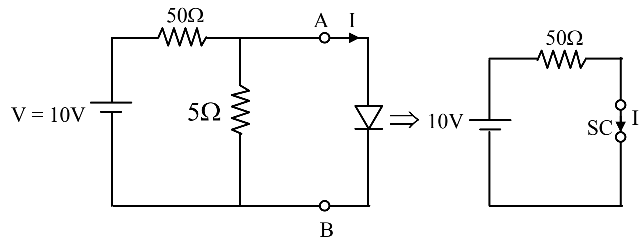


(a) 100 mA (b) 150 mA

(c) 200 mA (d) 250 mA

21. Ans: (c)

Sol:



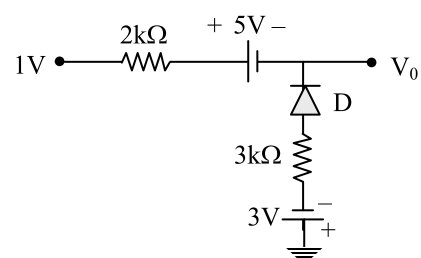
Diode current I

When diode (FB) $\rightarrow$ Short circuit

$$I = \frac{V}{50} = \frac{10}{50} = 0.2\text{Amps}$$

$$I = 200\times10^{-3} = 200\text{mA}$$

22. What is the output voltage V_0 for the circuit shown below assuming an ideal diode?

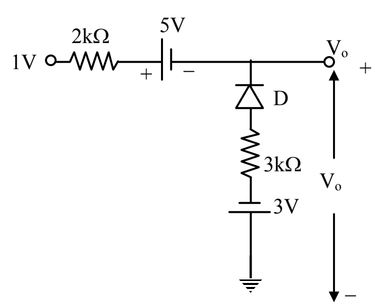


(a) $-\frac{18}{5}V$ (b) $\frac{18}{5}V$

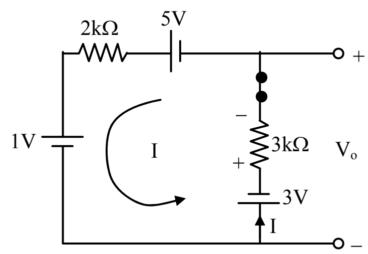
(c) $-\frac{13}{5}V$ (d) $\frac{13}{5}V$

22. Ans: (a)

Sol: The output voltage V_o



Diode is Ideal then according to current direction it acts as short circuit



$V_0 = -I\,(3k) - 3$………(1)

By KVL, $I = \dfrac{5-3-1}{2k+3k} \Rightarrow I = \dfrac{1}{5k}$

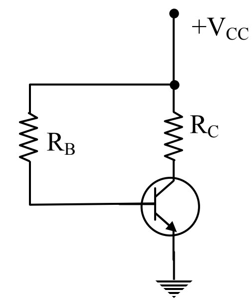
$V_o = -\dfrac{3k}{5k} - 3 = -\dfrac{18}{5}$ volts

23. In a semiconductor diode, cut-in voltage is the voltage:
(a) upto which the current is zero
(b) upto which the current is very small
(c) at which the current is 10% of the maximum rated current
(d) at which depletion layer is formed

23. Ans: (b)

Sol: Cut-in, offset or turn-on voltage V_γ is the voltage, below which the current is small (less than 1 percent of rated current).

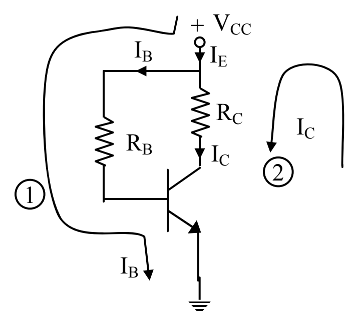
24. A transistor circuit is shown in the figure. Assume $\beta = 100$, $R_B = 200\ k\Omega$, $R_C = 1k\Omega$, $V_{CC} = 15\ V$, $V_{BE_{act}} = 0.7\ V$, $V_{BE_{sat}} = 0.8\ V$, $V_{CE_{sat}} = 0.2\ V$, $V_{CE_{act}} = 0.2V$.



The transistor is operating in:
(a) Saturation
(b) Cut-off
(c) Normal active
(d) Reverse active

24. Ans: (c)

Sol:



$V_{CC} = 15V$
$V_{BE(act)} = 0.7V$
$R_B = 200k\Omega$
$R_C = 1k\Omega$

Apply KVL to loop-(1)

$15 - 200\times10^3 I_B - 0.7 = 0$

$I_B = \dfrac{14.3}{200\times10^3}$

$I_B = 71.5\times10^{-6}A \Rightarrow I_B = 71.5\mu A$

$I_C = \beta\ I_B$

$I_C = 100\times71.5\times10^{-6} \Rightarrow I_C = 7.15mA$

Apply KVL to loop- (2)

$15 - I_CR_C - V_{CE} = 0$

$V_{CE} = 15 - I_CR_C$

$= 15 - 7.15\times10^{-3}\times1\times10^{3}$

$V_{CE} = 7.85V$

Since $V_{CE(active)} > V_{CE(sat)}$

The transistor is in normal active mode only.

25. The position of the intrinsic Fermi level of an undoped semiconductor (E_{Fi}) is given by :

(a) $\frac{E_C - E_V}{2} + \frac{kT}{2}\ln\frac{N_V}{N_C}$

(b) $\frac{E_C + E_V}{2} - \frac{kT}{2}\ln\frac{N_V}{N_C}$

(c) $\frac{E_C + E_V}{2} + \frac{kT}{2}\ln\frac{N_V}{N_C}$

(d) $\frac{E_C - E_V}{2} - \frac{kT}{2}\ln\frac{N_V}{N_C}$

25. Ans: (c)

Sol: The position of the intrinsic Fermi level of an undoped semiconductor is given by

$$E_{Fi} = \frac{E_C + E_V}{2} - \frac{KT}{2}\ln\frac{N_C}{N_V}$$

$$= \frac{E_C + E_V}{2} - \frac{KT}{2}\ln\frac{1}{\frac{N_V}{N_C}}$$

$$= \frac{E_C + E_V}{2} - \frac{KT}{2}\ln\left(\frac{N_V}{N_C}\right)^{-1}$$

$$E_{Fi} = \frac{E_C + E_V}{2} + \frac{KT}{2}\ln\frac{N_V}{N_C}$$

26. The stability factor S in a bipolar junction transistor is:

(a) $\frac{1+\beta}{1-\beta\left(\frac{dI_B}{dI_C}\right)}$

(b) $\left(\frac{1+\beta}{1-\beta}\right)\left[1-\frac{dI_B}{dI_C}\right]$

(c) $(1+\beta)\left[1-\beta\left(\frac{dI_B}{dI_C}\right)\right]$

(d) $\frac{\beta-1}{\left[1-\beta\left(\frac{dI_B}{dI_C}\right)\right]}$

26. Ans: (a)

Sol: $S = \frac{\partial I_C}{\partial I_{CO}}$ with β and V_{BE} constant

Consider the collector current equation of a BJT in CE configuration:

$I_C = \beta I_B + (1+\beta)\, I_{CO}$ ……(1)

Differentiating equation (1) with respect to I_C

$$1 = \beta\frac{\partial I_B}{\partial I_C} + (1+\beta)\frac{\partial I_{CO}}{\partial I_C}$$

$$\frac{\partial I_{CO}}{\partial I_C} = \frac{1-\beta\left(\frac{\partial I_B}{\partial I_C}\right)}{1+\beta} \Rightarrow \frac{\partial I_C}{\partial I_{CO}} = \frac{1+\beta}{1-\beta\left(\frac{\partial I_B}{\partial I_C}\right)}$$

$$\therefore S = \frac{\partial I_C}{\partial I_{CO}} = \frac{1+\beta}{1-\beta\left(\frac{\partial I_B}{\partial I_C}\right)}$$

27. The leakage current in an NPN transistor is due to the flow of:
(a) Holes from base to emitter
(b) Electrons from collector to base
(c) Holes from collector to base
(d) Minority carriers from emitter to collector

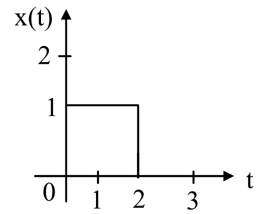
27. Ans: (c)

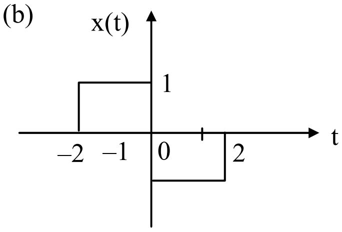
28. In Early effect:
(a) Increase in magnitude of Collector voltage increases space charge width at the input junction of a BJT
(b) Increase in magnitude of Emitter-Base voltage increases space charge width of output junction of a BJT
(c) Increase in magnitude of Collector voltage increases space charge width of output junction of a BJT
(d) Decrease in magnitude of Emitter-Base voltage increases space charge width of output junction of a BJT

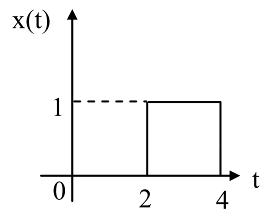
28. Ans: (c)

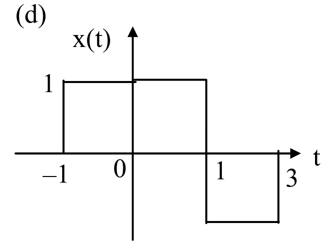
Sol: Output junction is C-B junction which is always Reverse Bias and by increasing the magnitude of Reverse Bias voltage depletion layer width at Collector – Base junction increases.

29. The signal $x(t) = u(t+2) - 2u(t) + u(t-2)$ is represented by :

(a)


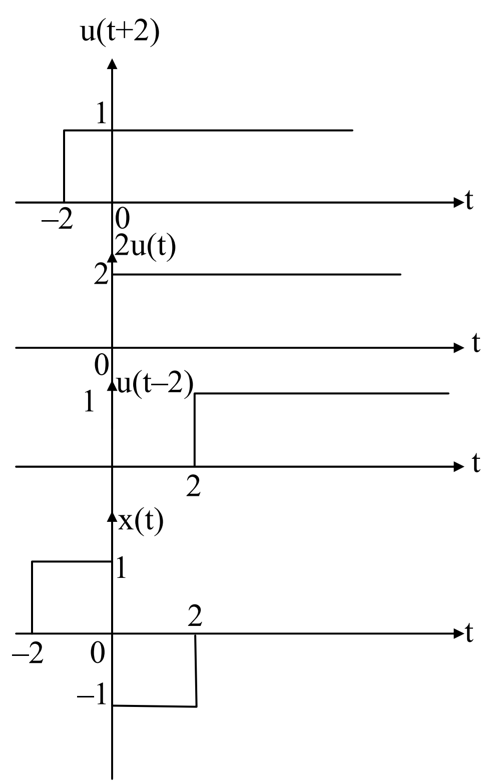
(b)


(c)


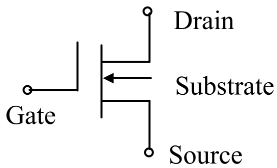
(d)


29. Ans: (b)

Sol: $x(t) = u(t + 2) - 2\,u(t) + u(t - 2)$



30. The figure shown represent:



(a) n-channel MOSFET

(b) Enhanced-mode E-MOSFET

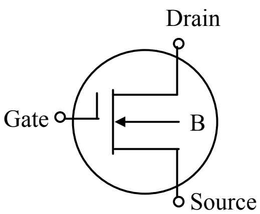
(c) p-Channel MOSFET

(d) J-FET

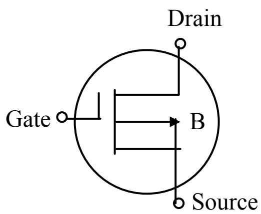
30. Ans: (a)

Sol:

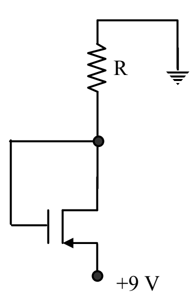
n-Channel MOSFET:



p-Channel MOSFET:



31. The PMOSFET circuit shown in the figure has $V_{TP} = -1.4V$, $K'_p = 25\mu A/V^2$, $L = 2\mu m$, $\lambda = 0$. If $I_{DS} = -0.1mA$ and $V_{DS} = -2.4V$ then the width of channel W and R are respectively:



(a) 16μm and 66 kΩ

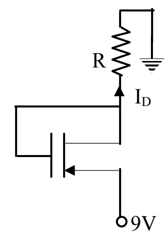
(b) 18 μm and 33 kΩ

(c) 16μm and 33 kΩ

(d) 18μm and 66 kΩ

31. Ans: (a)

Sol:



Since Gate and Drain are short, MOSFET is in saturation region.

$$I_D = \frac{1}{2}k'_n\frac{W}{L}(V_{GS} - V_T)^2$$

and $V_{GS} = V_{DS} = -2.4V$

$$0.1\times10^{-3} = \frac{1}{2}\times25\times10^{-6}\times\frac{W}{2\times10^{-6}}(-2.4-(-1.4))^2$$

$$W = \frac{0.4\times10^{-3}}{25} = 16\mu m$$

Apply KVL to the circuit

$9 + V_{GS} - I_DR = 0$

$9 + (-2.4) - 0.1\times10^{-3}\times R = 0$

$$R = \frac{9-2.4}{0.1\times10^{-3}}$$

$$R = \frac{6.6}{0.1\times10^{-3}}$$

$R = 66k\Omega$

32. Maximum energy of electrons liberated photoelectrically is:

(a) Proportional to light intensity and independent of frequency of the light

(b) Independent of light intensity and varies linearly with frequency of the light

(c) Proportional to both, light intensity and frequency of the light

(d) Independent of light intensity and inversely proportional to frequency of the light

32. Ans: (b)

Sol: The Einstein's photo electric equation, the kinetic energy of the emitted photo electron depends directly upon the frequency of the incident light and is independent of the intensity.

33. The response of a Gaussian random process applied to a stable linear system is:
  1. A Gaussian random process
  2. Not a Gaussian random process
  3. Completely specified by its mean and auto-covariance functions

Which of the above statements is/are correct ?

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

33. Ans: (d)

Sol: $m_y = m_x H(0)$

34. Consider a system, which computes the 'MEDIAN' of signal values in a window of size 'N'. Such a discrete time system is:

(a) Linear
(b) Non-linear
(c) Sometimes linear
(d) Sometimes non-linear

34. Ans: (b)

Sol: Median is a non linear operator

35. Consider a discrete time system which satisfies the additivity property, i.e., if the output for $u_1[n]$ is $y_1[n]$ and that for $u_2[n]$is $y_2[n]$, then output for $u_1[n]+ u_2[n]$ is $y_1[n] + y_2[n]$. Such a system is:

(a) Linear
(b) Sometimes linear
(c) Non-linear
(d) Sometimes non-linear

35. Ans: (b & d)

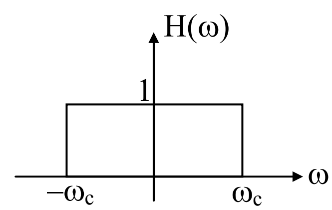
Sol: The system some times may satisfy (or) may not satisfy the scaling operation. So system is may be linear (or) may be Non-linear.

36. Consider an ideal low pass filter. Such a discrete-time system is:

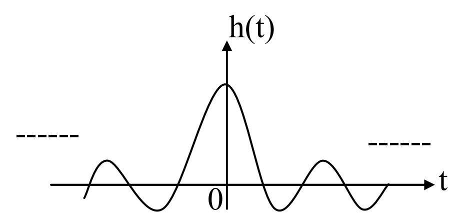
(a) always realizable physically
(b) never realizable physically
(c) a non linear system
(d) a linear, causal system

36. Ans: (b)

Sol: The frequency response of Ideal low pass filter is



The impulse response of Ideal low pass filter is



$h(t) \neq 0, t < 0$

So non causal system, never realizable physically.

37. The result of $h(2t)*\delta(t-t_0)$ ("*" denotes convolution and "$\delta(.)$" denotes the Dirac delta function) is:

(a) $h(2t-2t_0)$

(b) $h(2t_0-2t)$

(c) $h(-2t-2t_0)$

(d) $h(2t+2t_0)$

37. Ans: (a)

Sol: $x(t) * \delta(t - t_0) = x(t - t_0)$

$h(2t) * \delta(t - t_0) = h\,(2(t-t_0)) = h(2t - 2t_0)$

38. A ray of light incident on a glass slab (of refractive index 1.5) with an angle $\frac{\pi}{4}$, then the value of sine of angle of refraction is:

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

38. Ans: (c)

Sol: $n = \sqrt{\varepsilon_r} = 1.5$

$$\theta_i = \frac{\pi}{4}$$

From snell's law

$$\frac{\sin\theta_i}{\sin\theta_t} = \sqrt{\frac{\varepsilon_2}{\varepsilon_1}} = \sqrt{\frac{\varepsilon_{r_2}}{\varepsilon_{r_1}}} = \frac{n_2}{n_1}$$

$$\frac{\sin\pi/4}{\sin\theta_t} = \frac{1.5}{1}$$

$$\sin\theta_t = \frac{1}{1.5}\sin\pi/4$$

$$\sin\theta_t = \frac{\sqrt{2}}{3}$$

39. The complex exponential power form of Fourier series of x(t) is:

$$x(t) = \sum_{k=-\infty}^{\infty} a_k . e^{j\frac{2\pi}{T_0}.kt},$$

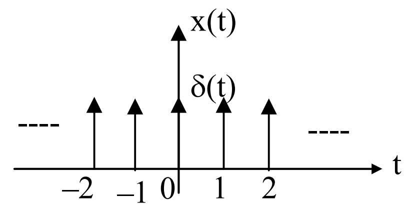
If $x(t) = \sum_{b=-\infty}^{\infty} \delta(t-b)$, then the value of a_k is :

(a) $1-(-1)^k$ (b) $1+(-1)^k$

(c) 1 (d) -1

39. Ans: (c)

Sol: $x(t) = \sum\limits_{b=-\infty}^{\infty} \delta(t-b)$

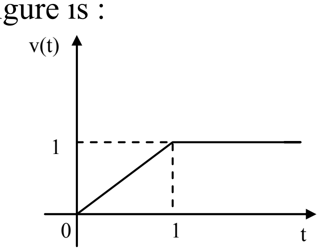


$$a_k = \frac{1}{T_0}\int_{t_a}^{t_a+T_0} x(t)e^{-j\frac{2\pi}{T_0}kt}$$

$$= \frac{1}{1}\int_0^1 \delta(t).e^{-j\frac{2\pi}{T_0}kt}$$

$a_k = 1$

40. Laplace transform of the function v(t) shown in the figure is :

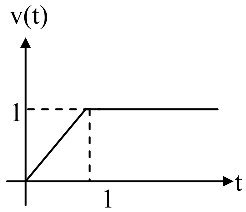


(a) $s^2[1-e^s]$ (b) $s^2[1-e^{-s}]$

(c) $\frac{1}{s^2}[1-e^s]$ (d) $\frac{1}{s^2}[1-e^{-s}]$

40. Ans: (d)

Sol:



$x(t) = r(t) - r(t-1)$

$r(t) \leftrightarrow \frac{1}{s^2}$

$r(t-1) \leftrightarrow \frac{e^{-s}}{s^2}$

$X(s) = \frac{1}{s^2}[1 - e^{-s}]$

41. In a discrete-time complex exponential sequence of frequency $\omega_0 = 1$, the sequence is :

1. Periodic with period $\frac{2\pi}{\omega_0}$

2. Non periodic

3. Periodic for some value of period N

Which of the above statements is/are correct?

(a) 1only

(b) 2 only

(c) 3only

(d) 1 and 3

41. Ans: (b)

Sol: $\omega_0 = 1$

A discrete time complex exponential is periodic if $\frac{\omega_0}{2\pi}$ is a rational number. But given $\omega_0 = 1$

$\frac{\omega_0}{2\pi} = \frac{1}{2\pi}$ is a irrational number, so non periodic

42. Consider the following transforms:

1. Fourier transform

2. Laplace transform

Which of the above transforms is/are used in signal processing ?

(a) 1only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

42. Ans: (c)

Sol: Both Fourier transform and Laplace transform is used. Fourier transform is used to find the spectrum, Laplace transform is used in the conversion of analog filter to digital filter.

43. The varactor diode has a voltage-dependent:

1. Resistance

2. Capacitance

3. Inductance

Which of the above is/are correct ?

(a) 1 only (b) 2 only

(c) 3 only (d) 1 and 3

43. Ans: (b)

Sol: A varactor diode is also called variable capacitance diode by varying the RB voltage, we can change the junction capacitance.

44. The impulse response for the discrete-time system:

$y[n] = 0.24\ (x[n]+x[n-1]+x[n-2]+x[n-3])$

is given by

(a) 0 for $0 \le n \le 3$ and 0.24 otherwise

(b) 0.24 for $0 \le n \le 3$ and 0 otherwise

(c) 0.24 for $n = 0$ to $n = \infty$

(d) 0 for $n = 0$ to $n = \infty$

44. Ans: (b)

Sol: $y(n) = 0.24\ (x[n]+x[n-1]+x[n-2]+x[n-3])$

$Y(z) = 0.24\ [X(z) + z^{-1}X(z) + z^{-2}X(z) + z^{-3}X(z)]$

$H(z) = 0.24\ [1 + z^{-1} + z^{-2} + z^{-3}]$

$h(n) = 0.24\ \delta(n) + 0.24\ \delta(n-1) + 0.24\ \delta(n-2) + 0.24\delta(n-3)$

$h(n) = [0.24, 0.24, 0.24, 0.24]$

$$h(n) = \begin{cases} 0.24 & 0 \le n \le 3 \\ 0 & \text{otherwise} \end{cases}$$

45. The product of emitter efficiency (γ) and Base transport factor (β^*) for a BJT is equal to:

(a) Small signal current gain

(b) High frequency current gain

(c) Power loss in the BJT

(d) Large-signal current gain

45. Ans: (d)

Sol: For a BJT,

$$\alpha = \beta^*\gamma \quad \left(\because \alpha = \frac{I_{PC}}{I_E}, \beta^* = \frac{I_{PC}}{I_{PE}}, \gamma = \frac{I_{PE}}{I_E}\right)$$

Where α is large signal current gain.

46. Consider a two-sided discrete-time signal (neither left sided, nor right sided). The region of convergence (ROC) of the Z-transform of the sequence is:

1. All region of z-plane outside a unit circle (in z-plane)
2. All region of z-plane inside a unit circle (in z-plane)
3. Ring in z-plane

Which of the above is/are correct ?

(a) 1only (b) 2 only

(c) 3 only (d) 1 and 3

46. Ans: (c)

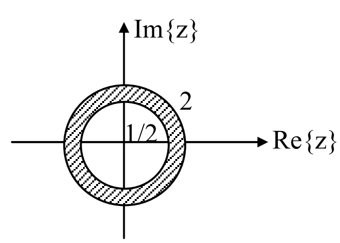
Sol: For example

$x(n) = (1/2)^n\ u(n) + (2)^n u(-n-1)$

$\text{ROC} = (|z|>1/2) \cap (|z| < 2)$

$$= \frac{1}{2} < |z| < 2,$$

It is a ring in z-plane



BSNL - JTO

Bharat Sanchar Nigam Limited (BSNL) may soon announce Junior Telecom Officer (JTO) Recruitment Notification to recruit more than 2500 Junior Telecom Officers.

Name of The Post : JTO - Telecom

Educational Qualification : Bachelor Degree in Engineering (Telecom/ Electronics / Radio/ Computer/ Electrical/ IT/ Instrumentation)

Selection Procedure : Written Examination

PAPER PATTERN

S.No.	Section	Subjects	No of Q's	Total marks
1.	Section - 1	Engineering - 1	50	100
2.	Section - 2	Engineering - 2	50	100
3.	Section - 3	General Ability	20	40

PAPER STRUCTURE

1.	Total marks	240
2.	Total Number Questions	120
3.	Time Allowed	3 Hours = 180 Minutes
4.	Medium of Examination	English
5.	Negative Marketing	Yes (25%)
6.	Type of Questions	Objective type

SYLLABUS

SECTION - 1 : Materials and Components, Physical Electronics, Electron Devices and ICs, Network theory, Electromagnetic Theory, Electronic Measurements and Instrumentation, Power Electronics

SECTION - 2 : Analog Electronic Circuits, Digital Electronic Circuits, Control Systems, Communication systems, Microwave Engineering, Computer Engineering, Microprocessors

SECTION - 3 : General ability test (General Knowledge, Current Affairs, General English)

(based on the previous exam papers)

47. When is a function f(n) said to be left sided ?

(a) $f(n) = 0$ for $n < 0$

(b) $f(n) < 0$ for $n > 0$

(c) $f(n) = 0$ for $n > n_0$

(d) $f(n) = \infty$ for $n < n_0$

($n_0 \rightarrow$ Positive or negative integer)

47. Ans: (c)

Sol: $f(n) = 0$, for $n > n_0$

48. Z-transform deals with discrete time systems for their:

1. Transient behavior

2. Steady-state behavior

Which of the above behaviours is/are correct?

(a) 1only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

48. Ans: (c)

Sol: Solving the difference equation with initial conditions using z-transform gives transient response and steady state response.

49. The response of a linear, time-invariant discrete-time system to a unit step input u[n] is δ[n]. The system response to a ramp input n u[n] would be:

(a) $\delta[n-1]$ (b) $u[n-1]$

(c) $n\,\delta[n-1]$ (d) $n\,u[n-1]$

49. Ans: (b)

Sol: $x(n) = u(n)$, $y(n) = \delta(n)$

We know that

$u(n)-u(n-1) = \delta(n)$

$y(n) = x(n) - x(n-1)$

Now $x(n) = nu(n)$

$y(n) = nu(n)-(n-1)\,u(n-1)$

$y(n) = n\,u(n) - n\,u(n-1) + u(n-1)$

$y(n) = n\,\delta(n) + u(n-1) = 0 + u(n-1)$

$y(n) = u(n-1)$

50. Consider a discrete-random variable z assuming finitely many values. The cumulative distribution function, $F_z(Z)$ has the following properties:

1. $\int_{-\infty}^{+\infty} F_z(z)dz = 1$

2. $F_z(z)$ is non-decreasing with finitely many jump-discontinuities

3. $F_z(z)$ is negative and non-decreasing

Which of the above properties is/are correct ?

(a) 1 only (b) 2 only

(c) 3 only (d) 2 and 3

50. Ans: (b)

51. Consider a random process given by :

$x(t) = A\cos(2\pi f_c t+\theta)$, where A is a Rayleigh distributed random variable and θ is uniformly distributed in [0, 2π]. A and θ are independent. For any time t, the probability density function (PDF) of x(t) is:

(a) Gaussian

(b) Rayleigh

(c) Rician

(d) Uniform in [–A, A]

51. Ans: (a)

Sol: The envelope of Gaussian random variable is Rayeigh and phase is uniform.

52. Poisson's equation is derived with the following assumption about the medium. The medium is:

(a) Non-homogeneous and isotropic

(b) Non-homogeneous and non-isotropic

(c) Homogeneous and non-isotropic

(d) Homogeneous and isotropic

52. Ans: (d)

Sol: $\nabla.\overline{D} = \rho_v$

$D = \varepsilon\overline{E}$

$\nabla.\left(\varepsilon\overline{E}\right) = \rho_v$

If the medium is homogenious and isotropic then only

$\nabla.\overline{E} = \frac{\rho_v}{\varepsilon}$

$E = -\nabla V$

$\nabla\cdot(-\nabla V) = \frac{\rho_v}{\varepsilon}$

$\nabla^2 V = -\frac{\rho_v}{\varepsilon}$

53. The state space representation of a linear time invariant system is:

$\dot{X}(t) = AX(t) + Bu(t)$

$Y(t) = CX(t)$

What is the transfer function H(s) of the system ?

(a) $C\,(sI - A)^{-1}B$ (b) $B\,(sI - A)^{-1}C$

(c) $C\,(sI - A)B$ (d) $B\,(sI - A)C$

53. Ans: (a)

Sol: $C[SI - A]^{-1}\,B$

54. $x(t) = \frac{1}{T_o} + \sum_{k=1}^{N} \frac{2}{T_o}\cos k\omega_o t$, is the combined trigonometric form of Fourier series for:

(a) Half rectified wave

(b) Saw-tooth wave

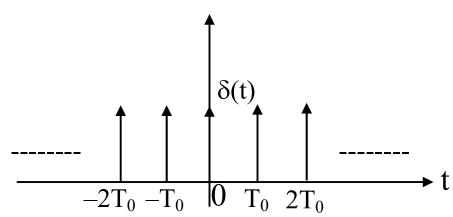
(c) Rectangular wave

(d) Impulse train

54. Ans: (d)

Sol: DC, cosine terms are exist, sine terms are zero. So it is a even signal

Consider periodic impulse train



$$a_0 = \frac{1}{T_0}\int_{t_a}^{t_a+T_0} x(t)dt = \frac{1}{T_0}\int_{t_a}^{t_a+T_0} \delta(t)dt = \frac{1}{T_0}$$

$$a_n = \frac{2}{T_0}\int_{t_a}^{t_a+T_0} x(t).\cos(k\omega_0 t)dt$$

$$= \frac{2}{T_0}\int_{t_a}^{t_a+T_0} \delta(t).\cos(k\omega_0 t)dt = \frac{2}{T_0}$$

$$b_n = \frac{2}{T_0}\int_{t_a}^{t_a+T_0} x(t).\sin(k\omega_0 t)dt$$

$$= \frac{2}{T_0}\int_{t_a}^{t_a+T_0} \delta(t).\sin(k\omega_0 t)dt$$

$$= 0$$

55. A signal x_n is given by $x_0 = 3$, $x_1 = 2$, $x_2 = 5$, $x_3 = 1$, $x_4 = 0$, $x_5 = 1$, $x_6 = 2$, $x_7 = 2$, $x_8 = 4$, where the subscript 'n' denotes time. The peak value of the auto correlation of x_{2n-11} is :

(a) 0 (b) 10

(c) 54 (d) 64

55. Ans: (b)

Sol:

$$x(n) = [\underset{\uparrow}{3},2,5,1,0,1,2,2,4]$$

$$x(n-11) = [\underset{\uparrow}{0},0,0,0,0,0,0,0,0,0,0,3,2,5,1,0,1,2,2,4]$$

$$y(n) = x(2n-11) = [\underset{\uparrow}{0},0,0,0,0,0,2,1,1,2]$$

y(n) correlation y(n) = y(n) * y(–n)

$$y(-n) = [2,1,1,2,0,0,0,0,0,\underset{\uparrow}{0}]$$

	2	1	1	2	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
2	4	2	2	4	0	0	0	0	0	0
1	2	1	1	2	0	0	0	0	0	0
1	2	1	1	2	0	0	0	0	0	0
2	4	2	2	4	0	0	0	0	0	0

y(n)*y(n) = [0,0,0,0,0,0,4,4,5,10,5,4,4,0,0,0,0,0,0]

Highest value is '10'

56. A system has impulse response h[n] = cos(n)u[n]. The system is:

(a) Causal and stable

(b) Non causal and stable

(c) Non causal and not stable

(d) Causal and not stable

56. Ans: (d)

Sol: h(n) = cos (n). u(n)

h(n) =0, n < 0, causal

$$\sum_{n=-\infty}^{\infty}|h(n)| = \sum_{n=0}^{\infty}|\cos(n)| = \infty \text{, not stable}$$

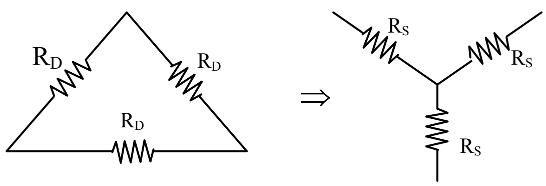
57. If the three resistors in a delta network are all equal in values i.e. R_{DELTA}, then the value of the resultant resistors in each branch of the equivalent star network i.e. R_{STAR} will be equal to:

(a) $\frac{R_{DELTA}}{3}$ (b) $\frac{R_{DELTA}}{2}$

(c) 2 R_{DELTA} (d) R_{DELTA}

57. Ans: (a)

Sol :



$Z \rightarrow Z/3$

$$R_{DELTA} \rightarrow \frac{R_{DELTA}}{3} = R_{STAR}$$

58. Loop-voltage equations of a passive circuit are given by:

$$\begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix}\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

1. $Z_{ij} = Z_{ji}$, i, j = 1, 2, 3
2. $Z_{ii} > 0$, i=1, 2, 3
3. $\Delta Z \le 0$

Which of the above relations are correct ?

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

58. Ans: (a)

Sol: Loop-voltage equations of a passive circuit

$$\begin{bmatrix} Z_{11} & Z_{12} & Z_{13} \\ Z_{21} & Z_{22} & Z_{23} \\ Z_{31} & Z_{32} & Z_{33} \end{bmatrix}\begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

1. $Z_{ij} = Z_{ji}$, i, j = 1, 2, 3
2. $Z_{ii} > 0$, i=1, 2, 3
3. $\Delta Z \le 0$

When it is passive network it is reciprocal

$Z_{ij} = Z_{ji}$

and Z_{ii} should greater than 0

ΔZ value should greater than zero

59. A function c(t) satisfies the differential equation $\dot{c}(t) + c(t) = \delta(t)$. For zero initial condition c(t) can be represented by:

(a) $\in^{-t}$ (b) $\in^{t}$
(c) $\in^{t}u(t)$ (d) $\in^{-t}u(t)$

Where u(t) is a unit step function.

59. Ans: (d)

Sol: $\dot{c}(t) + c(t) = \delta(t)$

$sC(s) – c(0) + C(s) = 1$

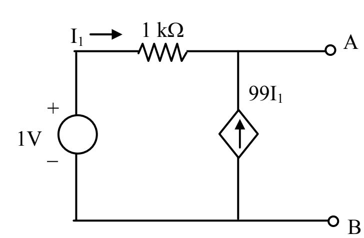
$c(0) = 0$

$C(s)\ \{s + 1\} = 1$

$$C(s) = \frac{1}{s+1}$$

$c(t) = e^{-t} \cdot u(t)$

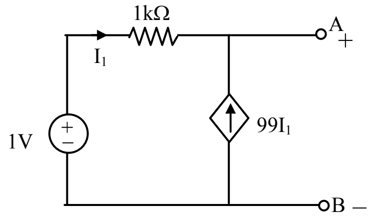
60. For the network shown, Thevenin's equivalent voltage source and resistance are, respectively:



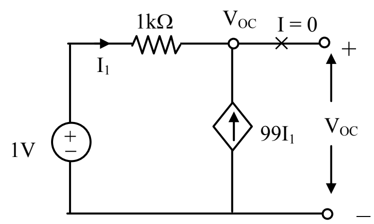
(a) 1mV and 10Ω (b) 1V and 1kΩ
(c) 1mV and 1kΩ (d) 1V and 10Ω

60. Ans: (d)

Sol: For the circuit thevenins equivalent



For V_{OC}



By KCL at V_{OC}

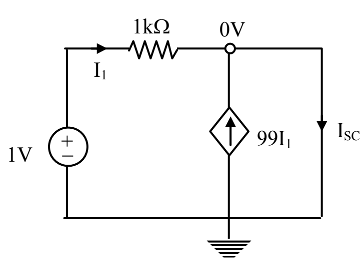
$I_1 + 99I_1 = 0$

$I_1 = 0$

$$\frac{1 - V_{OC}}{1k} = 0$$

$V_{OC} = 1\text{Volt}$

For I_{SC}



By KCL at '0' V

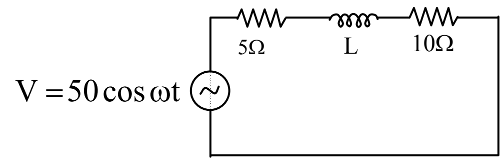
$I_1 + 99I_1 = I_{SC}$

$I_{SC} = 100I_1$

$$= 100\left(\frac{1-0}{1k}\right) = 0.1\text{Amps}$$

$$R_{Th} = \frac{V_{OC}}{I_{SC}} = \frac{1}{0.1} = 10\Omega$$

61. In the circuit shown, if the power consumed by the 5Ω resistor is 10W, then the power factor of the circuit is:

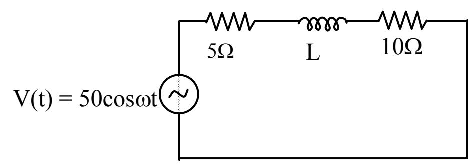


(a) 0.8 (b) 0.6

(c) 0.4 (d) 0.2

61. Ans: (b)

Sol:



$$\text{Power factor } = \cos\phi = \frac{V_{R_{eq}}}{V}$$

$$V = \frac{50}{\sqrt{2}} \text{ (RMS value)}$$

$R_{eq} = (5+10) = 15\Omega$

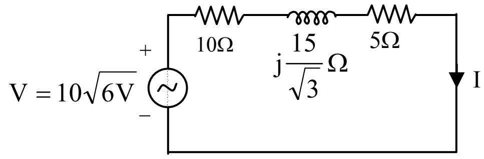
$I^2 5 = 10$

$I = \sqrt{2}$ A

$V_{R_{eq}} = IR_{eq} = 15\sqrt{2}$

$$\text{P–f} = \cos\phi = \frac{V_{R_{eq}}}{V} = \frac{50\sqrt{2}}{\frac{50}{\sqrt{2}}} = \frac{3}{5} = 0.6 \text{ lags}$$

62. For the circuit shown, if the power consumed by 5Ω resistor is 10W, then:



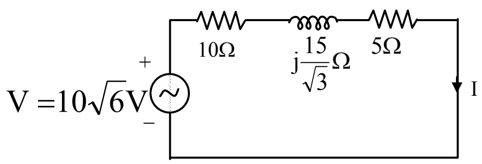
1. $|I| = \sqrt{2}A$
2. Total impedance = 5Ω
3. Power factor = 0.866

Which of the above are correct ?

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

62. Ans: (a)

Sol:



1. Power consumed by 5Ω is low

$I^2 5 = 10 \Rightarrow I = \sqrt{2}$ Amps

2. Total impedance $Z = \left(10 + 5 + j\frac{15}{\sqrt{3}}\right)\Omega$

$$Z = \left(15 + j\frac{15}{\sqrt{3}}\right)\Omega$$

$$Z = \frac{30}{\sqrt{3}} = 10\sqrt{3}\Omega$$

3. Power factor $\cos\phi = \frac{V_{R_{eq}}}{V} = \frac{IR_{eq}}{V}$

$$\cos\phi = \frac{\sqrt{2}(10+5)}{10\sqrt{6}} = \frac{15\sqrt{2}}{10\sqrt{6}} = \frac{\sqrt{3}}{2} = 0.866$$

63. For a given fixed tree of a network, the following form an independent set:

1. Branch currents
2. Link voltages

Which of the above is/are correct?

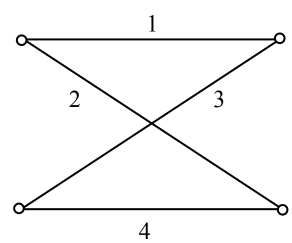
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

63. Ans: (d)

Sol: Branch voltages are related independent of cut set.

Link currents are related independent of Tieset.

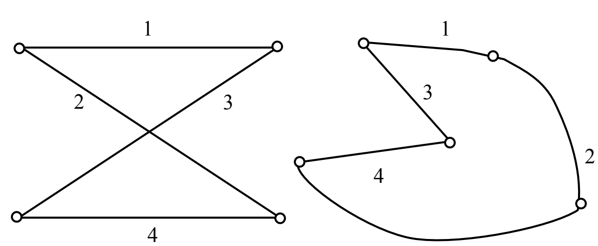
64. For the network graph, the number of trees (P) and the number of cut-sets (Q) are respectively:



(a) 4 and 2 (b) 6 and 2
(c) 4 and 6 (d) 2 and 6

64. Ans: (c)

Sol: The given graph



→ The no. of trees : 4 No. of cutsets = 6

As the total number of branches in the given graph 4, there only 4 possibilities with 3 branches.

→ From the given graph it can be observed that any 2 branches out of the total 4 branches from a cut-set. As 6 such combination are possible the number of cut-set Q = 6

65. For which one of the following measurements a thermistor can be used ?

(a) Velocity

(b) Humidity

(c) Displacement

(d) Percent of CO_2 in air

65. Ans: (a)

66. According to network graphs, the network with:

1. Only two odd vertices is traversable
2. No odd vertices is traversable
3. Two or more than two odd vertices are traversable

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) 3 only (d) 1 and 2

66. Ans: (d)

67. For any lumped network, for any cut sets and at any instant of time the algebraic sum of all branch currents traversing the cut-set branches is always:

(a) One

(b) Zero

(c) Infinity

(d) Greater than zero, but less than one

67. Ans: (b)

68. Which one of the following statements concerning Tellegen's theorem is correct?

(a) It is useful in determining the effects in all parts of a linear four-terminal network

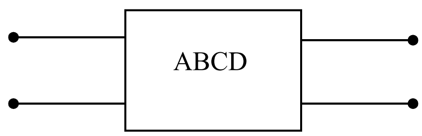
(b) It is applicable for any lumped network having elements which are linear or nonlinear, active or passive, time varying or time-invariant, and may contain independent or dependent sources

(c) It can be applied to a branch, which is not coupled to other branches in a network

(d) It states that the sum of powers taken by all elements of a circuit within constraints imposed by KCL and KVL is non-zero

68. Ans: (b)

69. The open circuit input impedance of a 2-port network is

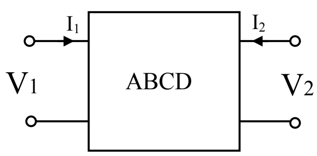


(a) $\frac{A}{C}\Omega$ (b) $\frac{B}{D}\Omega$

(c) $\frac{D}{C}\Omega$ (d) $\frac{A}{B}\Omega$

69. Ans: (a)

Sol: The open circuit impedance of a 2-port network



For ABCD parameters

$V_1 = AV_2 - BI_2$

$I_1 = CV_2 - DI_2$

Open circuit impedance $Z_{ij}\Big|_{I_i=0} = \frac{V_i}{I_j}$

$$Z_{11} = \frac{V_1}{I_1}\Big|_{I_2=0}$$

$$Z_{11} = \frac{AV_2}{CV_2} = \frac{A}{C}$$

70. Consider the following statements:

1. Two identical 2^{nd} order Butterworth LP filters when connected in cascade will make a 4^{th} order Butterworth LP filter.
2. A high 2^{nd} order filter will exhibit a peak if Q exceeds certain value.
3. A band pass filter cannot be of order one.
4. A network consists of an amplifier of real gain A and a β network in cascade with each other. The network will generate sinusoidal oscillations if the β network is a first order LP filter.

Which of the above statements are correct?

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

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

70. Ans: (b)

71. The lowest and the highest critical frequencies of RC driving point admittance are, respectively:

(a) a zero and a pole

(b) a pole and a zero

(c) a zero and a zero

(d) a pole and a pole

71. Ans: (a)

Sol: The lowest & highest critical frequencies of RC driving point impedance

→ For RL impedance and RC Admittance function the critical frequency nearest to the origin or at the origin must be a zero. Where as the critical frequency nearest to infinity or at infinity must be a pole.

72. The poles and zeros of a voltage function v(t) are: zero at the origin and simple poles at –1, –3 and the scale factor is 5. The contribution of the pole at –3 to v(t) is:

(a) $2.5 \in^{-3t}$ (b) $7.5 \in^{-3t}$

(c) $2.5 \in^{+3t}$ (d) $7.5 \in^{+3t}$

72. Ans: (b)

Sol:

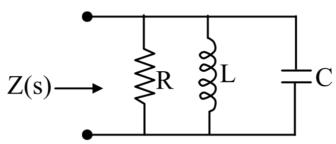
$$V(s) = \frac{5(s-0)}{(s+1)(s+3)} = \frac{5s}{(s+1)(s+3)}$$

$$= \frac{-5/2}{s+1} + \frac{15/2}{s+3}$$

$$v(t) = -\frac{5}{2}e^{-t}.u(t) + \frac{15}{2}e^{-3t}.u(t)$$

The contribution of the pole at '–3' to v(t) is $7.5e^{-3t}$ u(t)

73. The driving point impedance of the circuit shown is given by $Z(s)=\dfrac{0.2s}{s^2+0.1s+2}$



The component values R, L and C are respectively:

(a) 0.5 Ω, 1H and 0.1 F

(b) 2 Ω, 5 H and 5 F

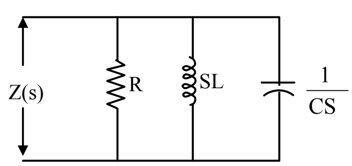
(c) 0.5 Ω, 0.1 H and 0.1 F

(d) 2 Ω, 0.1 H and 5 F

73. Ans: (d)

Sol: The driving point impedance of the circuit

$$Z(s) = \frac{0.2s}{s^2+0.1s+2}$$



$$Y(s) = \left(\frac{1}{R}+\frac{1}{sL}+Cs\right)$$

$$\frac{1}{Z(s)} = \frac{1}{R}+\frac{1}{sL}+Cs$$

$$\frac{s^2+0.1s+2}{0.2s} = \frac{1}{R}+\frac{1}{sL}+Cs$$

$$\frac{s}{0.2}+\frac{1}{2}+\frac{1}{0.1s} = \frac{1}{R}+\frac{1}{sL}+Cs$$

$R = 2$, $L = 0.1H$, $C = 5F$

74. Consider the following driving point impedances which are to be realized using passive elements:

1. $\dfrac{s+3}{s^2(s+5)}$ 2. $\dfrac{s^2+3}{s^2(s^2+5)}$

Which of the above is/are realizable?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

74. Ans: (d)

Sol: For driving point impedance function of passive circuit (RL, RC and LC). The poles and zeros are alternate then only it is realizable

1. $\dfrac{s+3}{s^2(s+5)}$ 2. $\dfrac{s^2+3}{s^2(s^2+5)}$

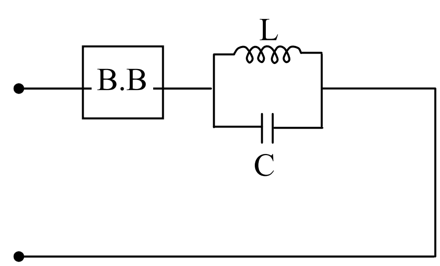
↓ ↓

poles are repeating poles are repeating

(OR)

Both can not be realized as the difference between highest degree of numerator and denominator polynomial is greater than one

75. A reactance function in the first Foster form has poles at ω = 0 and ω = ∞. The black-box (B.B) in the network contains:



(a) An inductor

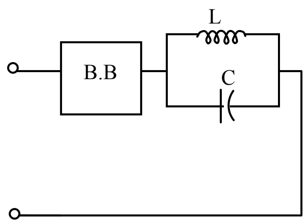
(b) A capacitor

(c) A parallel L – C circuit

(d) A series L – C circuit

75. Ans: (b)

Sol: A reactance function in the first Foster form has poles at $\omega = 0$ and $\omega = \infty$



pole at origin $\rightarrow$ It is capacitor in series

Black Box should contains only capacitor.

76. Consider the following statements :

1. The magnetic field at the centre of a circular coil of a wire carrying current is inversely proportional to the radius of the coil
2. Lifting power of a magnet is proportional to square of magnetic flux density
3. A static electric field is conservative (irrotational)
4. If the divergence of a vector 'A' is zero, then vector 'A' can be expressed as Curl of a vector F

Which of the above statements are correct?

(a) 1, 2 and 3 only

(b) 3 and 4 only

(c) 1, 2 and 4 only

(d) 1, 2, 3 and 4

76. Ans: (d)

Sol:

1. The magnetic field at the centre at circular coil

$$H = \frac{I}{2a}$$

$a \rightarrow$ radius

2. Lifting force $F = \frac{B^2 s}{2\mu}$

$F \alpha B^2$

3. $\nabla \times E = 0$

$E \rightarrow$ static electric field

Static electric field is irrotational

4. $\nabla \cdot A = 0$

$A = \nabla \times F$

Any solenoidal vector can be expressed as curl of some other vector

77. Consider the following:

1. Electric current flowing in a conducting wire
2. A moving charged belt
3. An electron beam in a cathode ray tube
4. Electron movement in a vacuum tube

Which of the above are examples of convection current?

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

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

77. Ans: (a)

Sol: Convection current

1. moving charged belt
2. electron beam in a cathode ray tube
3. electron movement in a vacum tube

78. Consider the following sources:

1. A permanent magnet
2. A charged disc rotating at uniform speed
3. An accelerated charge
4. An electric field which changes linearly with time

Which of the above are the sources of steady magnetic field?

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

78. Ans: (c)

Sol: Sources at steady magnetic field

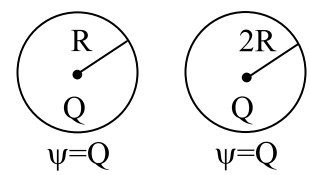
1. permanent magnet
2. a charged disc rotating at uniform speed
4. An electric field which changes linearly with time

79. A charge Q is enclosed by a Gaussian spherical surface of radius R. If R is doubled then the outward flux is

(a) Doubled
(b) Increased four times
(c) Reduced to a quarter
(d) Remains unaltered

79. Ans: (d)

Sol:



Flux does not changes with radius

80. Divergence of a vector div D in the cylindrical coordinate system is

(a) $\frac{1}{\rho}\frac{\partial}{\partial\rho}(D_\rho)+\frac{1}{\rho}\frac{\partial D_\phi}{\partial\phi}+\frac{\partial D_z}{\partial z}$

(b) $\frac{1}{\rho}\frac{\partial}{\partial\rho}(\rho D_\rho)+\frac{1}{\rho}\frac{\partial(\phi D_\phi)}{\partial\phi}+\frac{1}{z}\frac{\partial(ZD_z)}{\partial z}$

(c) $\frac{1}{\rho}\frac{\partial}{\partial\rho}(\rho D_\rho)+\frac{1}{\rho}\frac{\partial D_\phi}{\partial\phi}+\frac{\partial D_z}{\partial z}$

(d) $\frac{\partial D_\rho}{\partial\rho}+\frac{\partial D_\phi}{\partial\phi}+\frac{\partial D_z}{\partial z}$

80. Ans: (c)

Sol: $\nabla.D=\frac{1}{\rho}\frac{\partial}{\partial\rho}(\rho D_\rho)+\frac{1}{\rho}\frac{\partial D_\phi}{\partial\phi}+\frac{\partial D_z}{\partial z}$

81. What is the value of work required to move a +8 nC charge from infinity to a point P which is at 2 m distance from a point charge Q = + 5 μ C ?

(a) 180 μJ (b) 180 nJ
(c) 18 μJ (d) 18 nJ

81. Ans: (a)

Sol: $W = Q_1 V$

$$V = \frac{1}{4\pi\varepsilon}\frac{Q_2}{r}$$

$$W = \frac{1}{4\pi\varepsilon}\frac{Q_1Q_2}{r}$$

$$= \frac{9\times10^{9}\times8\times10^{-9}\times5\times10^{-6}}{2}$$

$W = 180\ \mu J$

82. An electrostatic force between two point charges increases when they are:

(a) More apart and dielectric constant of the medium between them decreases

(b) Less apart and dielectric constant of the medium between them decreases

(c) More apart and dielectric constant of the medium between them increases

(d) Less apart and dielectric constant of the medium between them increases

82. Ans: (b)

Sol: $F = \frac{1}{4\pi\varepsilon}\frac{Q_1Q_2}{R^2}$

$$F \propto \frac{Q_1Q_2}{\varepsilon R^2}$$

83. A plane Y = 2 carries infinite sheet of charge 6 nC/m^2. If medium is free space then force on a point charge of 10 mC located at the origin is:

(a) $-1080\pi\bar{a}_y$ N (b) $-108\pi\bar{a}_y$ N

(c) $-10.8\pi\bar{a}_y$ N (d) $-1.08\pi\bar{a}_y$ N

83. Ans: (d)

Sol: Plane y = 2

$$E = \frac{\rho_s}{2\varepsilon}\bar{a}_n = \frac{6\times10^{-9}}{2\times\frac{1}{36\pi}\times10^{-9}}\left(-\bar{a}_y\right)$$

$E = -108\pi\ \bar{a}_y$

$F = QE$

$= -10\times10^{-3}\times108\pi\ \bar{a}_y$

$= -1080\ \pi\ \bar{a}_y\times10^{-3}$

$F = -1.080\pi\ \bar{a}_y$ N

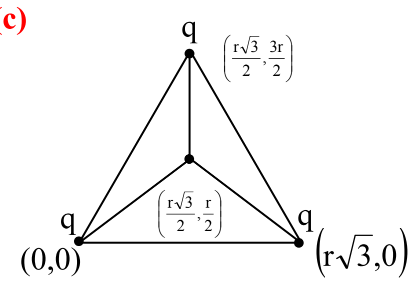
84. The potential at the centroid of an equilateral triangle of side $r\sqrt{3}$ due to three equal positive point charges each of value q and placed at the vertices of the triangle would be

(a) $\frac{q}{2\pi\epsilon_0 r}$ (b) $\frac{\sqrt{3}q}{8\pi\epsilon_0 r}$

(c) $\frac{3q}{4\pi\epsilon_0 r}$ (d) zero

84. Ans: (c)

Sol:



$V = V_1 + V_2 + V_3$

$$= \frac{1}{4\pi\varepsilon}\frac{q}{r}+\frac{1}{4\pi\varepsilon}\frac{q}{r}+\frac{1}{4\pi\varepsilon}\frac{q}{r}$$

$$V = \frac{3q}{4\pi\varepsilon r}$$

85. The point form of the relation connecting vector magnetic potential A and current density J is

(a) $\nabla \times A = J + \dfrac{\partial D}{\partial t}$

(b) $A = \int \dfrac{\mu_0 J}{4\pi \in R} dv$

(c) $\nabla^2 A = -\mu_0 J$

(d) $\dfrac{\partial A}{\partial t} = -\dfrac{J}{\sigma}$

85. Ans: (c)

Sol: $\nabla^2 A = -\mu_0 J$

Poisson's equation in the magnetic field

86. In the region $Z < 0$, $\varepsilon_{r1} = 2$, $\bar{E}_1 = -3\bar{a}_x + 4\bar{a}_y - 2\bar{a}_z$ V/m. For region $Z > 0$, where $\varepsilon_{r2} = 6.5$, $\bar{E}_2$ is:

(a) $-3\bar{a}_x + 4\bar{a}_y + \dfrac{6.5}{4}\bar{a}_z$ V/m

(b) $-3\bar{a}_x + 4\bar{a}_y + \dfrac{4}{6.5}\bar{a}_z$ V/m

(c) $-3\bar{a}_x + 4\bar{a}_y - \dfrac{6.5}{4}\bar{a}_z$ V/m

(d) $-3\bar{a}_x + 4\bar{a}_y - \dfrac{4}{6.5}\bar{a}_z$ V/m

86. Ans: (d)

Sol: $E_1 = -3\,\bar{a}_x + 4\bar{a}_y - 2\,\bar{a}_z$

$E_{1t} = -3\bar{a}_x + 4\bar{a}_y$

$E_{1n} = -2\bar{a}_y$

$E_2 = -3\,\bar{a}_x + 4\,\bar{a}_y + \dfrac{\varepsilon_1}{\varepsilon_2}(E_{1n})$

$E_2 = -3\,\bar{a}_x + 4\,\bar{a}_y - \dfrac{4}{6.5}\bar{a}_z$

87. Consider the following statements regarding a conductor and free space boundary:

1. No charge and no electric field can exist at any point within the interior of a conductor
2. Charge may appear on the surface of a conductor

Which of the above statements are correct ?

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

87. Ans: (c)

Sol:

Inside Conductor

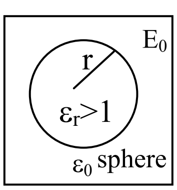
$E = 0$
$\rho_v = 0$

88. A sphere of homogeneous linear dielectric material of dielectric constant ≥ 1 is placed in a uniform electric field E_0, then the electric field E that exists inside the sphere is

(a) Uniform and $E \leq E_0$
(b) Uniform and $E \geq E_0$
(c) Varies but $E < E_0$ always
(d) Varies but $E > E_0$ always

88. Ans: (c)

Sol:



$$E_0 \alpha \frac{1}{\varepsilon_0} \Rightarrow E \alpha \frac{1}{\varepsilon} \Rightarrow E \alpha \frac{1}{\varepsilon_0 \varepsilon_r}$$

Electric field inside the sphere, $E = \frac{r\rho_v}{3\varepsilon}$

$\varepsilon_r > 1$

$E < E_0$

89. Which of the following Maxwell's equations represents Ampere's law with correction made by Maxwell?

(a) $\nabla . E = \frac{\rho}{\varepsilon_0}$

(b) $\nabla . B = 0$

(c) $\nabla \times E = -\frac{\partial B}{\partial t}$

(d) $\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 \frac{\partial E}{\partial t}$

89. Ans: (d)

Sol: $\nabla \times H = J + \frac{\partial D}{\partial t}$

$$\nabla \times \frac{B}{\mu} = J + \varepsilon \frac{\partial E}{\partial t}$$

$$\nabla \times B = \mu J + \mu\varepsilon \frac{\partial E}{\partial t}$$

90. Precision is composed of two characteristics, one is the number of significant figures to which a measurement may be made, the other is

(a) Conformity (b) Meter error
(c) Inertia effects (d) Noise

90. Ans: (a)

91. If phasors $P_1 = 3 + j4$ and $P_2 = 6 - j8$, then $|P_1 - P_2|$ is

(a) 5 (b) $\sqrt{53}$

(c) $\sqrt{73}$ (d) $\sqrt{153}$

91. Ans: (d)

Sol: If phasers $P_1 = 3+j4$ & $P_2 = (6-j8)$

then $|P_1 - P_2| = |(3+j4) - (6-j8)|$

$= |-3+j12|$

$|P_1 - P_2| = \sqrt{9+144} = \sqrt{153}$

92. A plane wave in free space has a magnetic field intensity of 0.2 A/m in the Y-direction. The wave is propagating in the Z-direction with a frequency of 3 GHz. The wavelength and amplitude of the electric field intensity are, respectively

(a) 0.05 m, and 75 V/m

(b) 0.10 m and 75 V/m

(c) 0.05 m and 150 V/m

(d) 0.10 m and 150 V/m

92. Ans: (b)

Sol: $H_0 = 0.2$

$f = 3\text{GHz}$

$$\lambda = \frac{V}{f} = \frac{3\times10^8}{3\times10^9}$$

$\lambda = 0.1$

$$\frac{E_0}{H_0} = 120\pi$$

$E_0 = (0.2)(377)$

$E_0 = 75.4$

93. For energy propagation in a lossless transmission line, the characteristic impedance of the line is expressed in ohm as below (where notations have usual meanings).

(a) $\sqrt{LC}\,\Omega$ (b) $\sqrt{\frac{L}{C}}\,\Omega$

(c) $\sqrt{\frac{C}{L}}\,\Omega$ (d) $\sqrt{\frac{R+j\omega L}{G-j\omega L}}\,\Omega$

93. Ans: (b)

Sol: $Z_0 = \sqrt{\frac{L}{C}}$

94. A quarter wave-length transformer is used to match a load of 200 Ω to a line with input impedance of 50 Ω. The characteristic impedance of the transformer would be

(a) 40 Ω (b) 100 Ω

(c) 400 Ω (d) 1000 Ω

94. Ans: (b)

Sol: $Z_{QWT} = \sqrt{Z_L Z_0}$

$= \sqrt{(200)(50)}$

$= 100$

95. For a lossless transmission line $L = 0.35\mu H/m$, $C = 90$ pF/m and frequency = 500 MHz. Then the magnitude of propagation constant is

(a) 14.48 (b)17.63

(c) 19.59 (d) 21.20

95. Ans: (b)

Sol: For lossless transmission line

$$\beta = \omega\sqrt{LC}$$

$$= 2\pi\left(500\times10^{+6}\right)\sqrt{90\times10^{-12}\times0.35\times10^{-6}}$$

$$\beta = 17.63$$

96. If an antenna has a main beam with both half-power beam widths equal to 20°, its directivity (D) is nearly

(a) 90.6 (b) 102.5

(c) 205 (d) 226

96. Ans: (a)

Sol: If we have significant minor lobes, then the approximate expression for directivity is given by

$$D \simeq \frac{72815}{\theta_{HP}^{\ 2} + \phi_{HP}^{\ 2}}$$

Given:

$\theta_{HP} = 20°$

$\phi_{HP} = 20°$

$$\therefore D \simeq \frac{72815}{800} \simeq 91.01$$

Note: If a major lobe and any minor lobes of very low intensity (minor lobes are ignore) are present then the directivity is approximately equal to

$$D_0 \simeq \frac{41253}{\theta_{HP}\phi_{HP}} \simeq \frac{41253}{400}$$

$$\therefore D \simeq 103.13$$

97. An instrument always extracts some energy from the measured medium. Thus the measured quantity is always disturbed by the act of measurement, which makes a perfect measurement theoretically impossible and it is due to

(a) Skin-effect (b) Inductive effect

(c) Loading effect (d) Lorenz effect

97. Ans: (c)

98. The characteristic impedance η_0 of a free space is

(a) $\frac{\mu_0}{\varepsilon_0}$ (b) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$

(c) $\sqrt{\mu_0\varepsilon_0}$ (d) $\mu_0\ \varepsilon_0$

98. Ans: (b)

Sol: $\eta_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}}$

99. A $3\frac{1}{2}$ digit voltmeter has an accuracy specification of ± 0.5% of reading ± one digit. What is the possible error in volts when the instrument displays 2.00V on the 10 V scale?

(a) 0.03 V (b) 0.02V

(c) 0.01 V (d) 0.005 V

99. Ans: (b)

Sol: error $= \pm\left[\frac{0.5}{100}\times 2V + 1\,\text{count}\right]$

$= \pm[0.01\text{V} + 00.01\text{V}]$

$= \pm\,[0.01\text{ V} + 0.01\text{ V}] \quad = \pm\,0.02\text{ V}$

(or)

Resolution $= \dfrac{1}{10^3} = 0.001$

On 10 V range, resolution

$= 0.001 \times 10 = 0.01$

$\therefore$ One digit = 0.01

Error $\pm$ 0.5% of reading

$\pm\dfrac{0.5}{100}\times 2 = 0.01$

$\therefore$ Total error = (0.01 + 0.01) = 0.02

100. A megger is an instrument used for measuring
   (a) Very high voltages
   (b) Very low voltages
   (c) Very high resistances
   (d) Very low resistances

100. Ans: (c)

101. The values of capacitance and inductance used in the series LCR circuit are 160 pF and 160 μH with the inherent tolerance – 10% in each. Then, the resonance frequency of the circuit is in the range of
   (a) 0.8 MHz to 1.2 MHz
   (b) 0.9 MHz to 1.0 MHz
   (c) 0.8 MHz to 1.0 MHz
   (d) 0.9 MHz to 1.2 MHz

101. Ans: (b)

102. Dynamic characteristics of instruments leading to variations during measurement are
   1. Speed of response
   2. Fidelity
   3. Dynamic error

   Which of the above are correct?
   (a) 1 and 2 only (b) 1 and 3 only
   (c) 2 and 3 only (d) 1, 2 and 3

102. Ans: (a)

103. The reliability of an instrument refers to
   (a) Degree to which repeatability continues to remain within specified limits
   (b) The extent to which the characteristics remain linear
   (c) Accuracy of the instrument
   (d) Sensitivity of the instrument

103. Ans: (a)

104. AC Voltmeters use diodes with
   (a) High forward current and low reverse current ratings
   (b) Low forward current and low reverse current rating
   (c) Low forward current and high reverse current ratings
   (d) High forward currents and high reverse current ratings

104. Ans: (a)

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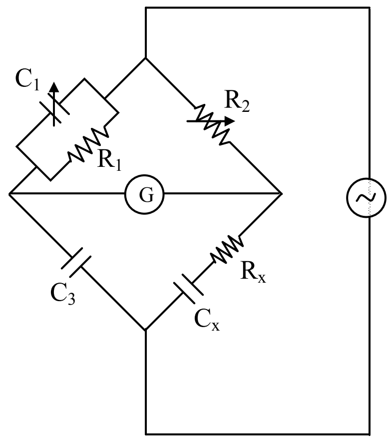
105. The bridge circuit shown can be used to measure unknown lossy capacitor C_X with resistance R_X. At balance.



(a) $R_X = \frac{C_1}{C_3} R_2 \text{ and } C_X = \frac{R_1}{R_2} C_3$

(b) $R_X = \frac{C_3}{C_1} R_1 \text{ and } C_X = \frac{R_2}{R_1} C_3$

(c) $R_X = \frac{R_1}{C_2} R_2 \text{ and } C_X = \frac{C_1}{R_1} R_2$

(d) $R_X = R_2$ and $C_X = C_3$

Where R_1, R_2, C_1 and C_3 can be assumed ideal components

105. Ans: (a)

106. Inductance of a coil having Q value in the range of (1< Q< 10), can be measured by using

(a) Hay's bridge
(b) De Sauty's bridge
(c) Maxwell's bridge
(d) Carry Foster's bridge

106. Ans: (c)

107. The instrument servomechanism is actually an instrument system made of components, which are

(a) Exclusively passive transducers
(b) Exclusively active transducers
(c) Combination of passive transducers and active transducers
(d) Exclusively primary sensing elements

107. Ans: (c)

108. The scale of an electrodynamometer usually reads the

(a) Average value of the ac
(b) Mean value of the ac
(c) Effective value of the ac
(d) Squared value of the ac

108. Ans: (b)

109. The resolution of an indicating instrument can be defined as

1. Variation in the meter reading for the same applied input
2. Detectable change in the deflection due to smallest change in the applied input
3. Detectable change in the output due to drifting of pointer

Which of the above statements are correct?

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

109. Ans: (b)

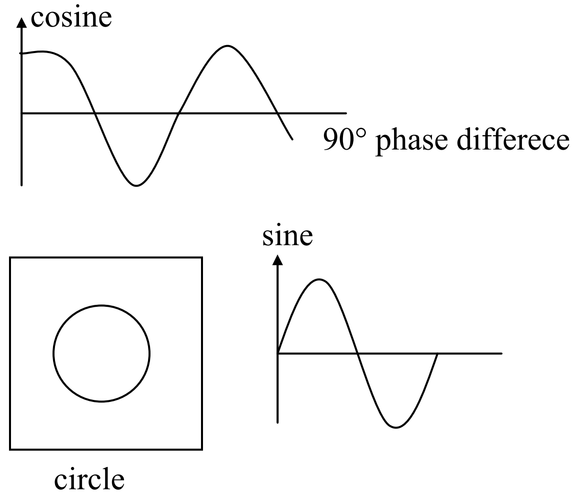
110. While measuring the phase difference between the signals $v_1(t) = 10 \sin \omega t$ and $v_2(t) = 10 \sin(\omega t + \phi)$, the Lissajous pattern observed on CRO is a circle. The value of ϕ is

(a) 2π (b) π

(c) $\frac{\pi}{2}$ (d) $\frac{\pi}{4}$

110. Ans: (c)

Sol:



111. The expected voltage across a resistor is 100 V. However, the voltmeter reads a value of 97 V. The relative error is

(a) 0.97 (b) 0.03

(c) 0.07 (d) 3.00

111. Ans: (b)

Sol: $\in_r = \frac{A_m - A_t}{A_t}$

$$= \frac{97 - 100}{100} = -0.03$$

112. A sinusoidal voltage of amplitude 150 V has been applied to a circuit having a rectifying device that prevents flow of current in one direction and offers a resistance of 15 Ω for the flow of current in the other direction. If hot wire type and PMMC type instruments are connected in this circuit to measure the electric current, their readings would respectively be

(a) 3.18A and 5A

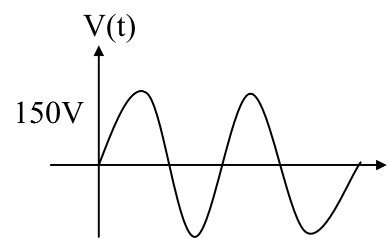
(b) 5 A and 3.18 A

(c) 3.18 A and 5 mA

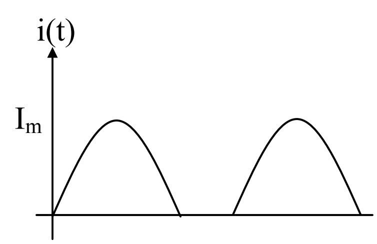
(d) 5 A and 3.18 mA

112. Ans: (b)

Sol:



This will be rectified by a single diode i.e., Half wave rectification.



$$I_m = \frac{150V}{15\Omega} = 10A$$

Hot wire instrument reads I_{rms}

$$I_{rms} = \frac{I_m}{2}$$

$$= \frac{10A}{2} = 5A$$

PMMC instrument reads I_{dc}

$$I_{dc} = \frac{I_m}{\pi}$$

$$= 0.318 \times 10\text{ A}$$

$$= 3.18\text{ A}$$

$\therefore$ Readings are 5A and 3.18A respectively.

(or)

Hot wire instrument measures RMS value

$$I = \frac{150}{15} = 10A$$

$$I_{rms} = \frac{10}{2} = 5A$$

(Half wave rectifier $I_{rms} = I_m/2$)

PMMC measures average value

$$I_{avg} = \frac{10}{\pi} = 3.18\,A$$

113. A tachometer encoder can be used for measurement of speed
(a) of false pulses because of electrical noise
(b) in forward and reverse directions
(c) in one direction only
(d) for single revolution in a multiple track

113. Ans: (c)

114. A rotameter works on the principle of variable
(a) Pressure (b) Length
(c) Area (d) Resistance

114. Ans: (c)

115. An input voltage required to deflect a beam through 3cm in a Cathode Ray Tube having an anode voltage of 1000V and parallel deflecting plates 1 cm long and 0.5 cm apart, when screen is 30 cm from the center of the plates is
(a) 300 V (b) 200 V
(c) 100 V (d) 75 V

115. Ans: (c)

Sol: We know, $S_V = \dfrac{d}{V_d}$

$$= \frac{LD}{2sV_a}$$

$$\frac{d}{V_d} = \frac{LD}{2sV_a}$$

Given that: d = 3cm, V_a= 1000V, L = 1 cm, s = 0.5cm, D = 30 cm

$$\therefore \frac{3\,cm}{V_d} = \frac{1\,cm \times 30\,cm}{2 \times 0.5\,cm \times 1000V}$$

$$\Rightarrow V_d = \frac{3000\,V}{30} = 100\,V$$

(or)

$$D = \frac{\ell L V_d}{2dV_a}$$

$$V_d = \frac{D \times 2 \times d \times V_a}{\ell \times L} = 100\text{ V}$$

116. A 6-bit ADC has a maximum precision supply voltage of 20 V. What are the voltage changes for each LSB present and voltage to be presented by (100110), respectively ?

(a) 0.317V and 12.06 V

(b) 3.17 V and 12.06 V

(c) 0.317 V and 1.206 V

(d) 3.17 V and 1.206 V

116. Ans: (a)

117. Which of the following transducers measure the pressure by producing emf as a function of its deformation?

(a) Photoelectric transducer

(b) Capacitive transducer

(c) Inductive transducer

(d) Piezoelectric transducer

117. Ans: (d)

118. Maxwell's bridge measure an unknown inductance in terms of

(a) Known inductance

(b) Known capacitance

(c) Known resistance

(d) Q of the coil

118. Ans: (b)

119. Strain gauges are constructed with Germanium chips because Germanium:

(a) has a strong Hall Effect

(b) is crystalline in nature

(c) can be doped

(d) has piezo-electric property

119. Ans: (c)

120. The advantages of an LVDT is/are

1. Linearity

2. Infinite resolution

3. Low Hysteresis

Which of the above advantages is/are correct?

(a) 1 only (b) 2 only

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

120. Ans: (d)