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# ESE 2020

## Preliminary Examination

### Detailed Solutions of

## Electrical Engineering

### (Set-A)

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| **E&T** | 235-245 | 225-235 | 185-195 | 185-195 | **E&T** | 226 | 221 | 176 | 165 |

## Electrical Engineering Paper Analysis
## ESE 2020 Prelims Exam

| Sl. | Subjects | Number of Questions |
|---|---|---|
| 1 | Engineering Mathematics | 12 |
| 2 | Electrical Materials | 11 |
| 3 | Electric Circuits | 6 |
| 4 | Signals and Systems | 12 |
| 5 | Power Systems | 12 |
| 6 | Measurements | 12 |
| 7 | Computer Fundamentals | 8 |
| 8 | Digital Electronics | 3 |
| 9 | Microprocessos | 3 |
| 10 | Analog Electronics | 17 |
| 11 | Communication Systems | 9 |
| 12 | Control Systems | 12 |
| 13 | Electrical Machines | 14 |
| 14 | Power Electronics | 13 |
| 15 | Electromagnetic Theory | 6 |

## UPSC ESE/IES Prelims 2020

Electrical Engineering analysis and expected cutoff by MADE EASY faculties

https://youtu.be/k0xskSX6BdY

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**1.** If $\lambda$ is eigenvalues of $A$, and $A$ is idempotent matrix, then

(a) $\lambda \neq 0$ (b) $\lambda \neq 1$

(c) Either $\lambda = 0$ or $\lambda = 1$ (d) $\lambda \neq 0$ and $\lambda = 1$

**Ans.** **(c)**

A is idempotent $\Rightarrow A^2 = A$

$\lambda$ is eigen value of $A$.

$$\Rightarrow \quad \lambda^2 = \lambda$$

$$\Rightarrow \quad \lambda^2 - \lambda = 0$$

$$\lambda(\lambda - 1) = 0$$

$$\lambda = 0 \text{ (or) } 1$$

*End of Solution*

**2.** The eigenvalues of the matrix $\begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$ are

(a) 5 and 2 (b) 1 and 4

(c) 1 and 6 (d) 7 and 5

**Ans.** **(c)**

$$A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$$

Characteristic equation of $A$ is,

$$|A - \lambda I| = 0$$

$$\begin{vmatrix} 5-\lambda & 4 \\ 1 & 2-\lambda \end{vmatrix} = 0$$

$$\lambda^2 - 7\lambda + 6 = 0$$

$$\lambda = 1, 6$$

*End of Solution*

**3.** Using Runge's formula of order 2, when $x = 1.1$, given $\frac{dy}{dx} = 3x + y^2$ and $y = 1.2$ when $x = 1$, taking $h = 0.1$. The value of $y$ will be nearly

(a) 1.3 (b) 1.5

(c) 1.7 (d) 1.9

**Ans.** **(c)**

$$\frac{dy}{dx} = 3x + y^2 = f(x, y)$$

$$y(1) = 1.2$$

$$h = 0.1$$

Using, $y_1 = y(1.1) = y$ at $x = 1.1$

By Runge Kutta method of second order,

$$y_1 = y_0 + k$$

$$k = \frac{k_1 + k_2}{2}$$

$$k_1 = hf(x_0, y_0)$$
$$= 0.1\ f(1, 1.2)$$
$$= 0.1\ [3(1) + (1.2)^2]$$
$$= 0.1[4.4] = 0.44$$

$$k_2 = hf(x_0 + h, y_0 + k_1)$$
$$= 0.1\ f(1.1, 1.64)$$
$$= 0.1[3(1.1) + (1.64)^2]$$
$$= 0.1[3.3 + 2.7]$$
$$= 0.1[6] = 0.6$$

$$k = \frac{0.44 + 0.6}{2} = \frac{1.04}{2} = 0.52$$

$$y_1 = y_0 + k$$
$$= 1.2 + 0.52 = 1.72 \approx 1.7$$

*End of Solution*

**4.** The expression $\left(\frac{\Delta^2}{E}\right)e^x \cdot \frac{Ee^x}{\Delta^2 e^x}$ (the interval of differencing being $h$) is

(a) $e^{x-h}$ (b) $e^{x+h}$
(c) $e^x$ (d) $2e^x$

**Ans. (c)**

$$\left(\frac{\Delta^2}{E}\right)e^x \cdot \frac{Ee^x}{\Delta^2 e^x} = [(E-1)^2 E^{-1}]e^x \cdot \frac{e^{x+h}}{(E-1)^2 e^x} \qquad [\text{We have, } \Delta = E - 1]$$

$$= (E-1)^2 e^{x-h} \cdot \left[\frac{e^{x+h}}{(E-1)^2 e^x}\right]$$

$$= e^{-h}[(E-1)^2 e^x] \cdot \frac{e^{x+h}}{[(E-1)^2 e^x]} = e^x$$

*End of Solution*

**5.** The solution of differential equation $(x^2y - 2xy^2)\,dx - (x^3 - 3x^2y)dy = 0$, is

(a) $\frac{x}{y} - 2\log x + 3\log y = c$ (b) $\frac{y}{x} - 2\log y + 3\log x = c$

(c) $\frac{x}{y} + 2\log x - 3\log y = c$ (d) $\frac{y}{x} + 2\log y - 3\log x = c$

**Ans. (a)**

$$(x^2y - 2xy^2)\,dx - (x^3 - 3x^2y)\,dy = 0 \quad \text{...(i)}$$

$$M = x^2y - 2xy^2$$

$$\frac{\partial M}{\partial y} = x^2 - 4xy$$

$$N = -x^3 + 3x^2y$$

$$\frac{\partial N}{\partial x} = -3x^2 + 6xy$$

$\frac{\partial M}{\partial y} \neq \frac{\partial N}{\partial x}$ equation (i) is non exact.

$$\text{I.F.} = \frac{1}{Mx + Ny}$$

$$= \frac{1}{x^3y - 2x^2y^2 - x^3y + 3x^2y^2} = \frac{1}{x^2y^2}$$

Equation (i) × I.F.,

$$\left(\frac{x^2y - 2xy^2}{x^2y^2}\right)dx - \left(\frac{x^3 - 3x^2y}{x^2y^2}\right)dy = 0$$

$$\left(\frac{1}{y} - \frac{2}{x}\right)dx - \left(\frac{x}{y^2} - \frac{3}{y}\right)dy = 0 \quad \text{...(ii)}$$

$$M_1 = \frac{1}{y} - \frac{2}{x}$$

$$N_1 = -\frac{x}{y^2} + \frac{3}{y}$$

$$\frac{\partial M_1}{\partial y} = -\frac{1}{y^2}$$

$$\frac{\partial N_1}{\partial x} = -\frac{1}{y^2}$$

$$\frac{\partial M_1}{\partial y} = \frac{\partial N_1}{\partial x}$$

Equation (ii) is exact

The solution is,

$$\int M_1 dx + \int (\text{Terms in } N_1 \text{ free from } x)\,dy = C$$

$$\int\left(\frac{1}{y} - \frac{2}{x}\right)dx + \int \frac{3}{y}dy = C$$

$$\frac{x}{y} - 2\ln x + 3\ln y = C$$

*End of Solution*

**6.** If $u = x \log xy$, where $x^3 + y^3 + 3xy = 1$, then $\frac{du}{dx}$ is

(a) $1-\log xy+\frac{x(x^2+y)}{y(y^2+x)}$ (b) $1-\log xy-\frac{y(x^2+y)}{x(y^2+x)}$

(c) $1+\log xy-\frac{x(x^2+y)}{y(y^2+x)}$ (d) $1+\log xy+\frac{x(x^2+y)}{y(y^2+x)}$

**Ans. (c)**

$$u = x\log(xy) \text{ and } x^3 + y^3 + 3xy = 1 \quad ...(ii)$$

$$\frac{\partial u}{\partial x} = \frac{\partial}{\partial x}[x\log(xy)]$$

$$= x\left[\frac{1}{xy}\cdot y\right]+\log(xy)\,(1) = 1+\log(xy)$$

Again, $$\frac{\partial u}{\partial y} = \frac{\partial}{\partial y}[x\log xy] = x\left[\frac{1}{xy}\cdot x\right] = \frac{x}{y}$$

Now differentiating (ii) with respect to $x$ in an ordinary way.

$$\frac{d}{dx}(x^3)+\frac{d}{dx}(y^3)+3\frac{d}{dx}(xy) = 0 \quad ...(i)$$

$$3x^2+3y^2\frac{dy}{dx}+3\left[x\frac{dy}{dx}+y\right] = 0$$

i.e., $$\frac{dy}{dx} = -\frac{(x^2+y)}{(y^2+x)}$$

Now by total differentiation concept,

$$du = \left(\frac{\partial u}{\partial x}\right)dx+\left(\frac{\partial u}{\partial y}\right)dy$$

i.e., $$\frac{\partial u}{\partial x} = \left(\frac{\partial u}{\partial x}\right)+\left(\frac{\partial u}{\partial y}\right)\frac{dy}{dx}$$

$$= 1+\log(xy)-\frac{x}{y}\left[\frac{x^2+y}{y^2+x}\right]$$

*End of Solution*

**7.** The solution of differential equation $\frac{\partial^3 z}{\partial x^3} - 3\frac{\partial^3 z}{\partial x^2 \partial y} + 4\frac{\partial^3 z}{\partial y^3} = e^{x+2y}$ is

(a) $z = f_1(y-x) + f_2(y+2x) + xf_3(y+2x) + \frac{e^{x+2y}}{27}$

(b) $z = f_1(y-x) + f_2(y+2x) + xf_3(y+2x) + \frac{e^{x+2y}}{23}$

(c) $z = f_1(y+x) + f_2(y+2x) + xf_3(y+2x) + \frac{e^{x+2y}}{27}$

(d) $z = f_1(y-x) + f_2(y-2x) + xf_3(y+2x) + \frac{e^{x+2y}}{23}$

**Ans.** **(a)**

$$\frac{\partial^3 z}{\partial x^3} - \frac{\partial^3 z}{\partial x^3 \partial y} + 4\frac{\partial^3 z}{\partial y^3} = e^{x\,+\,2y}$$

Writing, $\frac{\partial}{\partial x} = D$ and $\frac{\partial}{\partial y} - = D'$ we get

$$[D^3 - 3D^2D' + 4D'^3]z = e^{x\,+\,2y} \qquad \text{...(i)}$$

Auxiliary equation is $m^3 - 3m^2 + 4 = 0$

$$(m + 1)(m - 2)^2 = 0$$

$$\Rightarrow \quad m = -1 \text{ and } 2, 2$$

So, $\text{C.F.} = f_1(y - x) + f_2(y + 2x) + x\, f_3(y + 2x)$

$$\text{P.I.} = \frac{1}{f(D,D')}(e^{x+2y}) = \frac{1}{D^3 - 3D^2D' + 4D'^3}(e^{x+2y})$$

$$= \frac{1}{1^3 - 3(1)(2) + 4(2)^3}(e^{x+2y}) = \frac{e^{x+2y}}{27}$$

Hence, solution of (i) is,

$$Z = \text{C.F.} + \text{P.I.}$$

$$Z = f_1(y-x) + f_2(y+2x) + xf_3(y+2x) + \frac{e^{x+2y}}{27}$$

*End of Solution*

**8.** If the imaginary part $v = e^x(x \sin y + y \cos y)$ is part of analytic function $f(z) = u + iv$, then $f(z)$ is

(a) $(1 + z)e^z + c$ (b) $z\, e^z + c$

(c) $z\, e^{2z} + c$ (d) $(1 - z)e^z + c$

**Ans.** **(b)**

$$v = e^x(x \sin y + y \cos y)$$

$$v_x = e^x(\sin y) + (x \sin y + y \cos y)e^x$$

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$$v_y = e^x(x\cos y + \cos y - y\sin y)$$

$$f'(z) = u_x + iv_x \qquad \text{[From } CR \text{ equations, } u_x = v_y\text{]}$$

$$= v_y + iv_x$$

$$f'(z) = e^x(x\cos y + \cos y - y\sin y) + e^x(\sin y + x\sin y + y\cos y)$$

Put, $x = z,\quad y = 0$ in $f'(z)$,

$$f'(z) = e^z(z + 1 - 0) + e^z(0 + 0 + 0)$$

$$\int f'(z)\,dz = \int (ze^z + e^z)\,dz$$

$$f(z) = ze^z - e^z + e^z + C$$

$$\therefore \quad f(z) = ze^z + C$$

*End of Solution*

**9.** The first four terms of the Taylor series expansion of $f(z) = \dfrac{z+1}{(z-3)(z-4)}$, when $z = 2$ is

(a) $\dfrac{11}{4}(z-2) + \dfrac{27}{8}(z-2)^2 + \dfrac{59}{16}(z-2)^3 + \ldots$

(b) $\dfrac{11}{4}(z+2) - \dfrac{27}{8}(z-2)^2 - \dfrac{59}{16}(z+2)^3 + \ldots$

(c) $\dfrac{3}{2} + \dfrac{11}{4}(z-2) + \dfrac{27}{8}(z-2)^2 + \dfrac{59}{16}(z-2)^3 + \ldots$

(d) $\dfrac{3}{2} - \dfrac{11}{4}(z-2) - \dfrac{27}{8}(z-2)^2 - \dfrac{59}{16}(z-2)^3 + \ldots$

**Ans.** **(c)**

Let, $z - 2 = t$

Then, $f(z) = \dfrac{z+1}{(z-3)(z-4)}$

$\Rightarrow$ $f(t) = \dfrac{t+3}{(t-1)(t-2)}$

$$= \frac{-4}{t-1} + \frac{5}{t-2} = 4[1-t]^{-1} - \frac{5}{2}\left(1 - \frac{t}{2}\right)^{-1}$$

$$= 4[1 + t + t^2 + \ldots] - \frac{5}{2}\left(1 + \frac{t}{2} + \frac{t^2}{4} + \ldots.\right)$$

$$= \frac{3}{2} + \frac{11}{4}(t) + \frac{27}{8}t^2 + \ldots$$

$$= \frac{3}{2} + \frac{11}{4}(z-2) + \frac{27}{8}(z-2)^2 + \ldots$$

*End of Solution*

**10.** The mean deviation about mean μ of a normal distribution is nearly

(a) $\frac{3}{5}\sigma$ (b) $\frac{5}{3}\sigma$

(c) $\frac{4}{5}\sigma$ (d) $\frac{5}{4}\sigma$

**Ans. (c)**

Mean deviation about mean μ of normal distribution is,

$$E\{|x-\mu|\} = \int_{-\infty}^{\infty} |x-\mu| f(x)\,dx$$

$$= \int_{-\infty}^{\infty} |x-\mu| \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{\left(\frac{x-\mu}{\sigma}\right)^2}{2}} dx$$

$$= \frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} |x-\mu| \cdot e^{-\frac{\left(\frac{x-\mu}{\sigma}\right)^2}{2}} dx$$

Let, $\frac{x-\mu}{\sigma} = t$

$x - \mu = \sigma t$

$x = \mu + \sigma t$

$dx = \sigma dt$

$$= \frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} \sigma|t| \cdot e^{-t^2/2} \cdot \sigma\,dt$$

$$= \frac{\sigma^2}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} |t| e^{-t^2/2}\,dt$$

$$= \frac{\sigma}{\sqrt{2\pi}} \cdot 2\int_{0}^{\infty} t e^{-t^2/2} = \frac{\sqrt{2}}{\sqrt{\pi}}\sigma = \sqrt{\frac{2}{\pi}}\sigma$$

Which is approximately $\frac{4}{5}\sigma$.

*End of Solution*

**11.** Consider the following regression equations obtained from a correlation table :

$y = 0.516\,x + 33.73$

$x = 0.512\,y + 32.52$

The value of the correlation coefficient will be

(a) 0.514 (b) 0.586

(c) 0.616 (d) 0.684

**Ans.** **(a)**

The two regression lines are,

$$y = 0.516x + 33.73$$

$$b_{yx} = 0.516$$

$$x = 0.512y + 32.52$$

$$b_{xy} = 0.512$$

Coefficient of correlation is,

$$r = \sqrt{b_{yx} \cdot b_{xy}}$$

$$= \sqrt{0.516 \times 0.512} = 0.514$$

*End of Solution*

**12.** If the probability of a bad reaction from a certain injection is 0.001, the chance that out of 2000 individuals, more than two will get a bad reaction will be

(a) 0.72 (b) 0.54

(c) 0.32 (d) 0.14

**Ans.** **(c)**

Probability of a bad reaction from a certain injection is,

$$p = 0.001$$

$$n = 2000$$

Mean, $\lambda = np = 2000\ (0.001) = 2$

$$\lambda = 2$$

$$p(x > 2) = 1 - p(x \le 2)$$

$$= 1 - \{p(x = 0) + p(x = 1) + p(x = 2)\}$$

$$= 1 - \left\{\frac{e^{-\lambda}\lambda^0}{0!} + \frac{e^{-\lambda}\lambda^1}{1!} + \frac{e^{-\lambda}\lambda^2}{2!}\right\}$$

$$= 1 - e^{-\lambda}\left\{1 + \lambda + \frac{\lambda^2}{2}\right\}$$

$$= 1 - e^{-2}\{1 + 2 + 2\}$$

$$= 1 - 5e^{-2}$$

$$= 1 - 0.676 = 0.324$$

*End of Solution*

**13.** As per de Broglie's relationship, the wavelength $\lambda$ related to its mass $m$ and velocity $v$ is

(a) $\frac{h}{mv}$ (b) $\frac{hv}{m}$

(c) $\frac{hm}{v}$ (d) $\frac{mv}{h}$

Where:

$h$ = Planck's constant

**Ans.** **(a)**

According to de Broglie's relationship

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

$\lambda$ = wavelength
$h$ = Planck's constant
$p$ = momentum
$m$ = mass
$v$ = velocity

*End of Solution*

**14.** Which of the following statements regarding an atom are correct?

1. If two atoms with similar ionization potential form a bond, then this bond will most probably be either covalent or metallic.
2. When atoms with different ionization potentials form a bond, the bond will be mainly ionic.
3. If the atom or molecule already has its outer shells completely full, then the bonding between the atoms or molecules will be a secondary bond when it solidifies.

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

**Ans.** **(d)**

All statements are correct.

*End of Solution*

**15.** A barium titanate crystal is inserted in a parallel plate condenser of area 10 mm × 10 mm. The plates having a separation of 2 mm, give a capacitance of $10^{-9}$ F. If the value of $\varepsilon_0 = 8.854 \times 10^{-12}$ Fm$^{-1}$, the relative dielectric constant of the crystal will be nearly

(a) 2640
(b) 2450
(c) 2260
(d) 2080

**Ans.** **(c)**

$$C = \frac{\epsilon_r \epsilon_0 A}{d}$$

$$\Rightarrow \quad \epsilon_r = \frac{c.d}{\epsilon_0 A}$$

$$\Rightarrow \quad \epsilon_r = \frac{10^{-9} \times 2 \times 10^{-3}}{8.854 \times 10^{-12} \times 100 \times 10^{-6}} = 2258.8$$

Nearest option (c).

*End of Solution*

**16.** A transformer core is wound with a coil carrying an alternating current at a frequency of 50 Hz. The hysteresis loop has an area of 60000 units when the axes are drawn in units of $10^{-4}$ Wb $m^{-2}$ and $10^{2}$ $Am^{-1}$. If the magnetization is uniform throughout the core volume of 0.01 $m^3$, the power loss due to hysteresis will be

(a) 300 W (b) 350 W
(c) 400 W (d) 450 W

**Ans.** **(a)**

Hysteresis loss = Area of Hysteresis loop × Frequency × Volume of core
= (60000) $(10^{-4} \times 10^{2})$ (50) (0.01)
= 300 W

*End of Solution*

**17.** When ferromagnetic or ferrimagnetic materials are magnetized, the direction of magnetization in any domain will be rotated from its preferential direction. This will show an anisotropic behaviour. On removal of the magnetizing force, the total magnetization will in general have a non-zero value. This behaviour is due to

(a) Crystal anisotropic (b) Stress anisotropic
(c) Shape anisotropic (d) Crystal, stress and shape anisotropic

**Ans.** **(d)**

*End of Solution*

**18.** The paramagnetic susceptibility varies inversely with the absolute temperature for ordinary fields and temperatures. It is given by the relation

$$\chi = \frac{C}{T}$$

The relation is known as

(a) Phenomenon of magnetostriction (b) Curie law of paramagnetism
(c) Hall Effect (d) Diamagnetism

**Ans.** **(b)**

Curie law for paramagnetic materials,

$$\chi = \frac{C}{T}$$

$\chi$ = susceptibility; $C$ = Curie constant; $T$ = temperature in $K$

*End of Solution*

**19.** If the interaction between the atomic permanent dipole moments is zero or negligible and the individual dipole moments are oriented at random, the material will be a

(a) Ferromagnetic material (b) Ferrimagnetic material
(c) Paramagnetic material (d) Antiferromagnetic material

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**Ans.** **(c)**

Paramagnetic materials contain randomly oriented permanent dipoles. There is no interaction among the dipoles, hence net permanent dipole moment is zero in the absence of field.

*End of Solution*

**20.** The magnetic moments of diamagnetic materials are mainly due to

(a) Electron spin angular momentum
(b) Nuclear spin angular momentum
(c) Orbital angular momentum of the electrons
(d) Centrifugal angular momentum

**Ans.** **(c)**

Diamagnetism is a very weak form of magnetism that is non-permanent and persists only while an external field is being applied. It is induced by a change in the orbital motion of electrons due to an applied magnetic field.

*End of Solution*

**21.** The inductance of an air-cored coil is proportional to

1. The square of the number of turns.
2. The diameter of the coil.
3. A form factor, F, dependent on the ratio of coil radius to coil length plus winding depth.

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

**Ans.** **(b)**

$$L = \frac{N^2 \mu a}{l} = \frac{N^2 \mu \pi}{l} \frac{D^2}{4}$$

$L \propto N^2$

$L \propto D^2$

So second statement is incorrect.

*End of Solution*

**22.** Light is capable of transferring electrons to the free-state inside a material thus increasing the electrical conductivity of the material. When the energy imparted to the electrons is quite large, the latter may be emitted from the material into the surrounding medium. This phenomenon is known as

(a) Photoemissive effect
(b) Photovoltaic effect
(c) Photoconductivity effect
(d) Photo absorptive effect

**Ans.** **(a)**

*End of Solution*

**23.** Which of the following statements is/are correct?

1. Conductor contain a large number of electrons in the conduction band at room temperature. No energy gaps exist and the valence and conduction bands overlap.
2. A semiconductor is a material in which the energy gap is so large that practically no electron can be given enough energy to jump this gap.
3. An insulator is a solid with an energy gap small enough for electrons to cross rather easily from the valence band to the conduction band.

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

**Ans.** **(a)**

Insulators have very large energy gap while semi-conductors have small energy gap.

*End of Solution*

**24.** Which of the following statements regarding superconducting materials are correct, when a large number of metals becomes superconducting below a temperature?

1. The resistivity ρ of the superconductor is zero.
2. The magnetic flux density *B* vanishes through the substance.
3. Ferromagnetic and Antiferromagnetic metals are good examples of superconducting materials.

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

**Ans.** **(c)**

Conditions for superconductivity:

1. Resistivity should be equal to zero.
2. Perfect diamagnetism (magnetic flux inside the material should be zero).

*End of Solution*

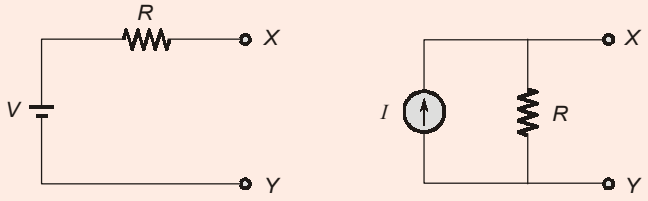
**25.** A voltage source-series resistance combination is equivalent to a current source-parallel resistance combination if and only if their

1. Respective open-circuit voltages are equal.
2. Respective short-circuit current are equal.
3. Resistance remains same in both cases.

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

**Ans.** **(d)**




*End of Solution*

**26.** For a network graph having its fundamental loop matrix $B_f$ and its sub-matrices $B_t$ and $B_l$ corresponding to twigs and links, which of the following statements are correct?

1. $B_l$ is always an identity matrix.
2. $B_t$ is an identity matrix.
3. $B_f$ has a rank of $b-(n-1)$, where $b$ is the number of branches and $n$ is the number of nodes of the graph.

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

**Ans.** **(c)**

*End of Solution*

**27.** The resistance $R$ of a conductor is

(a) $\frac{EA}{Jl}$ (b) $\frac{EJ}{Al}$
(c) $\frac{El}{JA}$ (d) $\frac{JA}{El}$

Where:

$E$ = Electrical field intensity
$A$ = Cross-sectional area
$J$ = Current density
$l$ = Length of conductor

**Ans.** **(c)**

As, $J = \sigma E$

$$J = \frac{1}{\rho}E$$

$$\rho = \frac{E}{J}$$

$$\therefore \quad \rho\frac{l}{A} = \frac{E}{J}\frac{l}{A}$$

As $R = \frac{\rho l}{A}$

$$\Rightarrow \quad R = \frac{El}{JA}$$

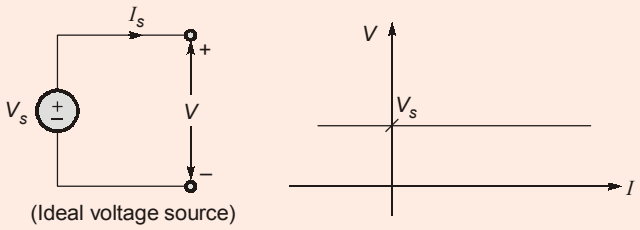
*End of Solution*

**28.** Which of the following statements are correct for an ideal constant voltage source?

1. Its output voltage remains absolutely constant whatever the change in load current.
2. It possesses zero internal resistance so that internal voltage drop in the source is zero.
3. Output voltage provided by the source would remain constant irrespective of the amount of current drawn from it.
4. Output voltage provided by the source varies with the amount of current drawn from it.

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

**Ans.** (d)



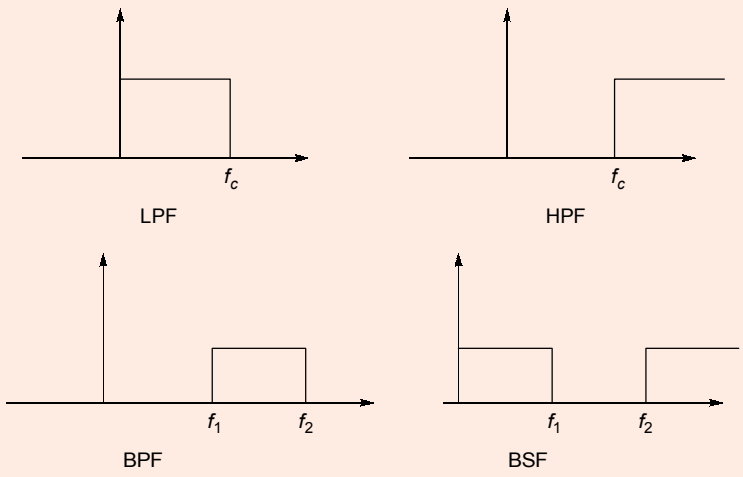

*End of Solution*

**29.** Which of the following statements are correct?

1. A lowpass filter passes low frequencies and stops high frequencies.
2. A highpass filter passes high frequencies and rejects low frequencies.
3. A bandpass filter passes frequencies within a frequency band and attenuates frequencies outside the band.
4. A bandstop filter passes frequencies within the band and blocks/attenuates frequencies outside a frequency band.

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

**Ans.** (d)



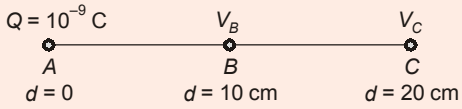

*End of Solution*

**30.** A point charge of $10^{-9}$ C is placed at a point A in the free space. The potential difference between the two points 20 cm and 10 cm away from the charge at A will be

(a) 40 V (b) 45 V

(c) 50 V (d) 55 V

**Ans.** **(b)**




$$V = \frac{Q}{4\pi \epsilon_0 d}$$

$$V_{BC} = V_B - V_C$$

$$= \frac{Q}{4\pi \epsilon_0}\left[\frac{1}{r_B} - \frac{1}{r_C}\right]$$

$$= (10^{-9})(9 \times 10^9)\left(\frac{100}{10} - \frac{100}{20}\right)$$

$$= 9\ (10 - 5)$$

$$= 45 \text{ Volt}$$

*End of Solution*

**31.** According to Gauss's theorem, the surface integral of the normal component of electric flux density $D$ over a closed surface, containing free charge is

(a) $Q$ (b) $\frac{Q}{\varepsilon_0}$

(c) $\varepsilon_0 Q$ (d) $\frac{Q^2}{\varepsilon_0}$

**Ans.** **(a)**

Gauss law say

$$\oiint \vec{D} \cdot \vec{ds} = Q_{enc}$$

$$= Q$$

*End of Solution*

**32.** A unit magnetic pole may be defined as that pole which when placed in vacuum at a distance of one metre from a similar and equal pole repels it with a force of

(a) $\frac{1}{4\pi}$ Newtons (b) $\frac{\mu_0}{4\pi}$ Newtons

(c) $\frac{\pi}{4\mu_0}$ Newtons (d) $\frac{1}{4\pi\mu_0}$ Newtons

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**Ans.** **(b)**

Force between two point magnetic poles present in free space is

$$F = \frac{\mu_0 m_1 m_2}{4\pi r^2} \text{ (Newton)}$$

Where, $m_1$ , $m_2$ are strengths of two magnetic poles in terms of unit magnet poles a unit magnet pole is defined as one that exerts a force of one dyne ($10^{-7}$ Newton) on another unit magnet pole when poles one in free space and separated by 1 meter distance in MKS system.

Unit magnet pole = $10^{-7}$ Newton

$$= \frac{\mu_0}{4\pi} \text{ Newton}$$

*End of Solution*

**33.** An analogous of magnetic circuit 'permeability' in electrical circuit is

(a) Reluctivity (b) Conductance

(c) Conductivity (d) Resistivity

**Ans.** **(c)**

Permeability, $\mu$ = (H/m)

$\Rightarrow \quad \vec{B} = \mu\vec{H}$

Conductivity, $\sigma$ = ($\mho$/m)

$\Rightarrow \quad \vec{J} = \sigma\vec{E}$

*End of Solution*

**34.** The magnetizing force at the centre of a circular coil varies ..,..

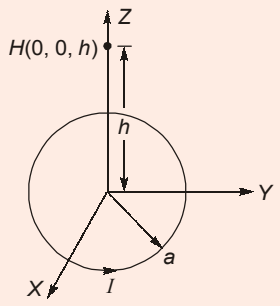
1. Directly as the number of its turns.
2. Directly as the current.
3. Directly as its radius.
4. Inversely as its radius.

Which of the above statements are correct?

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

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

**Ans.** **(c)**



$$H(0, 0, h) = \frac{Ia^2}{2(a^2 + h^2)^{3/2}}$$

At centre, $H(0, 0, 0) = \frac{Ia^2}{2(a^2)^{3/2}} = \frac{I}{2a}$

If $N$-turn circular coil then replace $I$ with $NI$

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

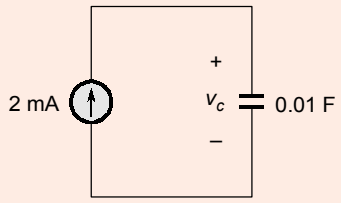
$N$ is number of turns.
$I$ is current in coil.
$a$ is radius of circular coil.

*End of Solution*

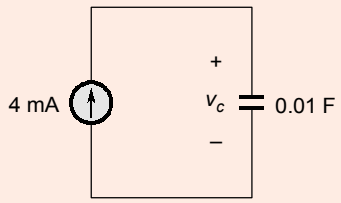
**35.** An uncharged capacitor of 0.01 F is charged first by a current of 2 mA for 30 s and then by a current of 4 mA for 30 s. The final voltage in it will be

(a) 12 V (b) 18 V
(c) 24 V (d) 30 V

**Ans. (b)**




$$v_c = \frac{1}{0.01}\int_0^{30}(2\times10^{-3})dt + 0 = 100\times2\times10^{-3}(t)\Big|_0^{30}$$




$$v_c = 6 + \frac{1}{0.01}\int_0^{30}(4\times10^{-3})dt = 6 + \left[100\times4\times10^{-3}\times(t)\Big|_0^{30}\right]$$

$= 6 + 12 = 18$ V

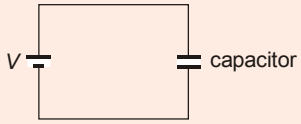
*End of Solution*

**36.** A capacitor of 10 pF is connected to a voltage source of 100 V. If the distance between the capacitor plates is reduced to 50%, while it remains connected to the 100 V supply, the value of potential gradient in the second case will be

(a) Half of earlier value
(b) Same as earlier value
(c) Twice of earlier value
(d) One-fourth of earlier value

**Ans.** (c)

$$E = \frac{V}{d};$$




Where $V$ is constant.

$$E \propto \frac{1}{d}$$

$$\Rightarrow \quad \frac{E_2}{E_1} = \frac{d_1}{d_2}$$

$$\Rightarrow \quad E_2 = \frac{d_1}{\left(\frac{1}{2}d_1\right)}E_1$$

$$E_2 = 2E_1$$

*End of Solution*

**37.** Which of the following statements are correct?

1. Accuracy is the closeness with which an instrument approaches the true value of the quantity being measured.
2. Precision is a measure of the reproducibility of the measurement.
3. Precision of an instrument can be improved upon by calibration.
4. Accuracy may be specified in terms of limits of errors.

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

**Ans.** (c)

*End of Solution*

**38.** An electrodynamometer instrument can be used as

1. Wattmeter and VAR meter.
2. Power factor meter and frequency meter.
3. Transfer instrument.

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

**Ans.** (d)

*End of Solution*

**39.** The moving iron instruments when measuring voltages or currents,
(a) Indicate the same values of the measurement for both ascending and descending values of current.
(b) Indicate higher values of the measurement for ascending values of current.
(c) Indicate higher values of the measurement for descending values of current.
(d) Indicate lower values of the measurement for both ascending and descending values of current.

**Ans.** (c)

*End of Solution*

**40.** True RMS-reading voltmeter
1. Measures the RMS value of voltage accurately.
2. Eliminates the error due to waveform.
3. Uses the thermocouple for heating.

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

**Ans.** (d)

*End of Solution*

**41.** Instrument transformers are
(a) Used to extend the range of the AC measuring instruments only.
(b) Used to isolate the measuring instruments from the high voltage only.
(c) Used to extend the range and isolate the measuring instruments.
(d) Not used at generating stations and transformer stations.

**Ans.** (c)

*End of Solution*

**42.** The power in a 3-phase circuit is measured with the help of 2-wattmeters; the readings of one of the wattmeters is positive and that of the other is negative. The magnitude of readings is different. It can be concluded that the power factor of the circuit will be
(a) Unity
(b) Zero
(c) 0.5
(d) Less than 0.5

**Ans.** (d)

*End of Solution*

**43.** In a Q-meter, distributed capacitance of a coil is measured by changing the capacitance of the tuning capacitor. The values of tuning capacitor are $C_1$ and $C_2$ for resonant frequencies $f_1$ and $2f_1$ respectively. The value of distributed capacitance will be
(a) $\frac{C_1 - C_2}{2}$
(b) $\frac{C_1 - 2C_2}{3}$
(c) $\frac{C_1 - 4C_2}{3}$
(d) $\frac{C_1 - 3C_2}{2}$

**Ans.** **(c)**

$$C_d = \frac{C_1 - nC_2}{(n^2 - 1)}$$

$$n = 2$$

$$\Rightarrow \quad C_d = \frac{C_1 - 4C_2}{3}$$

*End of Solution*

**44.** In a digital voltmeter, during start of conversion, zero indication is displayed and is called auto zeroing. This is achieved by

(a) Using a positive reference voltage
(b) Using a negative reference voltage
(c) Properly charging the differentiator circuit capacitance to ground
(d) Properly discharging the integrator circuit capacitance to ground

**Ans.** **(d)**

*End of Solution*

**45.** A CRT has an anode voltage of 2000 V and parallel deflecting plates 2 cm long and 5 mm apart. The screen is 30 cm from the centre of the plates. If the input voltage is applied to the deflecting plates through amplifiers having an overall gain of 100, the input voltage required to deflect the beam through 3 cm will be

(a) 1 V (b) 3 V
(c) 5 V (d) 7 V

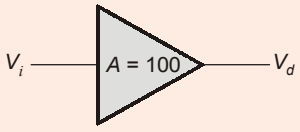
**Ans.** **(a)**

$V_a = 2000$ V,
$l_d = 2$ cm,
$d = 5$ mm $= 0.5$ cm,
$L = 30$ cm
$D = 3$ cm,
$V_d = ?$

$$D = \frac{L l_d \cdot V_d}{2 V_a \cdot d}$$

$$\Rightarrow \quad V_d = \frac{2 V_a \cdot d \cdot D}{L \cdot l_d}$$

$$V_d = \frac{2 \times 2000 \times 0.5 \times 3}{30 \times 2} = 100 \text{ Volt}$$




$$V_i = \text{Input} = \frac{V_d}{\text{gain}} = \frac{100 \text{ Volt}}{100} = 1 \text{ volt}$$

*End of Solution*

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**46.** An aquadag is used in a CRO to collect
(a) Primary electrons only
(b) Secondary emission electrons only
(c) Both primary electrons and secondary emission electrons
(d) Heat emission electrons

**Ans.** **(b)**

*End of Solution*

**47.** A resistance wire strain gauge with a gauge factor of 2 is bonded to a steel structural member subjected to a stress of 100 MN/m$^2$. The modulus of elasticity of steel is 200 GN/m$^2$. The percentage change in the value of the gauge resistance due to the applied stress will be
(a) 0.1% (b) 0.3%
(c) 0.5% (d) 0.7%

**Ans.** **(a)**

$$G_f = 2$$
$$\text{stress} = 100 \times 10^6 \text{ N/m}^2,$$
$$y = 200 \times 10^9 \text{ N/m}^2$$
$$G_f = \frac{\Delta R / R}{\epsilon}$$
$$\Rightarrow \quad \frac{\Delta R}{R} = G_f \cdot \epsilon$$
$$\% \frac{\Delta R}{R} = G_f \cdot \epsilon \times 100$$
$$y = \frac{\text{stress}}{\text{strain}}$$
$$\Rightarrow \quad \epsilon = \frac{100 \times 10^6}{200 \times 10^9} = 0.5 \times 10^{-3}$$
$$\% \frac{\Delta R}{R} = 2 \times 0.5 \times 10^{-3} \times 100 = 0.1\%$$

*End of Solution*

**48.** Capacitive transducers can be used for the measurement of liquid level. The principle of operation used in this case is the change of capacitance with change of
(a) Distance between plates (b) Area of plates
(c) Dielectric (d) Resonance

**Ans.** **(c)**

*End of Solution*

**49.** The hexadecimal of the binary number $(11010011)_2$ is

(a) $D3_{16}$ (b) $D4_{16}$

(c) $C3_{16}$ (d) $C4_{16}$

**Ans.** **(a)**

To convert a binary number into hexadecimal, we start from the LSB binary digit and from groups of 4 binary digits. Next, we write the hexadecimal equivalent of each group of 4 bits.

$$\underbrace{1101}_{D}\ \underbrace{0011}_{3}$$

*End of Solution*

**50.** Which one of the following relations from the Boolean algebra pertaining to, 'AND' operation **cannot** be verified when A and B can take on only the value 0 or 1?

(a) AB = BA (b) AA = A

(c) A1 = 1 (d) A0 = 0

**Ans.** **(c)**

Given, $A \cdot 1 = A$

A can be either 0 or 1

If $A = 0$, then, $A \cdot 1 = 0 \cdot 1 = 0$

If $A = 1$, then, $A \cdot 1 = 1 \cdot 1 = 1$

Hence, $A \cdot 1 = 1$ cannot be verified.

*End of Solution*

**51.** Which of the following design levels of a computer are widely used in computer design?

1. Gate level
2. Processor level
3. Register level
4. User level

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

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

**Ans.** **(b)**

*End of Solution*

**52.** Which one of the following is a powerful web platform for web applications and web services, built-in virtualization technologies, variety of new security tools, enhancements and streamlined configuration and management tools?

(a) Internet Explorer (b) Internet Information Services

(c) Web Matrix (d) Visual Web Developer

**Ans.** **(d)**

*End of Solution*

**53.** Which one of the following is the correct sequence of steps for executing an instruction during CPU's processing ?

(a) Fetch instruction, Read data, Decode instruction, Store data and Execute instruction
(b) Decode instruction, Read data, Execute instruction, Fetch Next instruction and Store data
(c) Decode instruction, Decode next operands, Fetch Next instruction and Store data
(d) Fetch instruction, Decode instruction, Read operands, Execute instruction and Store data

**Ans.** **(d)**

Basic steps of execution of an instruction.

*End of Solution*

**54.** Which one of the following is the correct combination of registers in DMA controller?

(a) Data register, Stack pointer and Data counter
(b) Data register, Address register and Data counter
(c) Data register, Stack pointer and Address register
(d) Data register, Program counter and Data counter

**Ans.** **(b)**

Address register to store source address, count register → to hold count of no. of bytes
Data registers → To hold data from memory or I/O while transferring.

*End of Solution*

**55.** A multiprocessing technology which enables software to treat a single processor as two processors to utilize the processing power in the chip that would otherwise go unused and lets the chip operate more efficiently resulting in faster processing is called

(a) Systematic multiprocessing
(b) Massively parallel processing
(c) Co–processing
(d) Hyper threading

**Ans.** **(d)**

*End of Solution*

**56.** A physical implementation of the type declaration in high-level programming languages where major information types should be assigned formats for identification is called

(a) Storage order
(b) Tag
(c) Error correction
(d) Error detection

**Ans.** **(a)**

*End of Solution*

**57.** Which of the following factors are to be considered while selecting number representations to be used in a computer?

1. Number types to be represented
2. Range of values to be encountered
3. Cost of the hardware to store and process the numbers
4. Positional notation with fixed weight

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

**Ans.** **(a)**

*End of Solution*

**58.** If a negative binary number is to be represented by n–bits, then the standard format will be

(a) Sign bit '0' on left and magnitude right
(b) Sign bit '1' on left and magnitude on right
(c) Sign bit '0' on right and magnitude on left
(d) Sign bit '1' on right and magnitude on left

**Ans.** **(b)**

In signed binary number representation, the MSB represents the sign of the number and remaining bits represent the magnitude of the number.

$$\overline{\text{Sign bit}}\ \overline{\text{Magnitude bits}}$$

Moreover, if the number is positive the sign bit = 0; and if the number is negative, the sign bit = 1.

*End of Solution*

**59.** The physical address translation in virtual memory address with Memory Management Unit (MMU) is done by which one of the following mechanisms?

(a) Multiply virtual, address by some constant
(b) Translation lookaside buffer (TLB)
(c) Encryption key
(d) Using general purpose register in CPU

**Ans.** **(b)**

*End of Solution*

**60.** Which one of the following satellite systems is most often used for Global Positioning System (GPS) ?

(a) Geosynchronous (b) Geostationary
(c) Low Earth Orbit (d) Medium Earth Orbit

**Ans.** **(d)**

*End of Solution*

**61.** In a tunnel diode, the width of the junction barrier is
(a) Directly proportional as the square root of impurity concentration
(b) Inversely proportional as the square root of impurity concentration
(c) Directly proportional as square of impurity concentration
(d) Inversely proportional as square of impurity concentration

**Ans.** **(b)**

$$W = \left(\frac{2\epsilon_0\epsilon_r V_j}{q} \times \frac{1}{\text{doping}}\right)^{1/2}$$

$$W \propto \frac{1}{\sqrt{\text{doping}}}$$

*End of Solution*

**62.** In a grounded-emitter transistor, when emitter current becomes zero in cut-off region the emitter potential is called
(a) Floating Emitter Potential
(b) Breaking Emitter Potential
(c) Cascading Emitter Potential
(d) Cut-off Emitter Potential

**Ans.** **(a)**

*End of Solution*

**63.** When maximum reverse-biasing voltage is applied between the collector and base terminals of the transistor and emitter is open circuited, breakdown occurs due to
(a) Avalanche breakdown
(b) Avalanche multiplication
(c) Punch–through
(d) Reach–through

**Ans.** **(b)**

$$\beta V_{CEO} = \frac{\beta V_{CBO}}{\sqrt[n]{\beta}}$$

Where, $n$ = Avalanche multiplication factor

*End of Solution*

**64.** In a Field Effect Transistor (FET) the maximum voltage that can be applied between any two terminals is given by

(a) Low $|V_{DS}|$ causing avalanche breakdown

(b) Low $|V_{GS}|$ causing avalanche breakdown

(c) $|V_{DS}| = 0$ when gate is reverse–biased

(d) $|V_{GS}| = 0$ when gate is reverse–biased

**Ans.** **(a)**

*End of Solution*

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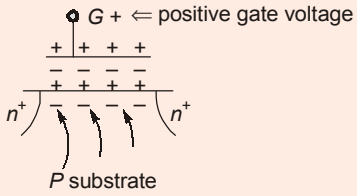
65. A depletion–type MOSFET can be operated in an enhancement mode where negative charges are induced into n–type channel by applying
(a) Positive Gate Voltage
(b) Negative Gate Voltage
(c) Positive Drain Voltage
(d) Negative Drain Voltage

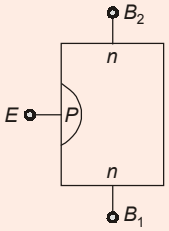
**Ans.** **(a)**




*End of Solution*

66. The double base diode which is operated with the emitter forward biased and a smaller emitter junction is called
(a) Field Effect Transistor (FET)
(b) Uni-Junction Transistor (UJT)
(c) Bipolar Junction Transistor (BJT)
(d) Metal Oxide Semiconductor Field Effect Transistor (MOSFET)

**Ans.** **(b)**




Uni junction transistor (UJT)

*End of Solution*

67. Which one of the following is **not** a distortion type that exists either separately or simultaneously in amplifiers?
(a) Linear distortion
(b) Non-linear distortion
(c) Frequency distortion
(d) Delay distortion

**Ans.** **(a)**

Linear distortion is not a distortion type in Amplifiers.

*End of Solution*

68. Transistor noise caused by the recombination and generation of carriers on the surface of the crystal is called
(a) Thermal noise
(b) Excess noise
(c) White noise
(d) Shot noise

**Ans.** **(b)**

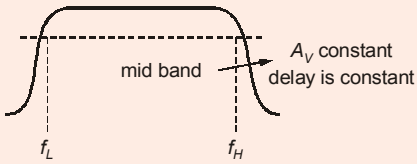
*End of Solution*

**69.** During a low frequency response of an amplifier which is invariably of RC–coupled type, there is a range of frequency characteristics over which the amplification is constant and delay is also constant, called

(a) Low band frequency
(b) Mid band frequency
(c) High band frequency
(d) Hyper band frequency

**Ans.** **(b)**

RC coupled amplifier frequency response




*End of Solution*

**70.** In a crystal oscillator, especially when piezoelectric crystal like quartz is applied, then the inductor L, capacitor C and resistor R are the analogs of the mechanical system as

(a) Mass, compliance, viscous-damping factor
(b) Mass, spring constant, viscous-damping
(c) Mass, momentum, viscous-damping factor
(d) Mass, displacement, viscous-damping factor

**Ans.** **(b)**

Mass, spring constant, viscous-damping factor.

*End of Solution*

**71.** In a phase shift oscillator using an FET, at a certain frequency if the phase shift introduced by the RC network is 180°, then the total phase shift from gate around the circuit and back to the gate will be

(a) 0°
(b) 90°
(c) 180°
(d) 270°

**Ans.** **(a)**

0° (zero degree)
overall phase shift will be
0° or $2\pi$

*End of Solution*

**72.** In a feedback amplifier, which configuration increases bandwidth, decreases non-linear distortion and improves transconductance with negative feedback ?

(a) Voltage-series
(b) Current-series
(c) Voltage-shunt
(d) Current-shunt

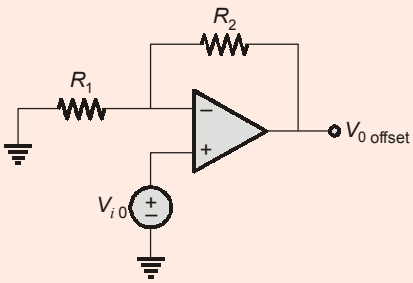
**Ans.** **(b)**

To improve transconductance current series is better.

*End of Solution*

**73.** In order to balance the offset voltage of an operational amplifier, a small DC voltage is applied to input terminals where the connection is
(a) Series with both inverting as well as non–inverting input
(b) Series with non–inverting input
(c) Shunt with inverting input
(d) Shunt with non–inverting input

**Ans.** **(b)**




Series with non inverting input.

*End of Solution*

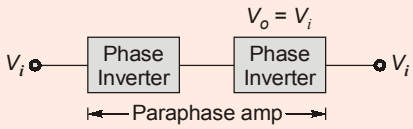
**74.** Multi-vibrator circuit that remains in stable state until a triggering signal causes transition to quasistable state and returns to stable state after certain time is called
(a) Astable multivibrator
(b) Monostable multivibrator
(c) Bistable multivibrator
(d) Unstable multivibrator

**Ans.** **(b)**
Mono stable multivibrator remains in stable state until a triggering signal causes a transition to quasistable state and return to stable state.

*End of Solution*

**75.** In a paraphase amplifier, where two amplifiers are connected in cascade, the output from second stage
(a) Equals signal input without change of sign
(b) Equals signal input with change of sign
(c) Does not equal to signal input and has no sign change
(d) Does not equal to signal input but has sign change

**Ans.** **(a)**




*End of Solution*

**76.** Which one of the following statements is **not** correct for an active filter used in the field of communications and signal processing ?
(a) It is more economical
(b) It does not cause loading of the source or load.
(c) It is easier to tune or adjust
(d) It exhibits insertion loss

**Ans.** **(d)**
Active filter will not have insertion loss.

*End of Solution*

**77.** A two–step procedure in a typical diffusion apparatus to obtain the complementary–error–function Gaussian distribution involves the first step and second step respectively as
(a) Predeposition and Drive–in
(b) Predeposition and Drive–out
(c) Drive–in and Postdeposition
(d) Drive–out and Postdeposition

**Ans.** **(a)**
Impurity diffusion is of two types:
(i) Predeposition which results in complementary error function profile.
(ii) Drive in diffusion which results in Gaussian distribution profile.

*End of Solution*

**78.** In AM modulation, the equation of the modulating signal is given by $f(t) = A_m \cos \omega_m t$. If the amplitude of the carrier wave is A and there is no over–modulation, the modulation efficiency will be
(a) 33.3%
(b) 38.6%
(c) 43.3%
(d) 48.6%

**Ans.** **(a)**
In AM: For no over modulation $\mu \leq 1$

Max. $\mu = 1$

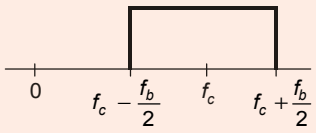
$$\text{Modulation efficiency} = \frac{\mu^2}{2+\mu^2} = \frac{1}{3} = 33.3\%$$

*End of Solution*

**79.** For a binary phase–shift keying modulator with a carrier frequency of 70 MHz and input bit rate of 10 Mbps, the maximum Upper Side Frequency (USF) and minimum Lower Side Frequency (LSF) are respectively
(a) 85 MHz and 65 MHz
(b) 75 MHz and 65 MHz
(c) 55 MHz and 45 MHz
(d) 55 MHz and 45 MHz

**Ans.** **(b)**

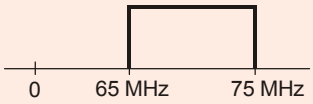
In BPSK: If binary sequence is represented by sinc pulses then, BPSK spectrum will be




Given, $f_c = 70$ MHz

$f_b = 10$ Mbps

BPSK spectrum:




*End of Solution*

**80.** In modulation system, the energy per bit–to–noise power density ratio $E_b/N_0$ is

(a) $\frac{C}{N} \times \frac{f_b}{B}$ (b) $\frac{N}{C} \times \frac{B}{f_b}$

(c) $\frac{C}{N} \times \frac{B}{f_b}$ (d) $\frac{N}{C} \times \frac{f_b}{B}$

Where, $N$ = Noise power of thermal (W)

$B$ = Bandwidth (Hz)

$C$ = Carrier power (W)

$f_b$ = Bit rate (bps)

**Ans.** **(c)**

$$E_b = \text{Power} \times \text{Time duration}$$
$$= C \times T_b$$

Thermal (or) white noise power $\Rightarrow N = N_0 B$

$$N_0 = \frac{N}{B}$$

$$\frac{E_b}{N_0} = \frac{C \times T_b}{(N/B)} = \frac{C \times B}{N \times R_b}$$

$\because$ $$T_b = \frac{1}{R_b} = \frac{C \times B}{N \times f_b}$$

*End of Solution*

**81.** Which one of the following is not a transmission parameter of a private line data circuit that utilizes public telephone network?

(a) Geographical parameter (b) Bandwidth parameter

(c) Interface parameter (d) Facility parameter

**Ans.** **(a)**

*End of Solution*

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**82.** The Shannon limit for information capacity $I$ is

(a) B $\log_2\left(1-\frac{S}{N}\right)$ (b) B $\log_2\left(1+\frac{S}{N}\right)$

(c) B $\log_{10}\left(1-\frac{S}{N}\right)$ (d) B $\log_{10}\left(1+\frac{S}{N}\right)$

Where
N = Noise power (W)
B = Bandwidth (Hz)
S = Signal power (W)

**Ans.** **(b)**

$$C = B\log_2\left(1+\frac{S}{N}\right)$$

$C \rightarrow$ Channel capacity

*End of Solution*

**83.** In a time division multiplexing, there are 8000 samples for a digital signal-0 channel that uses 8 kHz sample rate and 8 bit PCM code. The line speed will be

(a) 56 kbps (b) 64 kbps
(c) 76 kbps (d) 84 kbps

**Ans.** **(b)**

Speed of commutator in TDM

$\Rightarrow$ $R_b = Nnf_s$

Number of signals multiplexed is not given. So that TDM is normal PCM only, where only one signal is transmitted,

$R_b = nf_s \quad (\because N = 1)$
$= 8 \times 8\ k$
$= 64$ kbps

*End of Solution*

**84.** For an 8–PSK system, operating with an information bit rate of 24 kbps, the baud rate will be

(a) 16,000 (b) 12,000
(c) 8,000 (d) 6,000

**Ans.** **(c)**

Baud rate (or) symbol rate $= \frac{R_b}{\log_2 M}$

For 8-PSK $\Rightarrow M = 8$

$$\text{Baud rate} = \frac{24k}{\log_2 8} = 8k$$

*End of Solution*

**85.** During transformation of independent variable, if two signals identical in shape are displaced relative to each other, then the difference in propagation time from point of origin of transmitted signal results in

(a) Time shift
(b) Time reversal
(c) Time scaling
(d) Time reduction

**Ans.** **(a)**

*End of Solution*

**86.** Which of the following statements is/are correct?

1. A continuous-time system is a system in which, continuous-time input signals are applied; resulting in continuous-time output signals.
2. A system is said to be linear if it follows the superposition theorem.
3. A system is said to be non-linear if it follows the superposition theorem.

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

**Ans.** **(b)**

*End of Solution*

**87.** A discrete time signal is said to be unit sample sequence if

(a) $\delta(n) = 1$ for $n = 0$ $= 0$ for $n \neq 0$
(b) $\delta(n) = 2$ for $n = 0$ $= 0$ for $n \neq 0$
(c) $\delta(n) = -1$ for $n = 0$ $= 0$ for $n \neq 0$
(d) $\delta(n) = -2$ for $n = 0$ $= 0$ for $n \neq 0$

**Ans.** **(a)**

*End of Solution*

**88.** A signal is said to be

1. Deterministic if there is no uncertainty over the signal at any instant of time.
2. Deterministic if it is expressible through a mathematical equation.
3. Random or non–deterministic if there is uncertainty over the signal at the instant of time.
4. Random or non–deterministic if it is not expressible through a mathematical equation.

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

**Ans.** **(d)**

*End of Solution*

**89.** Linear time-invariant systems that, are designed to pass some frequencies essentially undistorted and significantly attenuate or eliminate others are

(a) Frequency-shaping filters (b) Frequency-selective filters
(c) Time-shaping filters (d) Time-selective filters

**Ans.** **(b)**

*End of Solution*

**90.** If the input signal $x(t)$ and impulse response $h(t)$ of a continuous-time system are described as
$x(t) = e^{-3t}\,u(t)$ and $h(t) = u(t-1)$, the output $y(t)$ will be

(a) $\frac{1}{3}\left[1-e^{-3(t-1)}\right]$ (b) $\frac{1}{3}\left[1-e^{-3t}\right]$
(c) $\frac{1}{3}\left[1+e^{-3(t-1)}\right]$ (d) $\frac{1}{3}\left[1+e^{-3t}\right]$

**Ans.** **(a)**

$$x(\tau) = e^{-3\tau}\,u(\tau)$$
$$h(t-\tau) = u(-\tau + (t-1))$$
$$y(t) = \begin{cases} \int_0^{t-1} e^{-3\tau}d\tau, & (t-1)>0 \\ 0, & t-1<0 \end{cases}$$
$$y(t) = \frac{1}{3}[1-e^{-3(t-1)}]; \quad t>1$$

*End of Solution*

**91** Consider the LTI system whose response to the input
$x(t) = [e^{-t} + e^{-3t}]\,u(t)$ is $y(t) = [2e^{-t} - 2e^{-4t}]\,u(t)$.
The system's impulse response will be

(a) $\frac{3}{2}[e^{-2t}+e^{-4t}]u(t)$ (b) $\frac{3}{2}[e^{-2t}-e^{-4t}]u(t)$
(c) $\frac{1}{2}[e^{-2t}+e^{-4t}]u(t)$ (d) $\frac{1}{2}[e^{-2t}-e^{-4t}]u(t)$

**Ans.** **(a)**

$$Y(s) = \frac{6}{(s+1)(s+4)} \quad ; \quad X(s) = \frac{2(s+2)}{(s+1)(s+3)}$$

So, $$H(s) = \frac{3(s+3)}{(s+2)(s+4)} = \frac{3/2}{s+2} + \frac{3/2}{s+4}$$

So, $$h(t) = \frac{3}{2}[e^{-2t}+e^{-4t}]\,u(t)$$

*End of Solution*

**92.** Consider an LTI system with a system function

$$H(z) = \frac{1}{1-\frac{1}{4}z^{-1}}$$

Its difference equation will be

(a) $y(n)-\frac{1}{2}y(n-1)=x(n)$ (b) $y(n)-\frac{1}{4}y(n-1)=x(n)$

(c) $y(n)+\frac{1}{2}y(n-1)=x(n)$ (d) $y(n)-\frac{1}{4}y(n+1)=x(n)$

**Ans. (b)**

$$H(z) = \frac{Y(z)}{X(z)} = \frac{1}{1-\frac{1}{4}z^{-1}}$$

$$Y(z)-\frac{1}{4}z^{-1}\cdot Y(z) = X(z)$$

$$y[n]-\frac{1}{4}y[n-1] = x[n]$$

*End of Solution*

**93.** It is assumed that quantization error, $e(n)$ is a sequence of random variable where

1. The statistics do not change with time.
2. It is a sequence of uncorrelated random variables.
3. It is uncorrelated with the quantizer input $x(n)$.
4. The probability density function is uniformly distributed over the range of values of quantization error.

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

**Ans. (b)**

*End of Solution*

**94.** For a given differential equation,

$$\frac{d^2y(t)}{dt^2}+4\frac{dy(t)}{dt}+5y(t)=5x(t)$$

with $y(0^-)=1$ and $\left.\frac{dy(t)}{dt}\right|_{0^-}=2$

and input $x(t) = u(t)$.

The output $y(t)$ will be

(a) $2u(t) - 2e^{-2t}\sin t$ (b) $u(t) + 2e^{-2t}\sin t$

(c) $u(t) - e^{-t}\sin t$ (d) $2u(t) + e^{-t}\sin t$

**Ans.** **(b)**

$$[s^2Y(s) - sy(0^-) - y'(0^-)] + 4[sY(s) - y(0^-)] + 5Y(s) = 5\,X(s)$$

So, $$Y(s) = \frac{s^2+6s+5}{s(s^2+4s+5)}$$

$$y(t) = u(t) + 2e^{-2t}\sin t$$

*End of Solution*

**95.** The Nyquist rate for the signal $x(t) = \frac{1}{2\pi}\cos(4000\,\pi t)\cos(1000\,\pi t)$ will be

(a) 5 kHz (b) 10 kHz
(c) 15 kHz (d) 20 kHz

**Ans.** **(a)**

$$x(t) = \frac{1}{2\pi}\cos 4000\pi t \cdot \cos 1000\pi t$$

So, $f_m = 2000 + 500 = 2.5$ kHz

So, $f_s = 5$ kHz

*End of Solution*

**96.** Which of the following statements is/are correct?

1. A system is said to be Finite Impulse Response (FIR), if the output samples of the system depend only on the present input and a finite number of past or previous input samples.
2. If the output of a system $y(n)$ depends only on the present input and past inputs, but not on past outputs, then it is called a non-recursive system.
3. If the output of a system $y(n)$ depends only on the present input and past inputs, but not on past outputs, then it is called a recursive system.

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

**Ans.** **(b)**

*End of Solution*

**97.** The value of the steady state error for first order system, $\frac{1}{sT+1}$ with Unit Ramp Function will be

(a) $\frac{1}{T}$ (b) $T$

(c) $T\left(1-e^{-\frac{t}{T}}\right)$ (d) $\frac{1}{T}e^{-\frac{t}{T}}$

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**Ans.** **(b)**

Given, $\frac{C(s)}{R(s)} = \frac{1}{1+sT}$

Also, $C(s) = \frac{1}{1+sT}R(s) = \frac{1}{1+sT}\frac{1}{s^2}$

By partial fraction:

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

Taking inverse Laplace transform

$$= tu(t) - Tu(t) + Te^{-t/T}$$

The error signal, $e(t) = r(t) - c(t)$

$$= tu(t) - [t - T + Te^{-t/T}]\ u(t)$$

$$e(t) = T[1 - e^{-t/T}]$$

Steady state error $= \lim_{t\to\infty}\left(T - Te^{-t/T}\right) = T$

*End of Solution*

**98.** If the number of zeros are less than the number of poles, i.e. $Z < P$, then the value of the transfer function becomes zero for $s \to \infty$. Hence way that there are zeros at infinity and the order of such zeros is

(a) $P + Z$ (b) $P - Z$

(c) $Z - P$ (d) $Z$

**Ans.** **(b)**

If the number of zeros are less than the number of poles ($Z < P$).

Then the number of zeros at $\infty$ when $s \to \infty$ is $P - Z$

Then the order of such zeros is $P - Z$.

*End of Solution*

**99.** The method for determination of the stability of the feedback system as a function of an adjustable gain parameter which does not provide detailed information concerning location of closed-loop poles as a function of gain $K$ is called

(a) Root locus method (b) Nyquist criterion method

(c) Bode plot method (d) Routh-Hurwitz criterion method

**Ans.** **(d)**

*End of Solution*

**100.** Consider the sinusoidal transfer function in time-constant form

$$G(j\omega) = \frac{2(1+j\omega)}{\left(1+\frac{j\omega}{10}\right)^2}$$

Asymptotic log magnitude characteristic of factor $(1 + j\omega)$ is straight line of

1. 0 dB for $\omega \le 1$.
2. +20 dB/decade for $\omega \ge 1$.
3. –20 dB/decade for $\omega \ge 1$.

Which of the above relations is/are correct?

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

**Ans.** **(b)**

*End of Solution*

**101.** A graphical technique for plotting the closed-loop poles of rational system functions as a function of the value of gain for both continuous-time and a discrete-time system is

(a) Root locus method (b) Nyquist criterion method
(c) Bode plot method (d) Routh-Hurwitz criterion method

**Ans.** **(a)**

*End of Solution*

**102.** Which one of the following statements regarding 'Root locus' is **not** correct?

(a) By addition of poles to left half, the root locus shifts towards right hand side and stability of system decreases.
(b) By addition of zero towards left, the root locus shifts towards left half, since root locus shifts towards left half, the relative stability of control system increases.
(c) By addition of zero towards left side, the root locus shifts towards left half, the relative stability remains same.
(d) By addition of poles to the left half, the system stability decreases, while by addition of zeros towards left half, the stability of system increase.

**Ans.** **(c)**

By addition of zero towards left side, the root locus shifts towards left half, the relative stability increases and by addition of pole towards left side, the root locus shifts towards right half, the relative stability decreases.

*End of Solution*

**103.** In time domain, the relative stability is measured by maximum overshoot and damping ratio. In frequency domain, the relative stability is measured by

(a) Steady state error (b) Damping ratio
(c) Resonant peak (d) Bandwidth

**Ans.** **(c)**

In frequency domain the relative stability is measured by resonant peak. Hence option (c) is correct.

*End of Solution*

**104.** Consider a feedback system with the characteristic equation

$1+K\dfrac{1}{s(s+1)(s+2)}=0$ for root locus,

The angles of asymptotes $\phi_A$ and the centroid of the asymptotes-$\sigma_A$ are respectively

(a) 60°, 120°, 180° and –1
(b) 45°, 90°, 300° and 0
(c) 60°, 180°, 300° and –1
(d) 45°, 90°, 180° and 0

**Ans.** **(c)**

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

$$1+\frac{K}{s(s+1)(s+2)} = 0$$

$$\therefore \quad G(s)H(s) = \frac{K}{s(s+1)(s+2)}$$

$$\therefore \quad \text{Centroid}\,(\sigma) = \frac{-1-2}{3} = -1$$

| $P-Z$ | Angle of asymptotes |
|---|---|
| 1 | 180° |
| 2 | +90°, 270° |
| 3 | 60°, 180°, 300° |
| 4 | 45°, 135°, 225°, 315° |

*End of Solution*

**105.** Which one of the following statements regarding an effect of phase lead network is ***not*** correct?

(a) The velocity constant is usually increased.
(b) The slope of the magnitude curve is reduced at the gain crossover frequency, as a result relative stability improves.
(c) Phase margin increased.
(d) The bandwidth decreased

**Ans.** **(d)**

Effect of phase lead network:

1. The velocity constant is usually increased.
2. The slope of the magnitude curve is reduced at the gain cross over frequency, hence relative stability improves.
3. Phase margin increased.
4. The bandwidth is increased.
5. Transient response improves.

*End of Solution*

**106.** A lead compensator
1. Speeds up the transient response.
2. Increases the margin of stability of system.
3. Helps to increases the system error constant though to a limited extent.

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

**Ans.** (d)

*End of Solution*

**107.** Which of the following statements are correct?
1. The pair $(AB)$ is controllable implies that the pair $(A^TB^T)$ is observable.
2. The pair $(AB)$ is controllable implies that the pair $(A^TB^T)$ is unobservable.
3. The pair $(AC)$ is observable implies that the pair $(A^TC^T)$ is controllable.
4. The pair $(AC)$ is observable implies that the pair $(A^TC^T)$ is uncontrollable.

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

where : $A$, $B$ and $C$ are having their standard meanings.

**Ans.** (a)

The pair $AB$ is controllable implies that the pair $A^TB^T$ is observable.
The pair $AC$ is observable implies that the pair $A^TC^T$ is controllable.

*End of Solution*

**108.** Bounded-input bounded-output stability implies asymptotic stability for
1. Completely controllable system
2. Completely observable system
3. Uncontrollable system
4. Unobservable system

Which of the above statements are correct?
(a) 1 and 4 only (b) 1 and 2 only
(c) 2 and 3 only (d) 3 and 4 only

**Ans.** (b)

BIBO stability implies asymptotic stability for completely controllable and completely observable system.

*End of Solution*

**109.** The degree of humming level of the noise caused in the transformers may be reduced by
(a) Magnetostriction (b) High flux density in core
(c) Tightening of core by clamps (d) Quality of transformer oil

**Ans.** (c)

*End of Solution*

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# List of Top 10 Rank Holders of GATE 2019 from MADE EASY

**CE** — 8 in Top 10

1 AIR Prakhar Singh

3 AIR Idris Mustafa M.

3 AIR Paramjeet Kr. Dubey

5 AIR Jayesh Atreya

7 AIR Chirag Rathi

7 AIR Shreyans Mehta

9 AIR Vishal Tiku

10 AIR Asif Reza Khan

**ME** — 8 in Top 10

1 AIR Sumit Bhamboo

2 AIR Anshul Goel

3 AIR Ankit Kulhari

4 AIR Siddarth Wadhwa

5 AIR Nilesh Raj

5 AIR Patel Charmin B.

7 AIR Aakash Verma

10 AIR Mahesh S. Yadav

**EE** — 10 in Top 10

1 AIR Ritesh Lalwani

2 AIR Kunal Gururani

2 AIR Mukesh Poonia

4 AIR Dakshesh kumar

5 AIR Pradeep Kumar

5 AIR Sayantan Bh.

7 AIR Deepika Kumari

7 AIR Deepita Roy

7 AIR Shubham Mittal

10 AIR Geeth George

**EC** — 8 in Top 10

1 AIR Rajat Soni

3 AIR Shubham Maurya

4 AIR Chaitanya Kumar

6 AIR Priyanshu Sharma

7 AIR Ankit

7 AIR Saikiran Cholleti

9 AIR J. Srinivasa Reddy

9 AIR Ranjit Kumar Singh

**CS** — 7 in Top 10

1 AIR Pranav Sharma

2 AIR Jay Bansal

3 AIR Nipun Mittal

3 AIR Prateek Agarwal

6 AIR Hari Shrawgi

8 AIR T D Sai Sravan Reddy


9 AIR Ravi Shankar M.

**IN** — 9 in Top 10


1 AIR Shashank Mangal


3 AIR Vineet Goswami


4 AIR Arjundas K


4 AIR Rajbhawani Rajawat


6 AIR Ramesh Kamulla


7 AIR Saish Mohit Kalaskar


7 AIR Shweta Yadav


9 AIR Adhvaryu Deep S.


9 AIR Bandaluppi Sreekar

**PI** — 10 in Top 10


1 AIR Suryanarayana VKV


3 AIR Rohit Khanna


4 AIR Garima Gupta


5 AIR Ayush Jham


6 AIR Raj Hemant Z.


7 AIR Amit Lal Shah


7 AIR Anuj Meena


9 AIR Atulya Jyoti


10 AIR Manmohan A.


10 AIR Shubham T.

## 7 STREAMS 7 TOPPERS all MADE EASY Students

**First rankers in CE, ME, EE, EC, CS, IN, PI**

**60 Selections in Top 10 | 426 Selections in Top 100**

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**110.** A transformer with a 10 : 1 ratio and rated at 50 kVA, 2400/240 V, 50 Hz is used to step down the voltage of distribution system. The low tension voltage is to be kept constant at 240 V. If the transformer is fully loaded at 0.8 power factor (lag), the load impedance connected to low-tension side will be nearly,

(a) 3.15 Ω (b) 2.60 Ω
(c) 1.15 Ω (d) 0.60 Ω

**Ans.** **(c)**

2400/240 V, 50 kVA transformer fully loaded @0.8 p.f. lagging

$\therefore$ Load in kW = 50 × 0.8 = 40 kW

$V_2 I_2 \cos\phi_2 = 40$ kW

$$\therefore \quad I_2 = \frac{40 \times 1000}{240 \times 0.8} = 208.33 \text{ A}$$

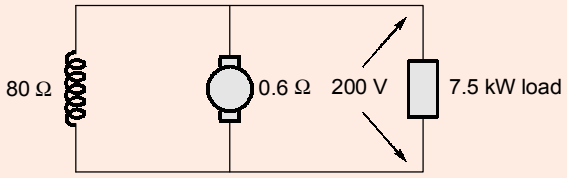
$$\therefore \text{ Load impedance } Z_L = \frac{V_2}{I_2} = 1.15 \ \Omega$$

*End of Solution*

**111.** A DC shunt generator supplies a load of 7.5 kW at 200 V. If the armature resistance is 0.6 Ω and field resistance is 80 Ω, the induced emf will be

(a) 224 V (b) 218 V
(c) 212 V (d) 204 V

**Ans.** **(a)**




$$I_L = \frac{7.5 \times 10^3}{200} = 37.5 \text{ A}$$

$$I_{sh} = \frac{V}{R_{sh}} = \frac{200}{80} = 2.5 \text{ A}$$

$I_a = I_h + I_{sh} = 40$ A

$E_g = V + I_a R_a = 200 + 40\ (0.6)$

$E_g = 224$ V

*End of Solution*

**112.** A 4-pole DC motor is lap-wound with 400 conductors. The pole shoe is 20 cm long and the average flux density over one-pole-pitch is 0.4 *T*, the armature diameter is 30 cm. When the motor is drawing 25 A and running at 1500 rmp, the torque developed will be nearly

(a) 30 Nm (b) 40 Nm
(c) 50 Nm (d) 60 Nm

**Ans.** **(a)**

$Z = 400$
$P = 4$
$A = 4$
$N = 1500$
$I_a \simeq I_L \simeq 25$ A
$l = 20$ cm
$d = 30$ cm
$B = 0.4$ T
Flux = Flux density × area

$$\text{Area/pole} = \frac{\pi DL}{P} = \frac{3.14 \times 30 \times 10^{-2} \times 20 \times 10^{-2}}{4} = 0.0471 \text{ m}^2$$

$$\phi = 0.4 \times 0.0471 = 0.01884 \text{ Wb}$$

$$T = \frac{60}{2\pi N} \times E_b I_a \text{ N-m}$$

$$E_s = \frac{\phi ZNP}{60.A} = \frac{0.01884 \times 400 \times 1500 \times 4}{60 \times 4} = 188.4 \text{ V}$$

$\therefore$ $$T = \frac{60}{2\pi(1500)}(188.4)(25)$$

$T = 30$ N-m

*End of Solution*

**113.** In an unloaded shunt generator, when switch is closed, a small field current is produced which leads to generation of still larger voltages due to addition of

(a) Armature voltage
(b) Residual flux voltage
(c) Generated voltage
(d) Voltage drop

**Ans.** **(b)**

*End of Solution*

**114.** The generator efficiency of a shunt generator will be maximum when its variable loss is equal to

(a) Constant loss
(b) Stray loss
(c) Iron loss
(d) Friction and windage loss

**Ans.** **(a)**

*End of Solution*

**115.** Induction motor can be regarded as a generalized transformer due to certain similarities except rated

(a) Frequency
(b) Flux
(c) Speed
(d) Induced emf

**Ans.** **(c)**

*End of Solution*

**116.** A 3-phase, 400/200 V, Y-Y connected wound-rotor induction motor has 0.06 Ω rotor resistance and 0.3 Ω standstill reactance per phase. To make the starting torque equal to the maximum torque, the additional resistance required in the rotor circuit will be

(a) 0.24 Ω/phase (b) 0.34 Ω/phase
(c) 0.42 Ω/phase (d) 0.52 Ω/phase

**Ans.** **(a)**

$R_2 = 0.06\ \Omega$/phase
$X_2 = 0.3\ \Omega$/phase

For, max starting torque,

$R_2 = X_2$
$R_2 + R_{ext} = X_2$
$\therefore \quad R_{ext} = 0.3 - 0.06 = 0.24\ \Omega$/phase

*End of Solution*

**117.** Potier triangle method is helpful in obtaining the voltage regulation of synchronous machines by determining the armature

(a) Leakage reactance and its reaction mmf
(b) Leakage reactance and air-gap flux
(c) Resistance and its reaction mmf
(d) Resistance and air-gap flux

**Ans.** **(a)**

*End of Solution*

**118.** In a synchronous motor, the magnitude of stator back emf, $E_b$ depends on

(a) Speed of the motor (b) Load on the motor
(c) Both the speed and rotor flux (d) Rotor excitation only

**Ans.** **(c)**

*End of Solution*

**119.** A stepper motor has a step angle of 2.5°. If the shaft is to make 25 revolutions, the number of steps required will be

(a) 1800 (b) 2200
(c) 2800 (d) 3600

**Ans.** **(d)**

Step angle $\alpha = 2.5°$
Shaft makes 25 revolutions

No. of steps per revolution $= \dfrac{360}{\alpha}$

$\therefore$ No. of steps $= \dfrac{360}{2.5°} = 144$

$\therefore$ Total steps $= 144 \times 25 = 3600$

*End of Solution*

**120.** In which of the following respects, the servomotor differ in application capabilities from large industrial motors?

1. They produce high torque at all speeds including zero speed.
2. They are capable of holding a static position.
3. They do not overheat at standstill or lower speeds.
4. Due to low-inertia they are not able to reverse direction quickly.

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

**Ans.** (b)

*End of Solution*

**121.** Which of the following statements regarding steam boilers are correct?

1. The boiler must be capable of quick starting and loading.
2. The boiler should have no joints exposed to flames.
3. The boiler must be capable of burning low ash content coal efficiently.

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

**Ans.** (d)

*End of Solution*

**122.** Which of the following are the main parts of a power system?

1. Generating stations
2. Transmission systems
3. Distribution network

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

**Ans.** (d)

*End of Solution*

**123.** Which of the following factors affect Corona?

1. Atmospheric conditions, temperature, humidity, moisture, ice and fog
2. Current of conductor
3. Waveform
4. Condition of surface of conductors, smoothness and dust

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

**Ans.** (c)

*End of Solution*

**124.** Bundled conductors that are used to increase line voltage in EHV lines for raising critical corona voltage depend on

(a Number of conductors in the group
(b) Voltage gradient
(c) Optimum spacing
(d) Communication interference

**Ans.** **(a)**

*End of Solution*

**125.** In a 275 kV transmission line with line constants $A = 0.85 \angle 5°$ and $B = 200 \angle 75°$, if the voltage profile at each end is to be maintained at 275 kV, the power at Unity Power Factor (UPF) will be nearly

(a) 98 MW
(b) 118 MW
(c) 144 MW
(d) 184 MW

**Ans.** **(b)**

For UPF load $Q_R = 0$

$$Q_R = 0 = \left(\frac{V_s V_R}{B}\right)\sin(\beta - \delta) - \left|\frac{AV_R^2}{B}\right|\sin(\beta - \alpha)$$

$$0 = \left(\frac{275 \times 275}{200}\right)\sin(75° - \delta) - \left|\frac{0.85 \times 275^2}{200}\right|\sin(75° - 5°)$$

$$\delta = 22°$$

Power at unit power factor,

$$P_R = \left|\frac{V_s V_R}{B}\right|\cos(\beta - \delta) - \left|\frac{AV_R^2}{B}\right|\cos(\beta - \alpha)$$

$$= \left|\frac{275 \times 275}{200}\right|\cos(75° - 22°) - \left|\frac{0.85 \times 275^2}{200}\right| \times \cos(75° - 5°)$$

$$= 117.63 \text{ MW} \approx 118 \text{ MW}$$

*End of Solution*

**126.** When the sinusoidal steady state current is called the symmetrical short circuit current, then the unidirectional transient component is called

(a) AC short circuit current
(b) DC short circuit current
(c) AC offset current
(d) DC offset current

**Ans.** **(d)**

The unidirectional transient current is called "DC offset current".

*End of Solution*

**127.** Consider the following balanced line-to-neutral voltages with *abc* sequence:

$$V_P = \begin{bmatrix} V_{an} \\ V_{bn} \\ V_{cn} \end{bmatrix} = \begin{bmatrix} 277\angle 0° \\ 277\angle -120° \\ 277\angle +120° \end{bmatrix} \text{ volts}$$

The values of $V_0$, $V_1$ and $V_2$ are respectively

(a) 0, 177 ∠ 0° and 177 ∠ 0°
(b) 277 ∠ 0°, 0 and 0
(c) 0, 277 ∠ 0° and 0
(d) 277 ∠ 0°, 0 and 177 ∠ 0°

**Ans.** **(c)**

Since the given voltage is balance and hence only +ve sequence component is present in it.

*End of Solution*

**128.** In an HVDC transmission, the DC output voltage can be controlled to get inverter operation when the firing angle $\alpha$ is

(a) $\alpha = 0°$
(b) $0° < \alpha < 90°$
(c) $90° < \alpha < 180°$
(d) $0° < \alpha < 180°$

**Ans.** **(c)**

*End of Solution*

**129.** In an HVDC transmission mode, the link which has two circuits that are almost independent of each other is called

(a) Monopolar link
(b) Bipolar link
(c) Homopolar link
(d) Dualpolar link

**Ans.** **(c)**

*End of Solution*

**130.** In a photovoltaic system, there is a thermally generated small reverse saturation current which flows even in the absence of light, called

(a) Photon current
(b) Diode current
(c) Leakage current
(d) Dark current

**Ans.** **(d)**

*End of Solution*

**131.** In a power system, due to interconnection or grid formation and transmission line redundancy, the ability to serve all power demands without failure over long periods of time, is due to

(a) Power system quality
(b) Power system reliability
(c) Computers and microprocessors
(d) Reserve generating capacity

**Ans.** **(b)**

*End of Solution*

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# MADE EASY Students Top in ESE 2019

**80% of Top 20 ranks** are secured by **MADE EASY Classroom Students**

**4** Streams **4** Toppers all **4** MADE EASY Students

**Selections in Top 10**
**40 out of 40**
(All 4 streams)
Selections from Classroom Course
**32 out of 40 (80%)**

**Selections in Top 20**
**78 out of 80**
(All 4 streams)
Selections from Classroom Course
**62 out of 78 (80%)**

**Total Selections**
- 465 out of 494 vacancies
- 94% of total selections

Selections from Classroom Course
**323 out of 465 (70%)**

## Civil Engineering

**10** in Top 10

**216** Selections out of 233 vacancies

93% of Total Selections are from MADE EASY

1 AIR — ABUZAR GAFFARI — Classroom T. S.

2 AIR — Pramit Debmallik — Classroom Course

3 AIR — Amarjeet — Classroom Course

4 AIR — Aman Gulia — Classroom Course

5 AIR — Ayush Chandra Dwivedi — Postal Course

6 AIR — Kabil Bhargava — Online T. S.

7 AIR — Abhishek Kumar — Classroom Course

8 AIR — Yogesh Kumar — Classroom Course

9 AIR — Ankit Kumar — Classroom Course

10 AIR — Tushar Garg — Classroom Course

## Mechanical Engineering

**10** in Top 10

**85** Selections out of 87 vacancies

98% of Total Selections are from MADE EASY

1 AIR — BHOSALE H. DNYANESHWAR — Classroom Course

2 AIR — Sahil Goyal — Interview Course

3 AIR — Kumar Chandan — Classroom Course

4 AIR — Saurav Kumar — Classroom Course

5 AIR — Himanshu Verma — Classroom Course

6 AIR — Ch. Pushpak Pramod — Classroom Course

7 AIR — Manish Rajput — Classroom Course

8 AIR — Hemant Kumar Singh — Online T. S.

9 AIR — Sabapara D. Manishbhai — Interview Course

10 AIR — Sumit Bhamboo — Classroom Course

## Electrical Engineering

**10** in Top 10

**79** Selections out of 86 vacancies

92% of Total Selections are from MADE EASY

1 AIR — KARTIKEYA SINGH — Classroom Course

2 AIR — Shambhavi Tripathi — Classroom Course

3 AIR — Abhishek Anand — Classroom Course

4 AIR — Ankit Tayal — Classroom Course

5 AIR — Kumar Mayank — Classroom Course

6 AIR — Ritesh Lalwani — Classroom Course

7 AIR — Kartikey Singh — Online T. S.

8 AIR — Anshuman Mitra — Classroom T. S.

9 AIR — Deepita Roy — Classroom Course

10 AIR — Ankita Sharma — Classroom Course

## E&T Engineering

**10** in Top 10

**85** Selections out of 88 vacancies

97% of Total Selections are from MADE EASY

1 AIR — RAJAT SONI — Classroom Course

2 AIR — Ankush Mangla — Classroom Course

3 AIR — Rohit Kumar Singhal — Classroom Course

4 AIR — Amir Khan — Classroom Course

5 AIR — Y. Naga Rahul — Classroom Course

6 AIR — Janga Srinivasa Reddy — Classroom Course

7 AIR — Rahul Jain — Classroom Course

8 AIR — Kuldeep Kumar — Classroom Course

9 AIR — Shubham Karnani — Classroom Course

10 AIR — Gaurav Srivastava — Classroom Course

**132.** In wind power, the speed which is considered as the single most important parameter is

(a) Wind speed
(b) Peripheral speed
(c) Tip speed
(d) Blade speed

**Ans.** (c)

*End of Solution*

**133.** Communication circuitry is an extra circuit used to turn off

(a) Line-commutated thyristors
(b) Phase-commutated thyristors
(c) Force-commutated thyristors
(d) Reverse-commutated thyristors

**Ans.** (c)

*End of Solution*

**134.** TRIAC as a bidirectional triode thyristor is used to control the output voltage by varying conduction time or firing delay angle in

(a) AC-DC converters (Controlled rectifiers)
(b) AC-AC converters (AC voltage controllers)
(c) DC-DC converters (DC choppers)
(d) DC-AC converters (Inverters)

**Ans.** (b)

*End of Solution*

**135.** For large power output, multiphase rectifiers are used along with filters to reduce level of harmonics by increasing the fundamental frequency in

(a) Diode rectifier
(b) Bridge rectifier
(c) Star rectifier
(d) Delta rectifier

**Ans.** (c)

*End of Solution*

**136.** In a Bipolar Junction Transistor (BJT) due to current flow to small portion of the base, hot spots are produced causing localized excessive heating and damaging the transistor. This switching limit is called

(a) Forward-Biased Safe Operating Area (FBSOA)
(b) Reverse-Biased Safe Operating Area (RBSOA)
(c) Power Derating
(d) Second Breakdown (SB)

**Ans.** (d)

*End of Solution*

**137.** In a three-phase inverter with 180° conduction, there are six modes of operation in a cycle where duration of each mode is

(a) 90° (b) 75°
(c) 60° (d) 45°

**Ans.** (c)

*End of Solution*

**138.** In a closed-loop control of squirrel cage induction motor, the field oriented control strategy implemented is

(a) Scalar control (b) Vector control
(c) Adaptive control (d) Frequency control

**Ans.** (b)

*End of Solution*

**139.** In a DC motor drive, if the armature current is revised by keeping field current positive producing a braking torque, then the drive is said to be operating is

(a) Motoring mode (b) Regenerative braking mode
(c) Dynamic braking mode (d) Plugging mode

**Ans.** (b)

*End of Solution*

**140.** If the induction motor drive is capable of bidirectional power flow where limited range of speed control is required for large power applications, then this arrangement is called

(a) Static conductance drive (b) Static Scherbius drive
(c) Static compressive drive (d) Static reluctance drive

**Ans.** (b)

*End of Solution*

**141.** In a DC-DC switched-mode converter if the output voltage polarity is opposite to input voltage, then this inverting regulator is called

(a) Buck regulator (b) Boost regulator
(c) Buck-Boost regulator (d) Cuk regulator

**Ans.** (c)

*End of Solution*

**142.** In a zero current switching resonant converter, the switching loss and noise are increased due to presence of capacitive coupling-called

(a) Miller capacitor (b) Series resonant capacitor
(c) Parallel resonant capacitor (d) Switch capacitor

**Ans.** (a)

*End of Solution*

**143.** Which one of the following devices is not a switched-mode DC power supply?

(a) Fly back forward converter (b) Full bridge converter
(c) Push-pull converter (d) Resonant converter

**Ans.** (d)

*End of Solution*

**144.** The ideal core should exhibit very high permeability in case of transformers and inductor core due to magnetic saturation caused by DC imbalance condition that can be minimized by

(a) Low permeability core only
(b) High permeability core only
(c) Low and high permeability combination core
(d) No permeability core

**Ans.** (b)

*End of Solution*

**Directions :** Each of the next Six (6) items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below:

**Codes:**

(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

**145.** **Statement (I) :** In a substitutional semiconductor, atom is replaced by an occasional foreign atom. The imperfections may be deliberately controlled or created in transistor material.

**Statement (II) :** The lattice vacancies created when certain atoms in a semiconductor are missing are known as Schottky defects.

**Ans.** (b)

Both statements are individually true.

*End of Solution*

**146.** **Statement (I) :** A cache is a memory unit placed between the CPU and main memory M and is used to store instructions, data or both.

**Statement (II) :** The cache's effect is to increase the average time required to access an instruction or data word, typically to just a single-clock cycle.

**Ans.** (c)

*End of Solution*

147. **Statement (I) :** A buffer is not an area in RAM or on the hard drive designated to hold input and output on their way in or out of the system.

**Statement (II) :** The process of placing items in a buffer so they can be retrieved by the appropriate device when needed is called spooling.

Ans. (b)

*End of Solution*

148. **Statement (I) :** The power diodes are three-layer devices.

**Statement (II) :** The impurity concentrations of power diodes vary layer to layer.

Ans. (b)

*End of Solution*

149. **Statement (I) :** Registers are used for storage of small data in the microprocessor.

**Statement (II) :** All registers are accessible to the user through instructions.

Ans. (c)

All registers are not accessible by the programmer/user.

*End of Solution*

Q150. **Statement (I) :** In a three-phase induction motor, the maximum torque is directly proportional to standstill reactance.

**Statement (II) :** In a three-phase induction motor, the speed or the slip at which maximum torque occurs is determined by the rotor resistance.

Ans. (d)

*End of Solution*