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ESE-2022
(PRELIMINARY EXAMINATION)

QUESTIONS WITH DETAILED SOLUTIONS

ELECTRICAL ENGINEERING

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ESE - 2022
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SET - D
20/02/22

SUBJECTWISE WEIGHTAGE

S. No.	NAME OF THE SUBJECT	Number of Questions
01	Engineering Mathematics	12
02	Electrical Materials	14
03	Electric Circuits & Fields	8+3
04	Electrical & Electronic Measurements	12
05	Computer Fundamentals	13
06	Basic Electronics Engineering & Analog	15
07	Communication Systems	10
08	Systems & Signal Processing	14
09	Control Systems	12
10	Electrical Machines	13
11	Power Systems	12
12	Power Electronics & Drives	12
Total No. of Questions		**150**

01. In a lap winding, there are always as many paths in parallel through the armature- winding as there are a number of poles. In such a lap winding, the current in each armature coil is
(a) one and one-half of the armature terminal current
(b) half of the armature terminal current
(c) equal to the armature terminal current divided by the number of poles
(d) equal to the number of poles divided by the armature terminal current

01. Ans: (c)

Sol: In lap winding,
no.of parallel path's = A = p
$\therefore$ The current in each parallel path = $\frac{I_a}{A}$

02. A four-pole d.c. machine armature has 54 slots. It is lap-wound with single-turn coils. How many armature coils are required?
(a) 27 (b)54
(c) 81 (d) 108

02. Ans: (a)

Sol: Poles, P = 4, slots S = 54

No of armature coils = $\frac{1}{2}$ (slots)

= 27

03. A shunt d.c motor is rated for 230V, 1350 r.p.m., 10 HP, the line current $I_L = 37.5$ A and the field current $I_f = 0.75$ A. It is known that the armature resistance $R_a = 0.35\Omega$ and the power dissipated across field winding P_{fw} = 519W at rated speed. The shunt d.c motor is to be equipped with the manually operated variable resistor starter. What is the maximum allowable armature current in starting resistance R_{st} to assure that the initial armature current does not exceed 150 percent of the rated value?
(a) 18.125A (b) 27.125 A
(c) 36.125 A (d) 55.125 A

03. Ans: (d)

Sol: $I_L = 37.5A$

$I_{sh} = 0.75$

$I_a = I_L - I_{sh} = 37.5 - 0.75$

$= 36.75A$

$I_{amax} = 1.5 \times 36.75 = 55.125$ A

04. Which one of the following statements is correct regarding lead or lag compensation?
(a) The lag compensator improves the steady-state performance of the system.
(b) The lead compensation becomes effective when the phase angle of uncompensated system decreases rapidly near the gain crossover frequency.
(c) Choose the lead compensator when reduced noise level is required.
(d) The combination of decreased open-loop gain and lead compensator improves steady-state error and phase margin.

04. Ans: (a)

Sol: LAG compensator improves steady state response where as LEAD compensator improves transient response.

05. Consider the following statements
1. Phase margin is defined as the amount of additional phase lag at the gain crossover frequency required to bring the system to the verge of instability.
2. The phase margin is always positive for stable feedback systems.
3. The phase margin is always negative for stable feedback systems.

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

05. Ans: (a)

Sol: According to definition of phase margin statement (I) is correct

For stable system G.M = +ve dB

& P.M = +ve°

Hence statement (II) is also correct

06. Consider the following statements for minimum and non-minimum phase systems:

1. Non-minimum phase systems have poles and/or zeros in the right half of the s-plane (RHP) of their transfer functions.
2. Minimum phase systems have no poles or zeros in the right half of the s-plane (RHP) of their transfer functions.
3. The modulus of the phase response for a non-minimum phase system is always larger than that for a system with mimum phase behaviour, through both may have the same amplitude response.

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

06. Ans: (d)

Sol: According to definition of M.P.S & N.M.P.S both statements (I) & (II) are correct

$\phi_{N.M.P.S} = \phi_{M.P.S} + \phi_{A.P.S}$

Hence $\phi_{N.M.P.S} > \phi_{M.P.S}$

So statement (III) is also correct

07. Consider a system described by

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u \quad y=[1\ \ 0]\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

Which one of the following is correct?

(a) The system is controllable only

(b) The system is observable only

(c) The system is controllable and observable

(d) The system is neither controllable nor observable

07. Ans: (c)

Sol: $A=\begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}$; $B=\begin{bmatrix}0\\ 1\end{bmatrix}$; $C=[1\ \ 0]$

Controllability: $M_c = [B \quad AB]$

Now $A.B=\begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}\begin{bmatrix}0\\ 1\end{bmatrix}=\begin{bmatrix}1\\ -1\end{bmatrix}$

$M_c=[B \quad AB]=\begin{bmatrix}0 & 1\\ 1 & -1\end{bmatrix}$

$|M_c| = 0\times(-1) - 1\times 1 = -1 \neq 0$

Hence given system is controllable

Observability: $M_0 = [C^T \ A^T \ C^T]$

Now $A^T \ C^T=\begin{bmatrix}1 & -2\\ 1 & -1\end{bmatrix}\begin{bmatrix}1\\ 0\end{bmatrix}=\begin{bmatrix}1\\ 1\end{bmatrix}$

$M_0=[C^T \ A^T \ C^T]=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}$

$|M_0| = 1 - 0 = 1 \neq 0 \Rightarrow$ observable

08. What is the state-transition matrix $\Phi(t)$ of the following system?

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

(a) $\Phi(t)=\begin{bmatrix}e^{-t}-e^{-2t} & e^{-t}-e^{-2t}\\ -2e^{-t}+2e^{-2t} & -e^{-t}+2e^{-2t}\end{bmatrix}$

(b) $\Phi(t)=\begin{bmatrix}2e^{-t}-e^{-2t} & e^{-t}-e^{-2t}\\ -2e^{-t}+2e^{-2t} & -e^{-t}+2e^{-2t}\end{bmatrix}$

(c) $\Phi(t)=\begin{bmatrix}2e^{-t}-e^{-2t} & e^{-t}-e^{-2t}\\ -e^{-t}+e^{-2t} & -e^{-t}+e^{-2t}\end{bmatrix}$

(d) $\Phi(t)=\begin{bmatrix}2e^{-t}-2e^{-2t} & 2e^{-t}-e^{-2t}\\ -2e^{-t}+2e^{-2t} & -2e^{-t}+2e^{-2t}\end{bmatrix}$

08. Ans: (b)

Sol: We know $S.T.M|_{t=0} = I$

By verification option (b) is correct

09. In the system shown in the figure, the numerical values of m, b and k are given as m = 1 kg, b = 2 N-sec/m and k = 100 N/m. The mass is displaced 0.05m and released without initial velocity. What is the frequency observed in the vibration, if the displacement x is measured from the equilibrium position?

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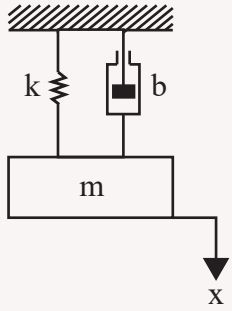


(a) 6.23 rad/sec (b) 7.76 rad/sec
(c) 9.95 rad/sec (d) 8.78 rad/sec

09. Ans: (c)

Sol: $T.F = \dfrac{X(s)}{F(s)}$

$$M\frac{d^2x}{dt^2} + B\frac{dx}{dt} + kx = F$$

$$T.F = \frac{X(s)}{F(s)} = \frac{1}{MS^2 + BS + k}$$

$$T.F = \frac{1/M}{s^2 + \frac{B}{M}s + \frac{k}{M}} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

$$\omega_n = \sqrt{\frac{k}{M}} = \sqrt{\frac{100}{1}} \Rightarrow \omega_n = 10$$

$$2\xi\omega_n = \frac{B}{M}$$

$$\xi = \frac{B}{2 \times \omega_n \times M} = \frac{2}{2 \times 10 \times 1} = \frac{1}{10}$$

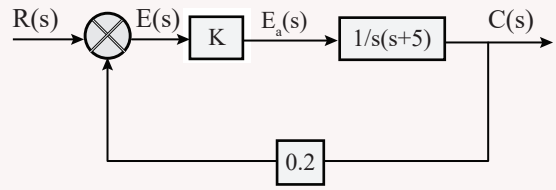
$$\Rightarrow \xi = \frac{1}{10}$$

$$\omega_d = \omega_n \sqrt{1 - \xi^2} = 10\sqrt{1 - \left(\frac{1}{10}\right)^2}$$

$$\omega_d = 10 \times \frac{\sqrt{100 - 1}}{10} = \sqrt{99}$$

$\cong 9.95$ rad/sec

10. A feedback control system is shown in the figure. What is the value of K for unit ramp input so that the system will have damping ratio of 0·5?



(a) 50 (b) 150
(c) 125 (d) 25

10. Ans: (c)

Sol: Given $G(s) = \dfrac{K}{s(s+5)}$; $H(s) = 0.2$

C.E $\Rightarrow 1 + G(s)\,H(s) = 0$

C.E $\Rightarrow s^2 + 5s + 0.2K = 0$

Standard $\Rightarrow$ C.E $\Rightarrow s^2 + 2\xi\omega_n s + \omega_n^2 = 0$

$$0.2K = \omega_n^2 \Rightarrow K = \frac{\omega_n^2}{0.2}$$

$2\xi\omega_n = 5$; Given $\xi = 0.5$

$2 \times 0.5 \times \omega_n = 5 \Rightarrow \omega_n = 5$

$$K = \frac{\omega_n^2}{2/10} = \frac{10}{2} \times 5^2 = 5 \times 5^2 = 125$$

11. Consider the following network:

$$G(s) = \frac{s + \frac{1}{T_1}}{s + \frac{1}{T_2}}$$

Which of the following conditions is /are correct?
(a) If $T_1 > T_2$, then the network is a lead network
(b) If $T_1 < T_2$, then the network is a lag network
(c) If $T_1 > T_2$, then the network is a lag network
(d) If $T_1 < T_2$, then the network is a lead network
Select the correct answer using the code given below.
(a) 1 only (b) 2 only
(c) 1 and 2 (d) 3 and 4

11. Ans: (c)

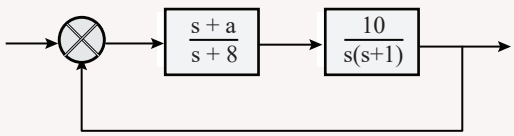
Sol: For LEAD compensator $\Rightarrow \dfrac{1}{T_1} < \dfrac{1}{T_2} \Rightarrow T_1 > T_2$

So statement (I) is correct

For LAG compensator $\dfrac{1}{T_1} > \dfrac{1}{T_2} \Rightarrow T_1 < T_2$

So statement (II) is correct

12. Consider the system shown in the figure. What is the value of a such that the damping ratio of the dominant closed poles is 0.5?



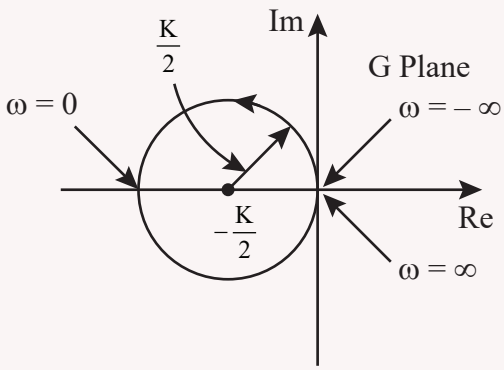
(a) 0.6 (b) 1.4
(c) 1.2 (d) 2.8

12. Ans: (d)

Sol: If $a = 6.6 \Rightarrow \sigma = \dfrac{-1-8-(-0.6)}{2} = -4.2$

If $a = 1.4 \Rightarrow \sigma = -3.8$
If $a = 1.2 \Rightarrow \sigma = -3.9$
If $a = 2.8 \Rightarrow \sigma = -3.1$
If "σ" is smaller than poles becomes more dominant hence option (d)

13. Consider the closed-loop system shown in the figure. What is the critical value of K for stability by the use of the Nyquist stability criterion?

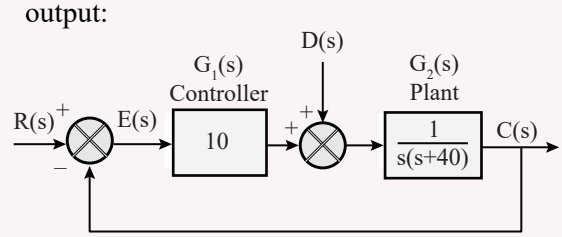


(a) 0.1 (b) 0.2
(c) 1 (d) 0.5

13. Ans: (c)

Sol: For critical stable or marginal stable
$|-K| = |-1 + j0|$
Hence $K = 1$
$K > 1 \Rightarrow$ stable
$K < 1 \Rightarrow$ unstable
$K = 1 \Rightarrow$ M.S

14. In the feedback control system shown in the figure, D(s) is step disturbance, R(s) is input and C(s) is output:



The steady-state error component due to a step disturbance for the system is

(a) –0.10 (b) –0.25
(c) 10 (d) 25

14. Ans: (a)

Sol: $\left.\dfrac{E(s)}{D(s)}\right|_{R(s)=0} = \dfrac{\dfrac{-1}{s(s+40)}}{1+\dfrac{10}{s(s+40)}} = \dfrac{-1}{s^2+40s+10}$

$D(s) = \dfrac{1}{s}$

$S.S.E = \underset{s\to 0}{Lt}\ sE(s) = \dfrac{-1}{10} = -0.1$

15. Consider the following statements related to steady-state error for a control system:
1. Steady-state error can be calculated from a system's closed-loop transfer function for a unity feedback system.
2. Steady-state error can be calculated from a system's open-loop transfer function for a unity feedback system.
3. Steady-state error is the difference between the input and the output for a prescribed test input as time tends to infinity.
4. Many steady-state errors in control systems can arise from non-linear sources.

Which of the above statements are correct?

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

15. Ans: (a)

Sol: Generally error arises from non-linear behavior of the elements but not sources so statement (IV) is wrong. Statements (I) & (II) are correct.

16. Which one of the following is not a basic functional characteristic of a protective relay?
(a) Reliability (b) Sensitivity
(c) Speed (d) Linearity

16. Ans: (d)

Sol: The properties of the protective relay are
(i) selectivity
(ii) sensitivity
(iii) Speed of operation
(iv) Reliability
(v) Minimum apparatus for design
(vi) Low lost
∴ Linearity is not the property of the relay, option (d) is correct.

17. In a system of 132 kV, the line-to ground capacitance is 0.01 μF and the inductance is 4 H. What is the voltage appearing across the pole of a circuit breaker if the instantaneous value of magnetizing current of 5 A is interrupted?
(a) 50 kV (b) $100/\sqrt{2}$ kV
(c) 100 kV (d) $100\sqrt{2}$ kV

17. Ans: (c)

Sol: The voltage that appears across the circuit breaker contacts is

$$V = I\sqrt{\frac{L}{C}}$$

$$= 5\sqrt{\frac{4}{0.01\times 10^{-6}}}$$

$$= 5\sqrt{400\times 10^{6}}$$

$$= 5\times 20\times 10^{3}$$

$$= 100 \text{ kV}$$

∴ Option (c) is correct

18. Which one of the following tests does not come under the testing types of circuit breaker?
(a) Short-circuit test (b) Open-circuit test
(c) Dielectric test (d) Thermal test

18. Ans: (b)

Sol: The types of tests that are performed on the circuit breaker are
(i) Mechanical Test
(ii) Thermal Test
(iii) Dielectric Test
(iv) Short circuit Test
Open circuit test will not be conducted on circuit breaker. So option (b) is correct.

19. In a power system, the maximum Power can be transferred from one end to another end when the reactance of the line is
(a) $\sqrt{3}$ times of the resistance
(b) $\sqrt{2}$ times of the resistance
(c) triple the resistance
(d) double the resistance

19. Ans: (a)

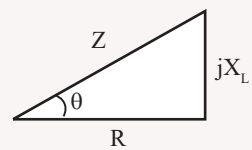
Sol: The power transferred in the line is

$$P = \frac{|V_S||V_R|}{|B|}\cos(\beta-\delta) - \frac{|A|}{|B|}|V_R|^2\cos(\beta-\alpha)$$

To have maximum power, $\beta = \delta$

$$\therefore P_{max} = \frac{|V_S||V_R|}{|B|} - \frac{|A|}{|B|}|V_R|^2\cos(\beta-\alpha)$$

For a transmission line the impedance is



$$Z = R + jX_L$$

$|Z| = R^2 + X_L^2$

$\theta = \tan^{-1}\left(\frac{X_L}{R}\right)$

$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 1 & Z \\ 0 & 1 \end{bmatrix}$

Here $|B| = |Z|$, $\theta = \tan^{-1}\left(\frac{X_L}{R}\right)$

$$P_{max} = \frac{|V_S||V_R|}{\sqrt{R^2 + X_L^2}} - \frac{1}{\sqrt{R^2 + X_L^2}} |V_R| \cos\left[\tan^{-1}\left(\frac{X_L}{R}\right)\right]$$

$\frac{dP_{max}}{dX_L} = 0$, We get $X_L = \sqrt{3}.R$

So option (a) is correct.

20. A 50 Hz, four-pole turbo, generator rated at 30 MVA, 13.2 kV has an inertia constant of H = 9.0 kW-sec/kVA. What is the KE stored in the rotor at synchronous speed?
(a) 135 MJ (b) 180 MJ
(c) 270 MJ (d) 360 MJ

20. Ans: (c)

Sol: The inertia constant

$$(H) = \frac{\text{Kinetic energy stored in the rotor}}{\text{VA rating}}$$

Kinetic Energy stored = H × VA rating
= 9 × 30
= 270 MJ

21. Which one of the following is not example of renewable energy?
(a) Solar (b) Wind
(c) Geothermal (d) Nuclear

21. Ans: (d)

Sol: From the given options
Nuclear Energy is not a renewable energy where as solar, wind and Geothermal are the forms of the renewable energy.

22. There are additional losses that arise from the non-uniform current distribution in the conductors and the core losses generated in the iron due to the distortion of the Magnetic flux distribution from the load currents. Such losses are known as
(a) steel losses
(b) frictional losses
(c) stray load losses
(d) windage losses

22. Ans: (c)

Sol: Due to non uniform distribution of current & flux distribution, the losses takes place in Iron & copper are called stray load losses.

23. If the magnetic core has a constant permeability by making air as media for a coil current and the resultant flux linkage, then
(a) the energy and coenergy are equal
(b) the energy is greater than the coenergy
(c) the energy is less than the coenergy
(d) the coenergy is not developed

23. Ans: (a)

Sol: As there is no saturation for air medium, Energy & Co-energy are equal

24. The structure of d.c commutator machine is generally designed with
(a) non-salient stator and salient rotor
(b) salient stator and non-salient rotor
(c) salient stator and salient rotor
(d) non-salient stator and non-salient rotor

24. Ans: (b)

Sol: In dc machine stator is having salient poles but not rotor.

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25. The steady-state external performance characteristic of a d.c generator has the relationship between
(a) generated e.m.f and field current at constant speed
(b) terminal voltage and field current, with constant armature current and speed
(c) generated e.m.f and field current, with constant armature current and speed
(d) terminal voltage and load current at constant speed

25. Ans: (d)

Sol: External characteristic's is draw between V and I_L.

26. A 250 V, 50 kW, short-shunt compound dc generator has the following data:
Armature resistance = 0. 05 Ω, series field resistance = 0.05 Ω, shunt field resistance = 130 Ω and 2 V is the total brush contact drop. What is the value of the total current supplied by the generator?
(a) 0.2 A (b) 2 A
(c) 0.2 kA (d) 2 kA

26. Ans: (c)

Sol: $I_L = \frac{50k}{250} = 200A$

$I_a = I_L + I_{sh}$

$I_{sh} = \frac{250 + 200 \times 0.05}{130} = 2A$

$I_a = 200+2 = 202 = 0.2$ kA

27. In generating mode, an induction machine operates as a generator with a shaft speed which is greater than the synchronous speed, if the slip is
(a) zero
(b) unity
(c) greater than unity
(d) less than zero

27. Ans: (d)

28. A three-phase, 60 Hz, 25 HP, wye-connected induction motor operates at a shaft speed of almost 1800 r.p.m. at no load and 1650 r.p.m. at full load. The number of poles of the motor is
(a) 2 (b) 3.33
(c) 4 (d) 6.66

28. Ans: (c)

29. A three-phase, 13.2 kV, 60 Hz, 50 MVA wye-connected cylindrical rotors synchronous generator has an armature reactance of 2.19 Ω per phase. The leakage reactance is 0.137 times the armature reactance. The armature resistance is small enough to be negligible. Also ignore the saturation. Assume that the generator delivers full-load current at the rated voltage and 0.8 lagging power factor. The synchronous reactance per phase is
(a) 0.32 Ω (b) 2.32 Ω
(c) 2.73 Ω (d) 2.49 Ω

29. Ans: (d)

Sol: $X_s = X_l + X_a$

$= (0.137 \times 2.19) + 2.19$

$= 2.49$ Ω/ph

30. For the commutated d.c. machine stator, it has riveted poles and the ends of the poles are called
(a) pole shoe (b) pole face
(c) pole arc (d) pole gap

30. Ans: (a)

Sol: The end of field pole is generally called as pole shoe

31. What is the z-transform of discrete-time unit step signal u(n)?
(a) $\frac{z}{z+1}, |z| > 1$ (b) $\frac{1}{z+1}, |z| > 1$
(c) $\frac{z}{z-1}, |z| > 1$ (d) $\frac{1}{z-1}, |z| > 1$

31. Ans: (c)

Sol: $u(n) \leftrightarrow \frac{1}{1-z^{-1}} (\text{or}) \frac{z}{z-1}\ ;\ |z| > 1$

32. Consider the following statements for quarter-wave symmetry:

A periodic function possesses a quarter-wave symmetry, if

1. it has either odd or even symmetry
2. it has half-wave symmetry

Which of the above statements is/are correct?

(a) Both 1 and 2 (b) Neither 1 nor 2

(c) 1 only (d) 2 only

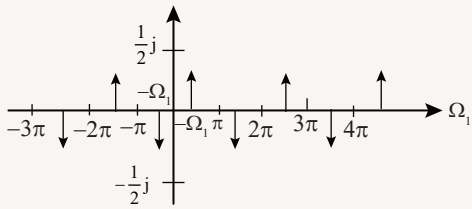
32. Ans: (a)

Sol: Quarter wave symmetry

$\Rightarrow$ means even + HW

odd + HW

33. What is the inverse discrete-time Fourier transform of the frequency domain representation shown in the figure?



(a) $x[n] = \frac{\pi}{2}\sin(\Omega_1 n)$ (b) $x[n] = \frac{3}{2\pi}\sin(\Omega_1 n)$

(c) $x[n] = \frac{1}{\pi}\sin(\Omega_1 n)$ (d) $x[n] = \frac{1}{2\pi}\sin(\Omega_1 n)$

33. Ans: (d)

Sol: $X(e^{ir})$

$\delta(n-n_0) \longleftrightarrow e^{-j\Omega n_0}$

i.e. $1.e^{j\Omega n} \leftrightarrow 2\pi\delta(\Omega-\Omega_0)$

$$X(e^{j\Omega}) = \frac{-j}{2}\delta(\Omega+\Omega_1) + \frac{j}{2}\delta(\Omega-\Omega_1)$$

$$= \frac{-j}{2(2\pi)}e^{j(-\Omega_1)n} + \frac{j}{2(2\pi)}e^{j\Omega_1 n}$$

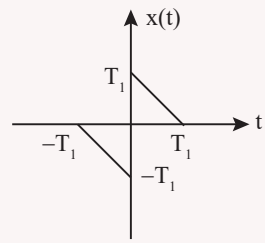
$$= \frac{1}{2\pi}\left[\frac{e^{-j\Omega_1 n}}{2j} - \frac{e^{j\Omega_1 n}}{2j}\right]$$

$$= -\frac{1}{2\pi}\left[\frac{e^{j\Omega_1 n} - e^{-j\Omega_1 n}}{2j}\right]$$

$$= \frac{-\text{Sin}\Omega_1 n}{2\pi}$$

(Negative sign missing)

34. What is the solution for a periodic signal x(t) as shown in the figure?



(a) $j\left(\frac{3\sin(\omega T_1)}{\omega^2} - \frac{2T_1}{\omega}\right)$

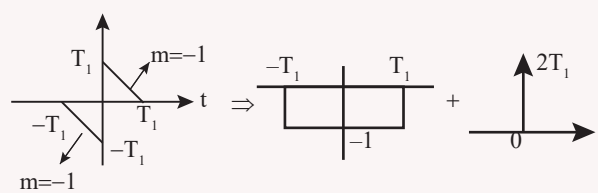
(b) $j\left(\frac{3\sin(\omega T_1)}{\omega} - \frac{3T_1}{\omega^2}\right)$

(c) $j\left(\frac{2\sin(\omega T_1)}{\omega^2} - \frac{2T_1}{\omega}\right)$

(d) $j\left(\frac{2\sin(\omega T_1)}{\omega} - \frac{3T_1}{\omega^2}\right)$

34. Ans: (c)

Sol:



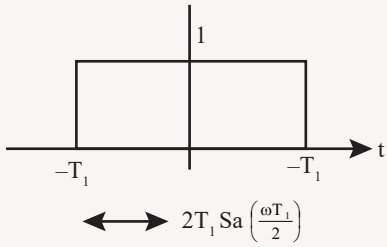
$$-\text{rect}(t/2T) + 2T_1\delta(t)$$

$$\dot{x}(t) = -2T_1\,\text{Sa}\left(\frac{\omega T_1}{2}\right) + 2T_1(1)$$

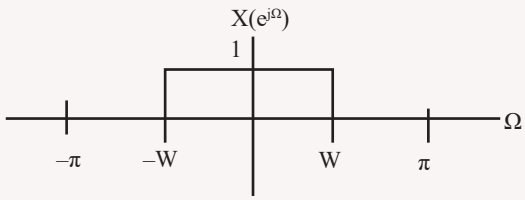
$$j\omega X(\omega) = -2T_1\,\text{Sa}\left(\frac{\omega T_1}{2}\right) + 2T_1$$

$$X(\omega)=\frac{-2T_1\sin\left(\frac{\omega T_1}{2}\right)}{j\omega(\omega T_1/2)}+\frac{2T_1}{j\omega}$$

$$=\frac{2j}{\omega^2}\sin\left(\frac{\omega T_1}{2}\right)-\frac{2T_1 j}{\omega}$$



35. For discrete-time sinc function, what is the inverse discrete-time Fourier transform of the function as shown in the figure?



(a) $x[n]=\frac{W}{\pi}\,\text{sinc}\left(\frac{Wn}{2\pi}\right)$

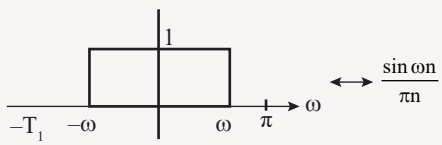
(b) $x[n]=\frac{W}{2\pi}\,\text{sinc}\left(\frac{Wn}{\pi}\right)$

(c) $x[n]=\frac{W}{\pi}\,\text{sinc}\left(\frac{Wn}{\pi}\right)$

(d) $x[n]=\frac{2W}{\pi}\,\text{sinc}\left(\frac{Wn}{2\pi}\right)$

35. Ans: (c)

Sol:



$$Sa(x)=\frac{\sin x}{x},\ \text{sincx}=\frac{\sin\pi x}{\pi x}$$

$$\frac{W\sin Wn}{\pi Wn}=\frac{WSa(Wn)}{\pi}$$

$$=\frac{W\,\text{sinc}\left(\frac{Wn}{\pi}\right)}{\pi}$$

36. What is the Fourier transform G(ω) of the signal of $g(t)=\frac{1}{1+jt}$?

(a) $2\pi e^{\omega}u(-\omega)$ (b) $\pi e^{\omega}u(-\omega)$

(c) $0.5\pi e^{\omega}u(-\omega)$ (d) $3\pi e^{\omega}u(-\omega)$

36. Ans: (a)

Sol: $e^{-t}u(t)\longleftrightarrow\frac{1}{1+j\omega}$ Duality

Apply duality $X(t)\leftrightarrow 2\pi x(-\omega)$

$$\frac{1}{1+jt}\longleftrightarrow 2\pi e^{+\omega}u(-\omega)$$

37. What is the convolution of the following two signals?

$x(t)=\begin{cases}1, -1<t<1\\0, \text{elsewhere}\end{cases}$ and $h(t)=\delta(t+1)+2\delta(t+2)$

(a) $y(t)=x(t+1)+2x(t-2)$

(b) $y(t)=x(t-1)+2x(t+2)$

(c) $y(t)=x(t+1)+2x(t+2)$

(d) $y(t)=x(t-1)+2x(t-2)$

37. Ans: (c)

Sol: $h(t)=\delta(t+1)+2\,\delta(t+2)$

$y(t)=x(t)*h(t)$

$=x(t)*[\delta(t+1)+2\,\delta(t+2)]$

$=x(t+1)+2x(t+2)$

38. What is the bilateral z-transform of t signal $x(n)=a^{n+1}u(n+1)$?

(a) $\frac{z}{1-az^{-1}},\ |z|>|a|$ (b) $\frac{z}{1+az^{-1}},\ |z|>|a|$

(c) $\frac{1}{1-az^{-1}},\ |z|>|a|$ (d) $\frac{1}{1+az^{-1}},\ |z|>|a|$

38. Ans: (a)

Sol: $x(n)=a^{n+1}u(n+1)$ $x[n-n_0]\leftrightarrow Z^{-n0}X(z)$

$$X(z)=\frac{Z^{-(-1)}}{1-az^{-1}}=\frac{Z}{1-az^{-1}};\ |z|>|a|$$

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39. Which one of the following statements not correct for convolution?
(a) The convolution of an odd and even function is an odd function
(b) The convolution of two odd functions is an even function.
(c) The convolution of two even functions is an even function.
(d) The convolution of two odd functions is an odd function.

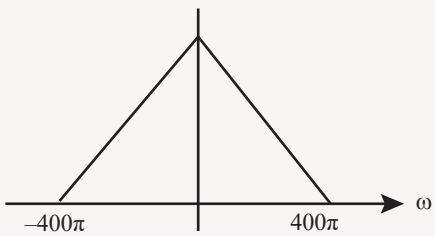
39. Ans: (d)

Sol: odd*even-odd
odd*odd=even
even*even=even
3 statements are correct

40. The sampling frequency of the sign $g(t) = \text{sinc}^2(200t)$ is
(a) 100 Hz (b) 200 Hz
(c) 400 Hz (d) 800 Hz

40. Ans: (c)

Sol:



$g(t) = \text{sinc}^2(200t)$

$= \dfrac{\sin^2(200\pi t)}{(200\pi t)^2}$

$\omega_{max} = 400\pi$ rad/sec

$f_{max} = 200$ Hz

$f_S = 2f_{max} = 400$Hz

41. What is the final value of the function $f(t) = e^{-2t}\sin 5t\, u(t)$?
(a) 0 (b) 1
(c) 5 (d) ∞

41. Ans: (a)

Sol: $f(t) = e^{-2t}\sin(5t)u(t)$

$$e^{-at}\sin btu(t) \longleftrightarrow \frac{S+a}{(S+a)^2+b^2}$$

$$F(s) = = \frac{S+2}{(S+2)^2+(5)^2}$$

$$f(\infty) = \lim_{S\to 0} SF(S) = \lim_{S\to 0}\frac{S(S+2)}{(S+2)^2+(5)^2} = 0$$

42. If a discrete signal represented by $x(n) = \alpha^n u(n)$, then what is the value of the signal $g(n) = x(n) - \alpha x(n-1)$?
(a) $g(n) = \delta(n)$
(b) $g(n) = \delta(n-1)$
(c) $g(n) = \alpha\delta(n-1)$
(d) $g(n) = \delta(n-\alpha)$

42. Ans: (a)

Sol: $x(n) = \alpha^n u(n)$

$g(n) = x(n) - \alpha x(n-1)$

$= \alpha^n u(n) - \alpha\alpha^{n-1}u(n-1)$

$= \alpha^n[u(n) - u(n-1)] = \alpha^n\delta(n) = \alpha^0\delta(n) = \delta(n)$

43. For an amplitude modulated double sideband full carrier wave, a peak modulated carrier voltage $V_c = 10V_p$ a load resistance $R_L = 10\,\Omega$ and a modulation coefficient m = 1. What is the total power of the modulated wave?
(a) 7.5 W (b) 2.5 W
(c) 1.25 W (d) 5.0 W

43. Ans: (a)

Sol: $V_c = 10Vp$

$R_L = 10\Omega$

$$P_c = \frac{A_C^2}{2R_L} = \frac{100V_P^2}{2\times 10} = 5V_P^2$$

$\mu = 1$

$$P_t = P_C\left[1 + \frac{\mu^2}{2}\right]$$

$$P_t = 5\ V_P^2\left[\frac{3}{2}\right] = 7.5\ V_P^2\ (W)$$

44. For a Citizens band receiver using high-side injection with an RF carrier of 27 MHz and an IF centre frequency of 455 kHz, what is the image frequency?

(a) 24.55 MHz (b) 27.91 MHz

(c) 28.45 MHz (d) 29.65 MHz

44. Ans: (b)

Sol: $f_{IM} = F_s + 2f_{IF}$

$= 27 \times 10^6 + 910 \times 10^3$

$= 27.91$ (MHz)

45. Which of the following statements are correct to improve the noise figure of a receiver?

1. The devices used for the amplifiers and mixer stages must produce low noise.
2. The receiver can be operated at low temperatures.
3. High-gain amplifiers are used to improve the noise figure.
4. The diodes and FETs are preferred to improve the noise figure.

Select the correct answer using the code given below.

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

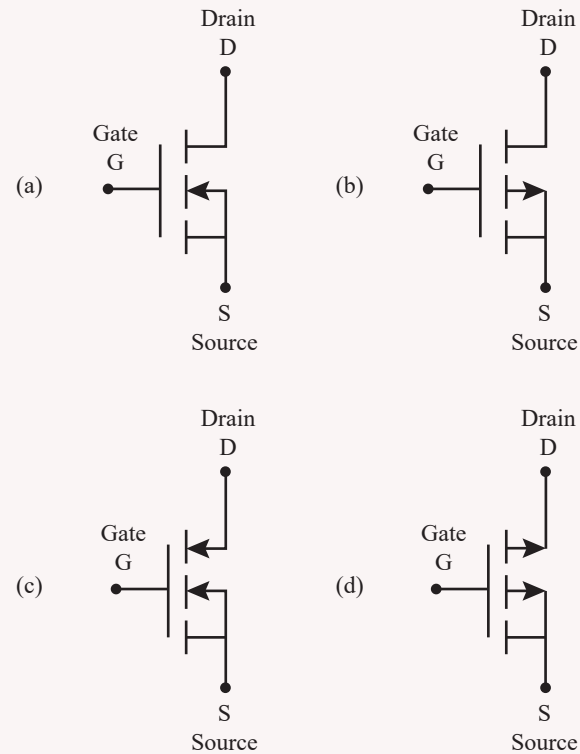
(c)1, 3 and 4 only (d) 1, 2, 3 and 4

45. Ans: (b)

Sol: → High-gain amplifiers are used to improve the noise figure.

→ The diodes and FETs are preferred to improve the noise figure.

46. Which one of the following is the circuit symbol of p-channel IGBT?



46. Ans: (b)

Sol: Options (a) and (b) are MOSFET symbols

Option (c) is N-channel IGBT

Option (d) is P-channel IGBT

Note: IGBT terminals should be collector and emitter, so there is printing mistake in options (c) and (d).

47. The regenerative action does not take place in which type of triggering method to turn on the SCR?

(a) Thermal triggering

(b) High forward voltage triggering

(c) Light triggering

(d) Gate triggering

47. Ans: (d)

Sol: Regenerative action is taking place in following three turn ON methods

(a) Thermal triggering

(c) Light triggering

(d) Gate triggering

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48. Which one of the following is also known as resonant commutation?
(a) Class A commutation
(b) Class C commutation
(c) Class D commutation
(d) Class E commutation

48. Ans: (a)

Sol: Resonant commutator → class "A" commutator

49. Which one of the following is a current controlled device?
(a) MOSFET (b) SIT
(c) MCT (d) GTO

49. Ans: (d)

Sol: GTO is current controlled device

50. In line frequency phase-controlled converters and single-quadrant step-down switch-mode d.c - d.c converters, the output current can become
(a) discontinuous at light loads on the motor
(b) zero current
(c) higher than the rated speed of the motor
(d) to match the motor load inertia

50. Ans: (a)

Sol: Output current can become discontinuous at light loads on the motor

51. When a separately excited d.c. motor is to be controlled from a three-phase supply fed from controlled rectifier in only first quadrant, which one of the following converters is used to serve the purpose?
(a) Half-wave converter (b) Full converter
(c) Semiconverter (d) Dual converter

51. Ans: (c)

Sol: First quadrant operation of D.C. motor

V_0 and $i_0 \Rightarrow$ +ve

semiconverter

52. In case of a squirrel-cage induction motor using three-phase bridge inverter, which one of the following statements is correct for speed control?
(a) If frequency increases, then starting torque decreases with constant supply voltage.
(b) If frequency increases, then starting torque increases with constant supply voltage
(c) If frequency decreases, then starting torque decreases with constant supply voltage
(d) If frequency decreases, then starting torque increases with constant supply voltage

52. Ans: (a, d)

Sol: Squirrel cage induction motor with 3-ϕ V.S.I,

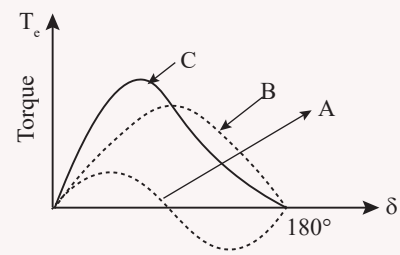
Constant supply voltage $\Rightarrow$ output of inverter constant

$\therefore$ Input to motor is also constant

$\downarrow T_{st} \propto \frac{1}{f\uparrow}$

Option (d) is also correct.

53. The following characteristics are drawn for salient-pole synchronous motor:



The curve B denotes
(a) output torque
(b) electromagnetic torque
(c) reluctance torque
(d) breakdown torque

53. Ans: (b)

Sol: From graph, maximum is occurring at 90°

So, P_{em} is max at 90°

$\therefore$ It represents electromagnetic Torque corresponding to P_{em}

54. While finding various factors of single-phase diode rectifiers, the transformer utilization factor of a half -wave rectifier is

(a) 0.482 (b) 0.572

(c) 0.286 (d) 1.11

54. Ans: (c)

Sol: 1-ϕ H.W.V.R

$$\text{T.U.F} = \frac{\text{DC power output}}{\text{VA rating of transformer}}$$

$$\text{DC power load} = V_{0avg} \times i_{0avg}$$

$$V_{0avg} = \frac{V_m}{\pi}$$

$$i_{0avg} = \frac{i_m}{\pi}$$

$$\text{DC power load} = \frac{V_m i_m}{\pi^2}$$

$$\text{Transformer secondary voltage} = \frac{V_m}{\sqrt{2}}$$

Transformer secondary current

$$= \left[\frac{1}{2\pi}\int_0^{\pi} i_m^2 \sin^2(\omega t)dt\right]^{1/2}$$

$$= \frac{i_m}{2\sqrt{\pi}} \times [\pi]^{1/2} = \frac{i_m}{2}$$

$$\therefore \text{Transformer VA rating} = \frac{V_m}{\sqrt{2}} \times \frac{i_m}{2} = \frac{V_m i_m}{2\sqrt{2}}$$

$$\therefore \text{T.U.F} = \frac{(V_m i_m/\pi^2)}{(V_m i_m/2\sqrt{2})} = \frac{2\sqrt{2}}{\pi^2} = 0.286$$

55. The positive sequence impedance component of three unequal impedances Z_a, Z_b and Z_c is

(a) $\frac{1}{3}(Z_a + aZ_b + a^2Z_c)$

(a) $\frac{1}{3}(Z_a + a^2Z_b + aZ_c)$

(c) $\frac{1}{3}(Z_a + Z_b + a^2Z_c)$

(d) $\frac{1}{3}(Z_a + aZ_b + Z_c)$

55. Ans: (a)

Sol:
$$\begin{bmatrix} Z_{a0} \\ Z_{a1} \\ Z_{a2} \end{bmatrix} = \frac{1}{3}\begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix}\begin{bmatrix} Z_a \\ Z_b \\ Z_c \end{bmatrix}$$

$$Z_{a1} = \frac{1}{3}(Z_a + aZ_b + a^2Z_c)$$

56. Which one of the following wiring systems is commonly used for light/fan load in domestic and commercial buildings?

(a) Led sheathed wiring

(b) Conduit wiring

(c) PVC wiring

(d) Cleat wiring

56. Ans: (b)

Sol: The type of the wiring used for domestic application is conduit wiring.

Conduit wiring is the most preferable in domestic and commercial applications.

57. Which one of the following is not an advantage in using bundle conductors?

(a) Reduced corona loss

(b) Reduced radio interference

(c) Increased voltage gradient

(d) Reduced surge impedance

57. Ans: (c)

Sol: When bundle conductors are used in the system, GMR of the conductor increases.

$$L = 2 \times 10^{-7} \ln\left(\frac{GMD}{GMR}\right)$$

As GMR increases $\Rightarrow$ Inductance decreases

$\Rightarrow$ Impedance (Reactance) decreases

$$\therefore \text{Surge impedance} = \sqrt{\frac{L}{C}} \Rightarrow \text{Decreases}$$

Option (d) is not correct

The electric field intensity

$$(E) \propto \frac{1}{\text{radius of conductor}}$$

$\propto$ corona

When GMR increases $\Rightarrow$ corona reduces

Option (a) is not correct

For constant power transfer,

$P = \frac{V_1 V_2}{X}\sin\delta$

When reactance (X) reduces $\Rightarrow$ voltage also reduce to maintain (P) constant.

Option (c) is correct.

The radio interference can be reduced by using the bundled conductors

Option (b) is not correct

58. Which one of the following is not a method of voltage control in power systems?
(a) Booster transformer
(b) Tap-changing transformer
(c) Series capacitor
(d) Shunt inductor

58. Ans: (c)

Sol: The methods of voltage control are
(i) Shunt capacitors
(ii) Shunt reactors (shunt inductors)
(iii) synchronous condenser
(iv) Synchronous phase modifiers
(v) Booster transformer
(vi) Tap changing transformer

The series capacitors are not preferred for the voltage control because they introduce the sub synchronous resonance in the circuit.

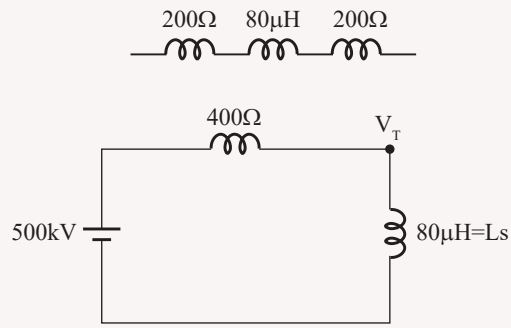
59. An inductance of 800 μH connects two sections of a transmission line each having a surge impedance of 200Ω. A 500 kV, 2 μsec rectangular surge travels along the line towards the inductance. What is the maximum value of the transmitted wave?

(a) $500\times\left[\frac{e-1}{e}\right]$ kV (b) $500\times\left[\frac{e+1}{e}\right]$ kV

(c) $250\times\left[\frac{e-1}{e}\right]$ kV (d) $250\times\left[\frac{e+1}{e}\right]$ kV

59. Ans: (a)

Sol:



The transmitted voltage $(V_T) = 500\text{kV}\times\frac{Ls}{400+Ls}$

$= 500\text{kV}\times\frac{s}{\left(s+\frac{400}{L}\right)}$

$= 500\text{kV}\left(e^{\frac{-400}{L}t}\right)$

$= 500\text{kV}\left(1-e^{\frac{-400\times2\times10^{-6}}{800\times10^{-6}}}\right)$

$= 500(1-e^{-1})$ kV

$= 500\left(\frac{e-1}{e}\right)$ kV

60. The faults on power systems are analyzed easily by making use of
(a) Superposition theorem
(b) Substitution theorem
(c) Thevenin's theorem
(d) Millman's theorem

60. Ans: (c)

Sol: the fault calculations always require Z_{Bus}. All the diagonal elements of Z_{Bus} are calculated from Thevenin's theorem.

61. Any device or circuit whose output is no a linear variation with the input can be used as
(a) an RF amplifier
(b) a mixer
(c) an IF amplifier
(d) a local oscillator

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61. Ans: (d)

Sol: Any device or circuit whose output is not a linear variation with the input can be used as a local oscillator.

62. In the receiver parameter, fidelity is a measure of
   (a) the ability of the receiver to accept a given band a frequencies and reject all other frequencies.
   (b) the minimum radio frequency signal level that can be detected at the input to the receiver and still produces a usable demodulated signal
   (c) the ability of a communication system to produce, at the output of the receiver, an exact replica of the original source information
   (d) the difference in decibels between the minimum input level necessary to discern a signal and the input level that will overdrive the receiver and produce distortion

62. Ans: (c)

Sol: In the receiver parameter, fidelity is measure of the ability of a communication system to produce, at the output of the receiver, an exact replica of the original source information.

63. Which one of the following statements is correct regarding turned radio frequency receiver?
   (a) The bandwidth is inconsistent and varies with centre frequency when turned over a wide range of input frequencies
   (b) It is stable due to the large number of RF amplifiers all turned to the same centre frequency.
   (c) The gain is uniform over a very wide frequency range
   (d) It has a very low sensitivity

63. Ans: (a)

Sol: In tuned radio frequency receiver the bandwidth s inconsistent and varies with center frequency when tuned over a wide range of input frequencies.

64. Which one of the following is a figure of merit used to indicate how much the signal-to-noise ratio deteriorates as a signal passes through a circuit or series of circuits?
   (a) Impulse noise
   (b) Noise figure
   (c) Correlated noise
   (d) Noise temperature

64. Ans: (b)

65. Consider the following statements related to the source coding:
   1. A conversion of the output of a discrete memoryless source (DMS) into a sequence of binary symbols· is called source coding.
   2. The source code efficiency (η) is defined as $\eta = \frac{L_{min}}{L}$, where L_{min} is the minimum possible value of L, and L is the average codeword length.
   3. The code redundancy (γ) is defined as $\gamma = 1 + \eta$.

   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

65. Ans: (d)

Sol: All the statements given regarding source coding are correct.

66. Consider the following statements regarding differential pulse-code modulator:
   1. The differential pulse-code modulator system employs a predictor.
   2. It needs far fewer bits each error sample than what would have been needed for the original samples themselves.
   3. It will have larger dynamic range than the original message itself.

   Select the correct statements using the code given below.
   (a) 1 and 3 only (b) 2 and 3 only
   (c) 1 and 3 only (d) 1, 2 and 3

66. Ans: (c)

67. How many minimum number of samples are required to exactly describe the following signal?
$x(t) = 10\cos(6\pi t) + 4\sin(8\pi t)$
(a) 4 samples per second
(b) 6 samples per second
(c) 8 samples per second
(d) 2 samples per second

67. Ans: (c)

Sol: $x(t) = 10\cos(6\pi t)+4\sin(8\pi t)$

$\omega_1 = 6\pi$ $\omega_2 = 8\pi$ G.C.D $= W_0(6\pi, 8\pi)$

$f_1 = 3Hz$ $f_2 = 4Hz$ $= 2\pi$

$f_0 = 1Hz$

To identify the frequency being present to represent a sine wave need min 2 samples/sec.
As 4 cycles are there we need 8 samples per sec.

68. Which one of the following is not a property of a Gaussian random process?
(a) A Gaussian process is completely described by its mean and autocorrelation
(b) If a Gaussian process is wide-sense stationary, then it is stationary in the strict sense too
(c) If a Gaussian process is given as input to an LTI system, the output process is also Gaussian
(d) If two process which are jointly Gaussian are uncorrelated, then they are statistically dependent

68. Ans: (d)

69. A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50×10^6 bits/sec. What is the maximum message signal bandwidth for which the system operates satisfactorily?
(a) 3.57 MHz (b) 4.55 MHz
(c) 7.55 MHz (d) 8.57 MHz

69. Ans: (a)

Sol: $n = 7$

$V_b = 50 \times 10^6$ (bps)

$50 \times 10^6 = 7 \times f_s$

$f_s = \frac{50}{7} \times 10^6$ (Hz)

$f_m = \frac{25}{7} \times 10^6$ (Hz)

$= 3.57$ (MHz)

70. **Statement (I):** Aluminium oxidizes quickly in normal atmospheric conditions and acquires a thin film of oxide Al_2O_3.
Statement (II): The high melting point of aluminium oxide coating and the rapidity with which a freely exposed aluminium surface becomes oxidized, make soldering difficult through conventional means.

70. Ans: (a)

71. **Statement (I):** When the signal is of the form of current, then series input devices are used.
Statement (II): An ammeter, which is a series device, thus should be designed with a low input impedance so that the current is correctly measured.

71. Ans: (a)

Sol: In series circuit current passing through all elements are same. Ammeter is a series device which is connected in series with a load. Ammeter internal resistance is low ideally zero. Because R_m and R_{sh} are low values and $R_{sh} < R_m$

The total resistance of ammeter is $R_a = R_{sh} \| R_m$

$R_a < R_{sh}$ = very low value

$\therefore$ don't connect Ammeter across the supply ($\therefore$It draws more current then it can damage)

72. **Statement (I):** If the gain margin is negative, this gives the decibel rise in open-loop gain, which is theoretically permissible without oscillation.
Statement (II): For a multistage amplifier, if the open loop gain $|\beta A|$ is unity when the phase shift is 180°, then the closed loop amplifier will oscillate.

72. Ans: (d)

Sol: For theoretically permissible without oscillation gain margin must be positive so, Statement (I) is

incorrect.

Open-loop gain is unity and phase shift is 180°, then the closed-loop amplifier will oscillate so, Statement II is correct.

73. **Statement (I):** When negative feedback is applied to the ideal amplifier, the differential input voltage is zero

Statement (II): There is no current flow into either input terminal of the ideal op-amp.

73. Ans: (b)

Sol: When negative feedback is applied to the ideal amplifier, the differential input voltage is zero, ($V_d \approx 0$), Statement (I) is correct

As $R_{in} \approx 0$, so there is no current flow into either input terminal of ideal op-amp, Statement II is correct.

Both statements are correct but statement II is not the correct explanation of statement I.

74. **Statement (I):** When the carrier is generated by a crystal oscillator, the frequency is fixed by the crystal.

Statement (II): The equivalent circuit of a crystal is an L-C-R circuit with both series and parallel resonant points.

74. Ans: (a)

Sol: Frequency of oscillation is fixed by the crystal,

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Statement I is correct

Statement II is also correct and statement II is the correct explanation of statement I

75. **Statement (I):** In FDM transmitter, if the signals which are to be multiplexed will each modulate a separate carrier, then the type of modulation can be AM, SSB, FM or PM.

Statement (II): In FDM transmitter, the modulator outputs will contain the sidebands of the corresponding signals.

75. Ans: (b)

Sol: Statement I is correct

Statement II is correct but statement II is not the correct explanation of Statement I

76. A transistor has $\beta = 105$ and $I_C = 840\ \mu A$. What is the value of I_B?

(a) 0.008 μA (b) 0.08 μA

(c) 0.8 μA (d) 8 μA

76. Ans: (d)

Sol: $\beta = 105, I_c = 840\mu A, I_B = ?$

$I_C = \beta I_B$

$$\Rightarrow I_B = \frac{I_C}{105}$$

$$= \frac{840}{105} \times 10^{-6}$$

$$= 8\mu A$$

77. What is the power gain of a transistor amplifier, if its current gain is 40 and voltage gain is 25?

(a) 100 (b) 1200

(c) 1000 (d) 950

77. Ans: (c)

Sol: $A_V = 25, A_I = 40, A_P = ?$

$A_P = A_V A_I$

$= 1000$

78. Which one of the following statements is not correct regarding common base amplifier?

(a) The output is in the same phase as the input alternating signal.

(b) It cannot operate at higher frequency as compared to CE amplifier

(c) The current gain is less than unity.

(d) Impedance matching is needed when cascading because there is very large difference in the input and output impedances, the input impedance is low and the output high.

78. Ans: (b)

Sol: Output is in the same phase as the input alternating signal. Option (a) is correct

It can operate at higher frequency because there

is no miller effect so it can be used as wide band amplifier. Option (b) is not correct.

Current gain (α) is less than unity. Option (c) is correct.

Option (d) is also correct

So, according to question option (b) is correct

79. When the quiescent point of an amplifier is biased just at the cut-off axis, so that only the positive half of the signal input is amplified and the negative half of the signal is cut off, it is refereed to as
(a) class AB amplification
(b) class A amplification
(c) class B amplification
(d) class C amplification

79. Ans: (c)

Sol: In class B amplification only the positive half of the signal input is amplified and negative half of the signal is cut-off

Option (c) is correct.

80. Which one of the following is a disadvantages of CE amplifier?
(a) It provides good current as well as voltage gain
(b) It provides the maximum power gain of the three configurations
(c) It has medium both input and output impedances
(d) Its frequency response bandwidth is lower than the amplifiers of the other two configurations

80. Ans: (d)

Sol: The main disadvantage of CE amplifiers is the frequency response bandwidth is lower than the amplifiers of the other two configurations.

81. Which one of the following consists of op-amp in inverting mode and network of RC components, and the op-amp being in inverting mode it serves two purposes of amplifying and at its output 180° shifted phase is obtained?
(a) Wien's bridge oscillator
(b) RC phase shift oscillator
(c) Triangular wave generator
(d) Charging capacitor

81. Ans: (b)

Sol: In R-C phase-shift oscillator, op-amp in inverting mode and network of R-C components.

82. Which one of the following statements is not correct related to oscillators?
(a) The frequency of a sinusoidal oscillator is determined by the condition that the loop-gain phase shift is zero.
(b) In every practical oscillator, the loop gain is slightly larger than unity and the amplitude of the oscillations is limited by the onset of non-linearity.
(c) The condition of unity loop gain $-A\beta = 1$ is called the Barkhausen criterion.
(d) Oscillations will be sustained if, at the oscillator frequency, the magnitude of the product of the transfer gain of the amplifier and the magnitude of the feedback factor of the feedback network are less than unity.

82. Ans: (d)

83. Which one of the following statements is not correct for a transistor?
(a) The region at the centre is always base region.
(b) Emitter region is more heavily doped and base region is very lightly doped
(c) Collector region is very lightly doped compared to base region
(d) Low power input can be converted to a large power output with the help of a small piece of semiconductor without any hassles of preheating and handling of large heat dissipation.

83. Ans: (c)

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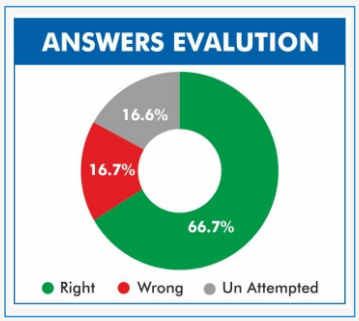

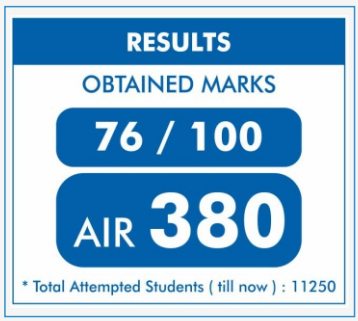

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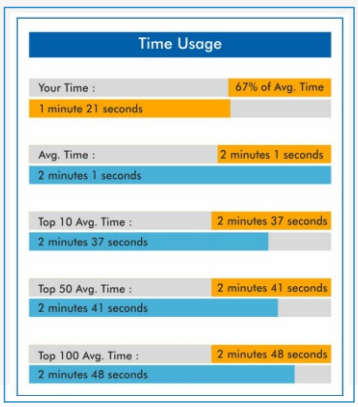

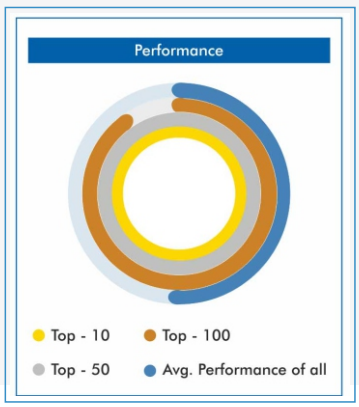

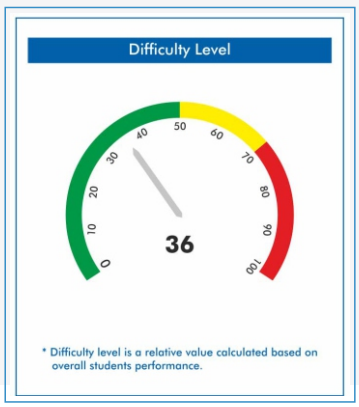

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Sol: Collector region is highly doped as compared to base region. So, option (c) is incorrect
That's why according to question option (c) is answer.

84. For certain of the reverse voltage in a transistor, the effective base width may reduce to zero resulting into the voltage breakdown. This phenomenon is called
(a) early effect
(b) avalanche multiplication
(c) punch through
(d) zones breakdown

84. Ans: (c)

Sol: Due to early effect, the effective base width may reduce to zero and resulting into the voltage breakdown
Option (a) is correct.

85. An n-type semiconductor specimen has a Hall coefficient of 300 cm^3/C and its resistivity is 0.1 Ω-cm. Its electron mobility is
(a) $300cm^2/V\text{-}sec$
(b) $30\ cm^2/V\text{-}sec$
(c) $3000\ cm^2.V\text{-}sec$
(d) $3\ cm^2/Vsec$

85. Ans: (c)

Sol: $R_H = 300\ cm^3/c$
Resistivity $\rho_n = 0.1\ \Omega\text{-cm}$
By definition, Hak coefficient

$$R_H = \frac{1}{\rho},\quad \rho \text{ -charge density}$$

Conductivity $\sigma_n = nq\mu_n$

$$\sigma_n = \rho\mu_n$$

$$\Rightarrow \mu_n = \sigma_n R_H = \frac{R_H}{\rho}$$

$$\mu_n = \frac{300}{0.1} = 3000\ cm^2/V\text{-}S$$

86. Which of the following motors are commonly used in power electronic systems?
1. Synchronous motors
2. dc motors
3. dc motors with brushes
Select the correct answer using the code given below.
(a) 1 and 3 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3

86. Ans: (c)

Sol: Power electronic systems commonly used motors are D.C motors with and without brushes

87. In PN junction diode, the reverse saturation current increases by 7.2% by a degree rise in junction temperature (in Celsius) and gets
(a) halved for every 10° C rise in temperature
(b) doubled for every 10° C rise in temperature
(c) halved for every 20° C rise in temperature
(d) doubled for every 20° C rise in temperature

87. Ans: (b)

Sol: Saturation current gets doubled for every 10°C rise in temperature.

88. Which one of the following controllers is to check the status of each device and inform the central processing unit of the status of each?
(a) Programmable I/O interrupt controller
(b) DMA controller
(c) Disk controller
(d) Pipeline controller

88. Ans: (a)

Sol: Programmable I/O Interrupt controller is to check the status of each device and inform the central processing unit of the status of each.

89. Which one of the following bus architectures is used to maximize throughput of video graphics memory?
(a) EISA bus (b) VESA bus
(c) PCI bus (d) MCA bus

89. Ans: (c)

Sol: PCI Bus architecture its used to maximize throughput video graphics memory.

90. Which one of the following bus architectures is having maximum data rate (MB/s)?
(a) VESA bus (b) PCI-64 bus
(c) MCA bus (d) EISA bus

90. Ans: (b)

Sol: Programmable Component Interface sometimes is also known as programmable chip interface provides highest speed among all other bus architectures.

91. The torque generated in th aluminium disk of induction type energy meter is maximum when the phase difference between the magnetic fields of shunt and series electromagnets is equal to
(a) 180° (b) 90°
(c) 45° (d) 0°

91. Ans: (b)

Sol: $\tau_d \alpha VI \sin(\Delta-\phi)$

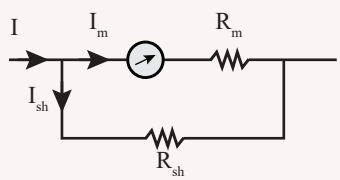
$\tau_d \alpha \phi_{sh} \phi_{se} \sin(\phi_{sh}, \phi_{se})$

If $\angle\phi_{sh,} \phi_{se} = \Delta-\phi = 90°$ the τ_d is maximum

92. A dc galvanometer of 4 Ω resistance reads up to 50 mA. What is the value of the resistance in parallel to enable the instrument to read up to 1 A?
(a) 0.21053 Ω (b) 0.26316 Ω
(c) 0.31285 Ω (d) 0.37347 Ω

92. Ans: (a)

Sol:



$I_m = 50$ mA

$I = 1A$

$R_m = 4\Omega$

$$m = \frac{I}{I_m} = \frac{1}{50 \times 10^{-3}} = \frac{1000}{50} = 20$$

$$R_{sh} = \frac{R_m}{m-1} = \frac{4}{20-1} = \frac{4}{19}$$

$R_{sh} = 0.21053\Omega$

93. Which one of the following is correct in the feedback circuit, having three resistance and capacitance elements with conditions as $R_1 = R_2 = R_3 = \bar{R}$ and $C_1 = C_2 = C_3 = \bar{C}$ for phase-shift oscillator?
(a) $f = \frac{0.065}{\bar{R}\bar{C}}$ (b) $f = \frac{0.078}{\bar{R}\bar{C}}$
(c) $f = \frac{0.045}{\bar{R}\bar{C}}$ (d) $f = \frac{0.038}{\bar{R}\bar{C}}$

93. Ans: (a)

Sol: $f = \frac{1}{2\pi RC\sqrt{6}} = \frac{0.065}{RC}$

94. Which one of the following statements is not correct for electrodynamometer type instrument?
(a) It can measure a range of currents and voltages up to 10 A and 600 V respectively.
(b) The deflecting torque is inversely proportinal tothe square of the current.
(c) It can be used for both ac and dc systems
(d) It has the same calibration for dc instruments as well as ac measurements

94. Ans: (b)

Sol: $\tau_d = I^2 \frac{dM}{d\theta}$

$\tau_d \propto I^2$

Electro dynamometer type (EMMC) instrument gives almost same reading for both AC and DC. So, this instrument also known as transfer type instrument.

It can measure both AC and DC

EMMC instrument converted in to ammeters, voltmeters and wattmeter.

Deflection torque is proportional to the square of the current.

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95. The controlling torque of a gravity controlled measuring instrument is directly proportional to
(a) θ (b) cos θ
(c) θ^2 (d) sinθ

95. Ans: (d)

Sol: $\tau_c = mgl \sin\theta$

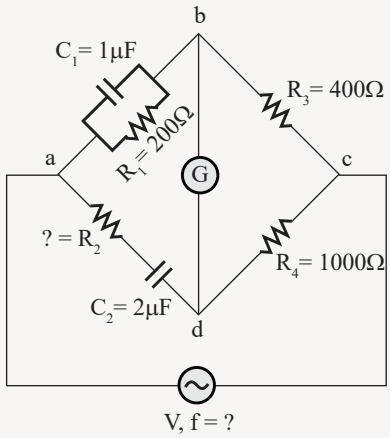
$\tau_c = wl \sin\theta$

$\tau_c \alpha \sin\theta$

96. The arms of a four arm bridge abcd, supplied with sinusoidal voltage, have the following values:
Arm ab: A resistance of 200 Ω in parallel with a capacitance of 1 μF
Arm bc: 400 Ω resistance
Arm cd: 1000 Ω resistance
Arm da: A resistance R_2 in series with a 2 μF capacitance
What are the values of R_2 and the frequency respectively at which the bridge will balance?
(a) 200 Ω, 456 Hz
(b) 400 Ω, 398 Hz
(c) 200 Ω, 398 Hz
(d) 400 Ω, 456 Hz

96. Ans: (b)

Sol: Wien's bridge:



If bridge is balance,

$Z_1 Z_4 = Z_2 Z_3$

$$\left(\frac{R_1}{1+R_1C_1S}\right)R_4 = \left(R_2 + \frac{1}{C_2S}\right)R_3$$

$S = j\omega$

$R_1R_2R_3C_1C_2S^2 + (R_2R_3C_2 + R_1R_3C_1 - R_1R_4C_2)S + R_3 = 0$

$(-R_1R_2R_3C_1C_2\omega^2 + R_3) + j\omega(R_2R_3C_2 + R_1R_3C_1 - R_1R_4C_2) = 0$

Imaginary parts = 0

$$R_2 = \frac{R_1R_4C_2 - R_1R_3C_1}{C_2R_3}$$

$$= \frac{200 \times 1000 \times 2 \times 10^{-6} - 200 \times 400 \times 1 \times 10^{-6}}{2 \times 10^{-6} \times 400}$$

$$= \frac{0.4 - 0.08}{8 \times 10^{-4}}$$

$R_2 = 400\Omega$

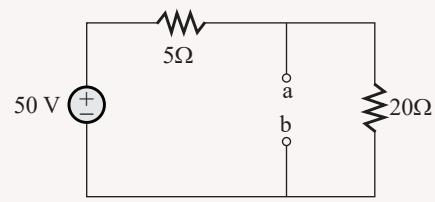
Real parts = 0

$$f = \frac{1}{2\pi\sqrt{R_1R_2C_1C_2}}$$

$$= \frac{1}{2\pi\sqrt{200 \times 400 \times 1 \times 10^{-6} \times 2 \times 10^{-6}}}$$

f = 398 Hz

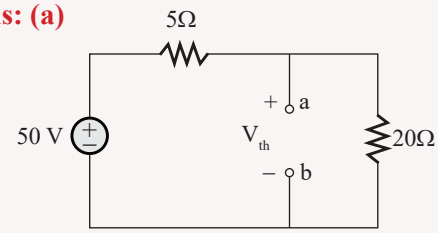
97. The Thevenin voltage and resistance across the terminal a-b of the circuit in the figure respectively are



(a) 40 V, 4 Ω (b) 20 V, 8 Ω
(c) 40 V, 8 Ω (d) 20 V, 4 Ω

97. Ans: (a)

Sol:

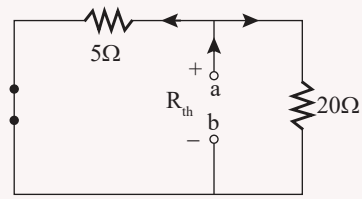


$$V_{Th} = V_{ab} = V_{20\Omega} = 50 \times \frac{20}{5+20}$$

$$= 50 \times \frac{20}{25}$$

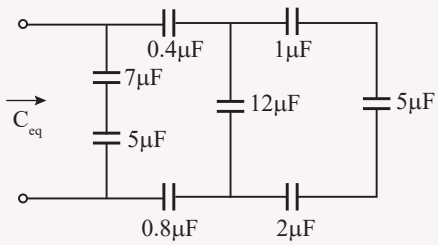
$$= 40 \text{ V}$$

R_{Th} : (VS → S.C)



$$R_{Th} = 5 \parallel 20 = \frac{5 \times 20}{5+20} = \frac{5 \times 20}{25} = 4\Omega$$

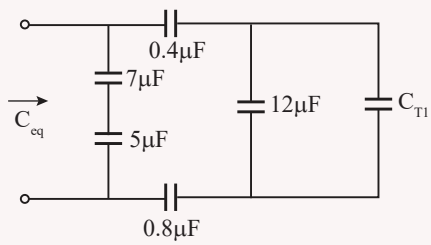
98. What is C_{eq} for the given circuit?



(a) 6.18 μF (b) 3.18 μF
(c) 8.23 μF (d) 12.67 μF

98. Ans: (b)

Sol:

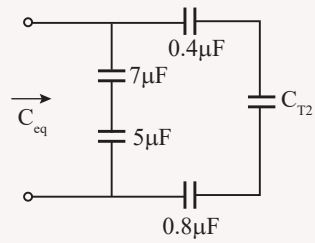


$$\frac{1}{C_{T1}} = \frac{1}{1} + \frac{1}{5} + \frac{1}{2}$$

$$\frac{1}{C_{T1}} = 1.7$$

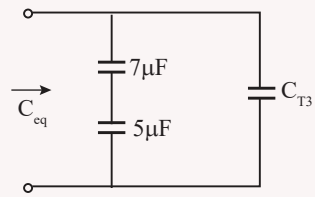
$$C_{T1} = \frac{10}{17}$$

$$C_{T2} = (12 \| C_{T1}) = 12 + C_{T1} = 12 + \frac{10}{17} = \frac{214}{17}$$



$$\frac{1}{C_{T3}} = \frac{1}{0.4} + \frac{1}{C_{T2}} + \frac{1}{0.8}$$

$$C_{T3} = \frac{428}{1639}$$



$$\frac{1}{C_{T4}} = \frac{1}{7} + \frac{1}{5}$$

$$\frac{1}{C_{T4}} = \frac{35}{12}$$

$$C_{eq} = (C_{T4} \| C_{T3}) = \frac{35}{12} + \frac{428}{1639}$$

$$C_{eq} = 3.18 \text{ μF}$$

99. Consider the following statements with respect to Kirchhoff's laws for a circuit comprising of resistances and independent sources:

1. The number of independent element volt-ampere equations is equal to the number of resistances
2. The number of independent KVL equations is equal to one more than the number of nodes.
3. The number of independent KVL equations equal to the number of independent loops.

Which of the above statements is/are not correct?

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

99. Ans: (a)

Sol: mesh (m) (or) independent loop is a closed path of a circuit or network which should not have further closed path in it.

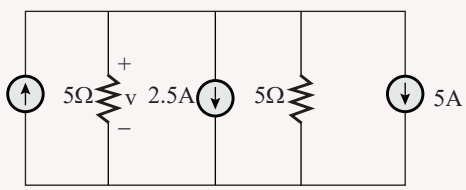
loop(ℓ) is a all possible closed paths of network or circuit.

All meshes are by default loop but not vice versa.

m = b – n + 1 (m = minimum number of KVL equations)

In nodal analysis we may neglect simples nodes but one of the principle node is consider as reference. So, the minimum no. of KCL equations required to solve the circuit or network = $n_p - 1$(n_p = no. of principle nodes)

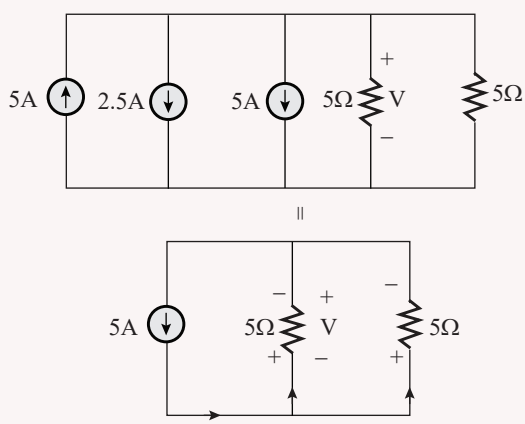
100. What is the voltage v in the circuit diagram?



(a) 7.5 V (b) 16.5 V
(c) 12.5 V (d) 14.4 V

100. Ans: (c)

Sol:



V = – 2.5 × 5

V = – 12.5 V

|V| = 12.5 V

101. When angular frequency for dc sources is zero, capacitor and inductor will acts like respectively
(a) short circuited, open circuited
(b) open circuited, short circuited
(c) open circuited, open circuited
(d) short circuited, short circuited

101. Ans: (b)

Sol: DC : (f = 0)

$\omega = 2\pi f = 0$

At steady state :

$$v_L(t) = L \times \frac{di_L(t)}{dt} = 0\ V$$

$X_L = \omega L = 0\Omega \Rightarrow L \rightarrow S.C$

$$i_c(t) = C \times \frac{dv_c(t)}{dt} = 0\ A$$

$$X_C = \frac{1}{\omega c} = \infty\Omega \Rightarrow C \rightarrow O.C$$

102. Which one of the following statements is not correct regarding potential due to a point charge?
(a) It is directly proportional to the magnitude of the charge
(b) It is inversely proportional to the distance from the charge
(c) It is inversely proportional to the relative permittivity of the medium in which the charge is placed
(d) It is directly proportional to the electric field intensity.

102. Ans: (d)

Sol: Electric potential due to point charge 'Q' located at some position in a medium of permittivity 'ε' is given by

$$V = \frac{Q}{4\pi\varepsilon R}\ ;\ \text{Where, } \varepsilon = \varepsilon_0 \varepsilon_r$$

Potential is
(i) Proportional to magnitude of charge,'Q'
(ii) Inversely proportional to distance from the point charge 'Q'
(iii) Inversely proportional to relative permittivity of medium, where the point charge is located.

Therefore statement in option (d) is not correct.

103. The relation between electric flux density (D) and field intensity (E) with absolute and relative permittivity is expressed as

(a) $E = \frac{\varepsilon_0 \varepsilon_r}{D}$ (b) $E = \frac{D}{\varepsilon_0 \varepsilon_r}$

(c) $E = \frac{D\varepsilon_0}{\varepsilon_r}$ (d) $E = \frac{D\varepsilon_r}{\varepsilon_0}$

103. Ans: (b)

Sol: The relation between electric flux density & electric field intensity is given by

$$\vec{D} = \varepsilon_0 \varepsilon_r \vec{E} \text{ (or) } \vec{E} = \frac{\vec{D}}{\varepsilon_0 \varepsilon_r}$$

Where:

ε_0 : Absolute (or) free space permittivity

ε_r : relative permittivity (or) dielectric constant.

104. If L is self-inductance, I is current, λ is flux linkage of a magnetic field, then the energy stored in the magnetic field is

(a) $0.5\lambda^2/L$ (b) $2\lambda^2/L$

(c) $0.5\ \lambda/L^2$ (d) $2\lambda/L^2$

104. Ans: (a)

Sol: Magnetic flux linkage, $\lambda \propto I$

$$\lambda = LI$$

$$I = \frac{\lambda}{L} \text{ (or) } L = \frac{\lambda}{I}$$

Energy stored in magnetic field is given by

$$W_M = \frac{1}{2}LI^2$$

$$= \frac{1}{2}L\left(\frac{\lambda}{L}\right)^2$$

$$= \frac{1}{2}L\frac{\lambda^2}{L^2}$$

$$\therefore W_M = \frac{0.5\lambda^2}{L}(J)$$

105. The time constant of R-L series circuit may be defined as the time at which the current through the RL series circuit rises to

(a) 36.8% of steady state value

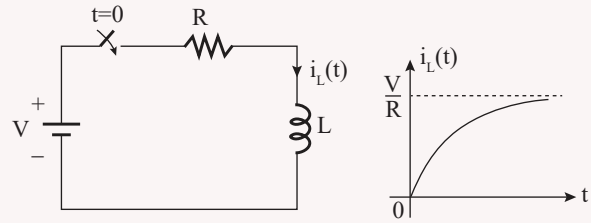
(b) 63.2% of steady state value

(c) 23.2% of steady state value

(d) 46.8% of steady state value

105. Ans: (b)

Sol:



$$i_L(t) = i_L(\infty)[1 - e^{-t/\tau}] ; t > 0$$

$$i_L(\infty) = \frac{V}{R} = \text{final value or steady state value.}$$

At $t = \tau$;

$$i_L(t) = \frac{V}{R} - \frac{V}{R}e^{-1} = 0.632\frac{V}{R}$$

$$i_L(t) = 0.632\ i_L(\infty)$$

At one time constant, the current reaches 63.2% of its final value.

106. Which one of the following functions is not performed by the USB host controller?

(a) Configure the scheduling algorithms

(b) Packet generation

(c) Serializer/Deserializer

(d) Process request from device and host

106. Ans: (a)

Sol: Except (a), All other options are responsibilities of USB host controller

107. Which one of the following layers in PCI express protocol architecture is used for compatibility with PCI, initialization and enumeration of the devices connected to the PCI express?

(a) PCI express physical layer

(b) Software layer

(c) Data link layer

(d) Hardware layer

107. Ans: (a)

Sol: Initialization and enumertion of the devices is done by physical layer. Hence option (a) is answer.

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108. Which one of the following tools is used to protect critical sections and prevent race conditions?

(a) Mutex lock (b) Semaphore lock

(c) Spooling lock (d) Livelock

108. Ans: (a)

Sol: First lets understand Critical Section and Race Condition

Critical Section: Critical section is a section of the program where a process access the shared resources during its execution.

Race Condition: Race condition is a situation occurs in a multiprogrammed system,where the final output produced depends on the execution order of instructions of different processes.

Protecting Critical Section: a critical section object can be owned by only one thread at a time, which makes it useful for protecting a shared resource from simultaneous access.

To avoid race conditions, any operation on a shared resource - that is, on a resource that can be shared between threads must be executed atomically.

(a) The mutex locking mechanism ensures only one thread can acquire the mutex and enter the critical section. This thread only releases the mutex when it exits in the critical section. **Since only one thread is in its critical section at any given time, there are no race conditions, and data always remain consistent.**

(b) Semaphore is essentially a non-negative integer that is used to solve the critical section problem by acting as a signal. This variable is used to solve the critical section problem and to achieve process synchronization in the multiprocessing environment. **It allows more than one thread to access the critical section.**

(c) Spooling - simultaneous peripheral operations on-line, spooling refers to as a process that putting jobs in a buffer or say spool, or temporary storage area, a special area in memory or on a disk where a device can access them when it is ready. Spooling is useful because devices access data at different rates.

(d) Live lock is a form of liveness failure in which a thread while not blocked still cannot make progress because it keeps retrying an operation that will always fail. A live lock is similar to a deadlock, except that the states of the processes involved in the live lock constantly change with regard to one another, none progressing.

109. To arise a deadlock situation, which of the following conditions hold simultaneously in a system?

1. Mutual exclusion
2. Hold and wait
3. Preemption

select the correct answer using the code given below.

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

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

109. Ans: (b)

Sol: Deadlock can arise if four conditions hold simultaneously

Mutual exclusion: only one process at a time can use a resource

- Hold and wait: a process holding at least one resource is waiting to acquire additional resources held by other processes
- No preemption: a resource can be released only voluntarily by the process holding it, after that process has completed its task
- Circular wait: there exists a set $\{P_0, P_1, \ldots, P_n\}$ of waiting processes such that P_0 is waiting for a resource that is held by P_1, P_1 is waiting for a resource that is held by P_2, …, P_{n-1} is waiting for a resource that is held by P_n and P_n is waiting for a resource that is held by P_0.

The statement 3 is pre-emption instead of No-Preemption which is not the condition of deadlock. Preemption is the condition to prevent the deadlock

So answer should be statement 1 and 2 only.

110. Which of the following issues are addressed by redundant arrays of independent disks?
(a) Performance and reliability
(b) Performance and stability
(c) Performance and process
(d) Performance and storage space

110. Ans: (a)

Sol: In RAID's we use the concept of mirroring where we replicate the copies of the same data more than once. Hence performance and reliability are addressed by this technique.

111. Stack-oriented machine
(a) contains any accumulator or general purpose registers
(b) does not contain only a stack pointer which points to the stack top
(c) requires any operand address for arithmetic, logical and comparison instructions.
(d) does not contain any accumulator or general purpose registers.

111. Ans: (d)

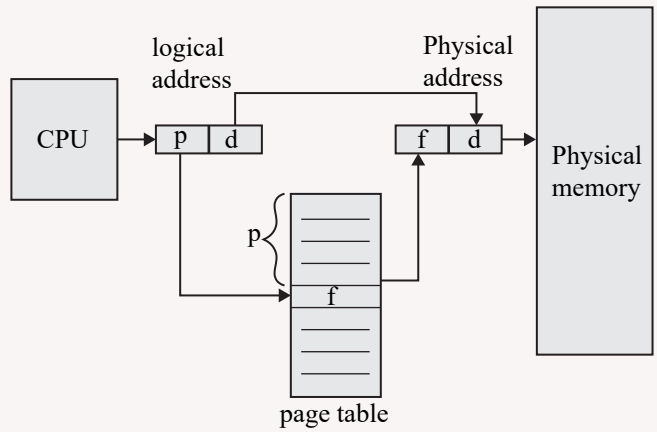
Sol: Stack oriented machine doesn't contain any accumulater or general purpose register

112. Virtual memory implements the translation of a program's address space to
(a) Virtual addresses (b) Physical addresses
(c) Mapping addresses (d) Page addresses

112. Ans: (b)

Sol: Virtual memory implements the translation of a program's address space into physical memory address space.

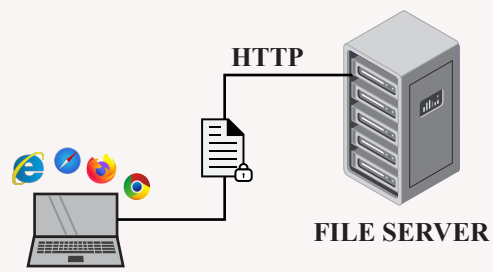
Addresses generated by programs are virtual addresses. The actual memory cells have physical addresses. A piece of hardware called a memory management unit (MMU) translates virtual addresses to physical addresses at run-time. The process of translating virtual addresses into real addresses is called mapping.



113. Which one of the following provides an interface to which a client can send a request to perform an action, in response, the server executes the action and sends back results to the client?
(a) File server system
(b) Open-source system
(c) Compute server system
(d) Peer-to-peer system

113. Ans: (c)

Sol: (a) A file server is a type of server responsible for the storage, access, and management of data files for a network of devices.



(b) In a peer to peer system, the nodes collectively use their resources and communicate with each other.

(c) A compute system or Server is any computing device which is the combination of hardware, firmware, and system software that runs business applications. A computing system in cloud essentially means a computer; however,

data centers use specific computers called servers, and so throughout this course, the term computing system will often be used to refer to a server. Generally, in a data center, applications are typically deployed on compute clusters for high availability and for balancing computing workloads.

File servers only make a remote file system accessible to clients. In compute server system, a server is a central node that services many client nodes. Open source system refers to a software program or platform with source code that is readily accessible and which can be modified or enhanced by anyone.

114. Which of the following statements are correct regarding multiprocessing architecture?
1. It can cause a system to change its memory access model from uniform memory access to non-uniform memory access.
2. There are two types of systems such as asymmetric multiprocessing and symmetric multiprocessing.
3. It adds CPUs to decrease computing power.

Select the correct answer using the code given below.

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

114. Ans: (b)

Sol: Multiprocessing is the use of two or more central processing units within a single computer system.

Statement 1 true: Non-uniform memory access (NUMA) is a computer memory design used in multiprocessing, where the memory access time depends on the memory location relative to the processor. Under NUMA, a processor can access its own local memory faster than non-local memory

Statement 2 true: Two types of multiprocessing systems are Asymmetric Multiprocessing and Symmetric Multiprocessing.

Asymmetric Multiprocessing system is a multiprocessor computer system where not all of the multiple interconnected central processing units (CPUs) are treated equally. In Asymmetric Multiprocessing there is a one master processor that controls the tasks.

Symmetric multiprocessing is the use of two or more identical processors are connected and sharing a common memory space. Each processor has access to I/O and memory devices.

Statement 3 False: In Multiprocessing system, two or more processors in a computer simultaneously process two or more different portions of the same program. The primary advantage of a multiprocessor computer is increasing the speed.

115. Consider a parallel circuit having three branches-the current in first branch is 50 ±2 A, in the second branch in 100±3A and in the third branch is 200±5A. What is the value of the total current, assuming the errors as standard deviations?

(a) 350 ±10A (b) 350 ±3.16 A
(c) 350 ±6.16 A (δ) 350 ±5 A

115. Ans: (c)

Sol: $I = (I_1 + I_2 + I_3) \pm \sigma_I$

$$\sigma_I = \pm \sqrt{\left(\frac{\partial I}{\partial I_1}\right)^2 \sigma_{I_1}^2 + \left(\frac{\partial I}{\partial I_2}\right)^2 \sigma_{I_2}^2 + \left(\frac{\partial I}{\partial I_3}\right)^2 \sigma_{I_3}^2}$$

$$\frac{\partial I}{\partial I_1} = \frac{\partial I}{\partial I_2} = \frac{\partial I}{\partial I_3} = 1$$

$$\sigma_I = \pm \sqrt{(1)^2 \times 2^2 + (1)^2 \times 3^2 + (1)^2 \times 5^2}$$

$$\sigma_I = \pm 6.1644$$

$$\therefore I = (50 + 100 + 200) \pm 6.1644$$

$$I = (350 \pm 6.1644)A$$

116. Which one of the following is not a self-generating type of transducer?
(a) Bourdon gauge for the measurement of pressure
(b) Pitot tube for the measurement of fluid flow velocity
(c) Thermistor for the measurement of tempera-

ture

(d) Photovoltaic cell

116. Ans: (d)

Sol: Bourdon gauge, pitot tube, Thermistor all are passive transducer it requires external excitation source.

Photo voltaic cell is a active transducer or self generating. It doesn't required extra external source.

117. The approximate range of gauge factor for a semi-conductor strain gauge is

(a) 2-3 (b) 50-90

(c) 10-20 (d) 100-200

117. Ans: (d)

Sol: $GF = \frac{\Delta R/R}{\Delta L/L}$

GF for semiconductor $= 1 + 2\mu + \frac{\Delta\rho/\rho}{\Delta L/L}$

for semiconductor strain gauge in addition to geometrical effect (ΔL, ΔA) there exist also resistivity effect ($\Delta\rho$) not only exists but also it contributes value in generating higher gauge factor is 250.

118. The approximate pressure range for ionization gauge measuring device is

(a) 10^{-8} to 10^{-3} torr (b) 10^{-3} to 10^{-2} torr

(c) 10^{-10} to 10^{-8} torr (d) 10^{-2} to 10^{-1} torr

118. Ans: (a)

Sol: Ionization gauge can measure low vacuum pressure in the range 10^{-10} to 10^{-3} torr

119. A half-wave rectifier type a.c. voltmeter is fed with a 20 V r.m.s. signal. What is the equivalent d.c. output voltage?

(a) 6.4V (b) 9V

(c) 12.8 V (d) 18V

119. Ans: (b)

Sol: HWR:

$$V_{DC} = V_{avg} = \frac{V_m}{\pi}$$

$$V_{AC} = V_{rms} = 20V = \frac{V_m}{\sqrt{2}}$$

$$V_m = V_{rms} \times \sqrt{2}$$

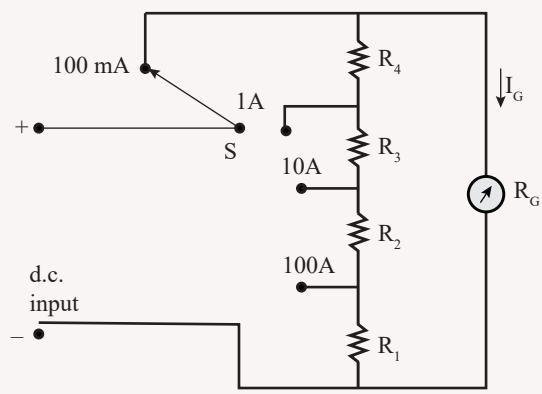
$$V_{DC} = \frac{V_{rms} \times \sqrt{2}}{\pi}$$

$$V_{DC} = \frac{\sqrt{2}}{\pi} \times V_{rms}$$

$$V_{DC} = 0.45 \times 20$$

$$V_{DC} = 9V$$

120. A D'Arsonval movement has a resistance of 100Ω and full deflection current of 2 mA and is used for construction of multirange ammeter as shown in the figure:



What are the values of ressitances R_1, R_2,R_3 and R_4, if the shunt resistances are connected as shown in the figure?

(a) $R_1 = 0.002\Omega$, $R_2 = 0.018\Omega$,R_3=0.18Ω and R_4 = 1.836Ω

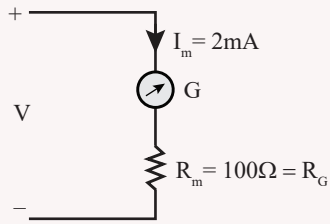
(b) $R_1 = 0.002\Omega$, $R_2 = 0.18\Omega$,R_3=0.018Ω and R_4 = 1.836Ω

(c) $R_1 = 1.836\Omega$, $R_2 = 0.18\Omega$,R_3=0.018Ω and R_4 = 0.002Ω

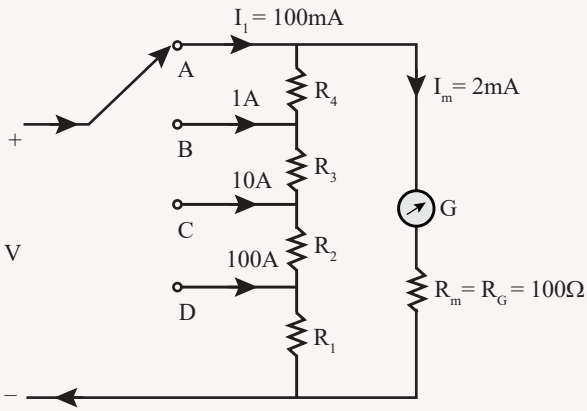
(d) $R_1 = 1.836\Omega$, $R_2 = 0.018\Omega$,R_3=0.18Ω and R_4 = 0.02Ω

120. Ans: (a)

Sol:



S at A:

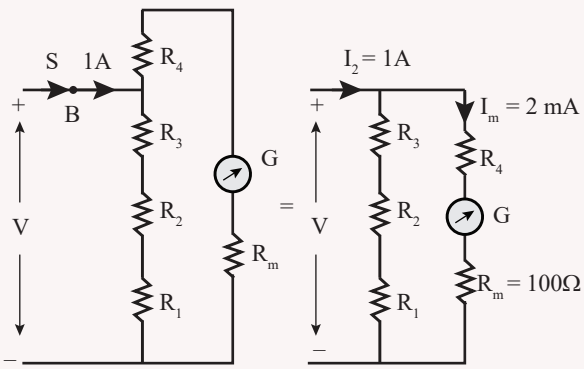


$$R_{sh1} = R_1 + R_2 + R_3 + R_4 = \frac{R_m}{m_1 - 1}$$

$$m_1 = \frac{I_1}{I_m} = \frac{100mA}{2mA} = 50$$

$$R_1 + R_2 + R_3 + R_4 = \frac{100}{50-1} = \frac{100}{49} = 2.04 \text{.....(1)}$$

S at B:



$$R_{sh2} = R_1 + R_2 + R_3 = \frac{R_4 + R_m}{m_2 - 1}$$

$$m_2 = \frac{I_2}{I_m} = \frac{1}{2mA} = \frac{1}{2 \times 10^{-3}}$$

$$m_2 = 500$$

$$R_1 + R_2 + R_3 = \frac{R_4 + 100}{500 - 1}$$

$$R_1 + R_2 + R_3 = \frac{R_4 + 100}{499} \text{.....(2)}$$

S at C :

$$R_{sh3} = R_1 + R_2 = \frac{R_3 + R_4 + R_m}{m_3 - 1}$$

$$m_3 = \frac{I_3}{I_m} = \frac{10}{2 \times 10^{-3}} = 5000$$

$$R_1 + R_2 = \frac{R_3 + R_4 + 100}{5000 - 1}$$

$$R_1 + R_2 = \frac{R_3 + R_4 + 100}{4999} \text{.....(3)}$$

S at D:

$$R_{sh4} = R_1 = \frac{R_2 + R_3 + R_4 + 100}{m_4 - 1}$$

$$m_4 = \frac{I_4}{I_m} = \frac{100}{2 \times 10^{-3}} = 50000$$

$$R_1 = \frac{R_2 + R_3 + R_4 + 100}{49999} \text{.....(4)}$$

Solve (1) and (2) $\Rightarrow R_4 = 1.83673\Omega$

Substitute R_4 value in equation (2) and (3)

$$R_1 + R_2 + R_3 = \frac{1.83673 + 100}{499} \text{.....(5)}$$

$$R_1 + R_2 = \frac{R_3 + 1.83673 + 100}{4999} \text{.....(6)}$$

Solve (5) and (6) $\Rightarrow R_3 = 0.1836\Omega$

Substitute R_3 and R_4 in (4) $\Rightarrow R_1 = 0.002\Omega$

Substitute R_1, R_3 and R_4 in (1) $\Rightarrow R_2 = 0.018\Omega$

121. A workshop has several machines. During a typical month, two machines will break down. The probability of more than two machines will break down

in a month is

(a) $1-3e^{-2}$ (b) $1-4e^{-2}$

(c) $1-5e^{-2}$ (d) $1-6e^{-2}$

121. Ans: (c)

Sol: $\lambda = 2$

$$P(x > 2) = 1 - [P(X=0)+P(X=1)+P(X=2)]$$

$$= 1 - [e^{-\lambda} + \lambda e^{-\lambda} + \frac{\lambda^2}{2} e^{-\lambda}]$$

$$= 1 - e^{-\lambda}[1 + \lambda + \frac{\lambda^2}{2}]$$

$$= 1 - e^{-2}[1+2+2]$$

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

122. Villages A,B,C and D are connected by overhead telephone lines joining AB, AC, BC, BD and CD. As a result of severe gales, there is a probability p (the same for each link) that any particular link is broken. Then the probability that a call can be made from A to B is

(a) $1-p^2-2p^3+3p^4-p^5$

(b) $1+2p^2-2p^3+4p^4-2p^5$

(c) $1-3p^2+2p^3-3p^4+p^5$

(d) $1+4p^2+2p^3-4p^4+2p^5$

122. Ans: (a)

123. What is regression line of Y on X for the following six pairs of observations?

i	1	2	3	4	5	6
x_i	1	3	4	5	7	8
y_i	2	8	9	10	14	19

(a) Y=1.18X – 0.49 (b) Y=1.18X – 0.16

(c) Y=2.18X + 0.49 (d) Y=2.18X + 0.16

123. Ans: (d)

Sol:

$$\bar{x} = \frac{\sum x_i}{n} = \frac{(1+3+4+5+7+8)}{6}$$

$$= \frac{28}{6} = \frac{14}{3} \simeq 4.7$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{(2+8+9+10+14+19)}{6}$$

$$= \frac{62}{6} = \frac{31}{3} \simeq 10.3$$

We know that any line of regression passes through $(\bar{x}, \bar{y})$

from option (d); y = 2.18 X + 0.16 is satisfied by $(\bar{x}, \bar{y}) = (4.7, 10.3)$

$\therefore$ (d) is correct

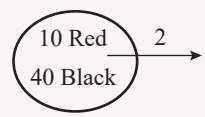
124. A bag contains 50 balls of which 10 are red and the remainder black. If two balls are drawn successively from the bag at random, what is the probability of selecting one red and one red and one black ball?

(a) $\frac{9}{245}$ (b) $\frac{156}{245}$

(c) $\frac{16}{49}$ (d) $\frac{156}{49}$

124. Ans: (c)

Sol:



Required Probability =

$$\frac{10_{C_1} \times 40_{C_1}}{50_{C_2}} = \frac{10 \times 40}{\left(\frac{50 \times 49}{2}\right)}$$

$$= \frac{16}{49}$$

125. A random variable y has a known probability distribution given by

y	2	4	6	8	10
P(y)	0.17	0.23	0.2	0.3	0.1

Then the expected value of y is

(a) 7.67 (b) 6.88

(c) 5.86 (d) 4.89

125. Ans: (c)

Sol:

y	2	4	6	8	10
p(y)	0.17	0.23	0.2	0.3	0.1

$E(y) = \Sigma\, yp(y)$

$= 2(0.17)+4(0.23)+6(0.2)+8(0.3) + 10(0.1)$

$= 0.34+0.92+1.2+2.4+1$

$= 5.86$

126. The fourier series for $f(x) = \sin^2 x$ defined over the range $-\pi \le x \le \pi$ is

(a) $\frac{1}{2} - \frac{\cos 2x}{2}$ (b) $1+\cos 2x$

(c) $\frac{1}{2} - \frac{\cos x}{2}$ (d) $\frac{\cos 2x}{2} + \frac{1}{2}$

126. Ans: (a)

Sol: $f(x) = \sin^2 x \quad ; -\pi \le x \le \pi$

$= \frac{(1-\cos 2x)}{2}$

127. What is the general solution of the partial differential equation.

$\frac{\partial \psi}{\partial x} + 2\frac{\partial \psi}{\partial y} + (2x-y)\,\psi = 0$?

(a) $\psi(x,y) = f(2x-y)e^{-(2x^2+2y^2-3xy)/5}$

(b) $\psi(x,y) = f(2x-y)e^{-(-2x^2-2y^2+3xy)/5}$

(c) $\psi(x,y) = f(2x-y)e^{-(-2x^2+2y^2+3xy)/5}$

(d) $\psi(x,y) = f(2x-y)e^{-(2x^2-2y^2+3xy)/5}$

127. Ans: (d)

Sol: From option (d)

$\psi(x,y) = f(2x-y)e^{-(2x^2-2y+3xy)/5}$ ..... (1)

$\frac{\partial \psi}{\partial x} = f(2x-y)e^{-(2x^2-2y^2+3xy)/5}\left(\frac{-4x-3y}{5}\right)$

$+ e^{-(2x^2-2y^2+3xy))/5} 2f'(2x-y)$ .....(2)

$\frac{\partial \psi}{\partial y} = f(2x-y)e^{-(2x^2-2y^2+3xy)/5}\left(\frac{4y-3x}{5}\right)$

$+ e^{-(2x^2-2y^2+3xy)/5}(-f'(2x-y)$ .....(3)

From (2) & (3)

$\frac{\partial \psi}{\partial x} + 2\frac{\partial \psi}{\partial y} = f(2x-y)e^{-(2x^2-2y^2+3xy)/5}\left(\frac{-4x-3y}{5} + \frac{8y-6x}{5}\right)$

$= \psi(x,y)\left(\frac{-10x+5y}{5}\right)$

$= -(2x-y)\psi(x,y)$

$\frac{\partial \psi}{\partial x} + 2\frac{\partial \psi}{\partial y} + (2x-y)\psi(x,y) = 0$

Remaining options will not satisfy

128. The functions $f(x,t)$ and $F(x)$ are defined by $f(x,t) = e^{-xt}$ and $F(x) = \int_0^x f(x,t)dt$, Then $\frac{dF}{dx} =$

(a) $f(x.t) + \int_0^x \frac{\partial f(x,t)}{\partial x}dt$

(b) $f(x,x) + \int_0^x \frac{\partial f(x,t)}{\partial x}dt$

(c) $f(0,0) + \int_0^x \frac{\partial f(x,t)}{\partial x}dt$

(d) $f(t,t) + \int_0^x \frac{\partial f(x,t)}{\partial x}dt$

128. Ans: (b)

Sol: $F(x) = \int_0^x f(x,t)dt$

$\Rightarrow \frac{dF}{dx} = \frac{d}{dx}\left[\int_0^x f(x,t)dt\right]$

$= \int_0^x \frac{\partial f(x,t)}{\partial x}dt + f(x,x)\frac{dx}{dx} - f(x,0)\frac{d}{dx}(0)$

$= f(x,x) + \int_0^x \frac{\partial f(x,t)}{\partial x}dt$

129. The distances of the variable point P which has coordinates x,y,z from the fixed points (0,0,1) and (0,0,–1) are denoted by u and v respectively. New variables ζ, η, ϕ are defined by $\zeta = \frac{1}{2}(u+v)$, $\eta = \frac{1}{2}(u-v)$ and ϕ is the angle between the plane y=0 and the plane containing the three points, i.e. $\phi = \tan^{-1}\left(\frac{y}{x}\right)$ over $1 \le \zeta < \infty$, $-1 \le \eta < 1$, $0 \le \phi < 2\pi$. The Jacobian of $\frac{\partial(\xi,\eta,\phi)}{\partial(x,y,z)}$ has the value

$(\zeta^2-\eta^2)^{-1}$, then $\int\int\int_{\text{all space}} \frac{(u-v)^2}{uv}\exp\left(-\frac{u+v}{2}\right)$ dxdydz =

(a) $\frac{16\pi}{e}$ (b) $\frac{8\pi}{3e}$

(c) $\frac{16\pi}{3e}$ (d) $\frac{8\pi}{e}$

129. Ans: (c)

Sol: Given that; $\left.\begin{aligned}\xi &= \frac{1}{2}(u+v)\\ \eta &= \frac{1}{2}(u-v)\end{aligned}\right\}$ u = (ξ+η) & v = (ξ–η)

$$\iiint_{\text{space}} \frac{(u-v)^2}{uv} e^{-\left(\frac{u+v}{2}\right)} dxdydz$$

$$\int_{\phi=0}^{2\pi}\int_{\eta=-1}^{1}\int_{\xi=1}^{\infty} \frac{(2\eta)^2}{(\xi+\eta)(\xi-\eta)} e^{-\xi} \frac{\partial(x,y,z)}{\partial(\xi,\eta,\phi)} d\xi d\eta d\phi$$

$$= \int_{\phi=0}^{2\pi}\int_{\eta=-1}^{1}\int_{\xi=1}^{\infty} \frac{4\eta^2}{(\xi^2-\eta^2)} e^{-\xi}(\xi^2-\eta^2) d\xi d\eta d\phi$$

$$\left(\text{Given } \frac{\partial(\xi,\eta,\phi)}{\partial(x,y,z))} = (\xi^2-\eta^2)^{-1}\right.$$

$$= \int_{\phi=0}^{2\pi} d\phi \int_{\eta=-1}^{1} 4\eta^2 d\eta \int_{\xi=1}^{\infty} e^{-\xi} d\xi$$

$$= (\phi)_0^{2\pi} 8\left(\frac{\eta^3}{3}\right)_0^1 (-e^{\xi})_1^{\infty}$$

$$= -(2\pi)\times\left(\frac{8}{3}\right)\times(0-e^{-1})$$

$$= \frac{16\pi}{3e}$$

Option (c) is correct

130. The function

$f(x,y) = x^3 - 12xy+48x+by^2, b \neq 0$

has two, one or zero stationary points, according to whether |b| is

(a) Lessthan, equal to or greater than 3

(b) less than, equal to or greater than 4

(c) less thean, equal to or greater than 8

(d) less than, equal to or greater than 2

130. Ans: (a)

Sol: $f(x,y) = (x^3 - 12xy + 48x + by^2)$ $(b \neq 0)$

$$\frac{\partial f}{\partial x} = 0 \Rightarrow (3x^2 - 12y + 48) = 0$$

$$3(x^2 - 4y + 16) = 0 \quad \ldots\ldots (1)$$

$$\frac{\partial f}{\partial y} = 0 \Rightarrow (-12x + 2by) = 0$$

$$\Rightarrow y = \frac{6x}{b} \quad \ldots\ldots (2)$$

put (2) in (1)

$$\therefore \left(x^2 - \frac{24x}{b} + 16\right) = 0$$

$$(bx^2 - 24x + 16b) = 0$$

$$\therefore x = \frac{24 \pm \sqrt{(576 - 64b^2)}}{2b}$$

$\Rightarrow (576-64b^2) \geq 0$; (or ≤ 0)

$576 \geq 64b^2$

$b^2 \leq \frac{576}{64}$

$b^2 \leq 9$

$\therefore -3 \leq b \leq 3$

$\therefore |b| < 3$ or $|b| > 3$

(a) is correct

131. What are the values of α and β that make $dF(x,y) = \left(\frac{1}{x^2+2} + \frac{\alpha}{y}\right) dx + (xy^{\beta}+1)\, dy$ an exact differential equation?

(a) $\alpha = -1, \beta = -2$ (b) $\alpha = 1, \beta = -2$

(c) $\alpha = -1, \beta = 2$ (d) $\alpha = -2, \beta = -1$

131. Ans: (a)

Sol: $dF(x,y) = \left(\frac{1}{x^2+2} + \frac{\alpha}{y}\right) dx + (xy^{\beta}+1)\, dy$

$$\frac{\partial M}{\partial y} = \frac{-\alpha}{y^2} \& \frac{\partial N}{\partial x} = y^{\beta}$$

$$\therefore \frac{\partial M}{\partial y} = \frac{\partial N}{\partial X} \Rightarrow \alpha = -1 \ \& \ \beta = -2$$

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TOTAL 36 RANKS IN TOP 10

ME	EE	E&T	CE
10	09	10	07

132. A and B are real non-zero 3×3 matrices and satisfy the equation $(AB)^T + B^{-1} A = 0$. If B is orthogonal, than A is
(a) Symmetric (b) Anti-symmetric
(c) Hermitian (d) Anti-Hermitian

132. Ans: (b)

Sol: $(AB)^T + B^{-1}A = 0$
$B^TA^T + B^TA = 0$ ($\because$ 'B' is orthogonal)
$\therefore B^T (A^T + A) = 0$
$\Rightarrow A^T = -A$
$\therefore$ 'A' is Anti-symmetric (Skew-symmetric matrix)

133. Consider a buck converter with the controlled switch as MOSFET and the uncontrolled switch as diode, the input to the buck converter is 60V. The MOSFET is turned on for 20μ sec and turned off for 10μ sec periodically. Assuming ideal components, the output voltage of the buck converter is
(a) 20V (b) 30V
(c) 40V (d) 50V

133. Ans: (c)

Sol: Buck converter

$$V_{0avg} = D \times V_s$$

$$= \frac{T_{ON}}{T} \times V_s$$

$$= \frac{20 \times 10^{-6}}{30 \times 10^{-6}} \times 60$$

$$V_{0avg} = 40 \text{ V}$$

134. Consider the following statements related to d.c.–d.c. converters:
1. The polarity of output voltage and input voltage of a single-ended primary inductance converter is opposite.
2. The polarity of output voltage and input voltage of a Cuk converter is opposite.
3. Th polarity of output voltage and input voltage of a buck-boost converter is same.
4. The polarity of output voltage and input voltage of a boost converter is same.

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

134. Ans: (d)

Sol: In cuk and buck-boost converters V_{in} and V_{out} polarities are opposite.

135. In d.c. power supplies, the switching frequency is much greater than
(a) the d.c. power source frequency, enabling the transformer to be small.
(b) the d.c. power source frequency, enabling the transformer to be large.
(c) the a.c. power source frequency, enabling the transformer to be large
(d) the a.c. power source frequency, enabling the transformer to be small.

135. Ans: (d)

Sol: Frequency increases, size of transformer is decreases.

136. Transient disturbance is produced in a circuit whenever
(a) currents in electrical circuit are associated with resistors
(b) circuit is suddenly connected to or disconnected from the supply
(c) the source is over damped
(d) the source is under damped

136. Ans: (b)

Sol: Whenever a network containing energy storage elements such as inductor or capacitor is switched from one condition to another, either by change in applied source or change in network elements, the response current and voltage changes from one state to the other state.
L-oppose the sudden change in current, 'C' - oppose sudden change in voltage.
The time taken to change from an initial steady state to the final steady state is known as the transient

period.

If load is suddenly connected (or) disconnected transient disturbance will come.

137. Choke coils are made of iron core, because
(a) it has less loss in iron cores
(b) large-valued flux densities can be produced in iron cores
(c) It is easily available in the market
(d) it has laminated core with high resistance.

137. Ans: (b)

Sol: Advantages of Iron cores:
1. It offers very high permeability
2. In compared with air core, same value of the flux can be produced with small size iron core
3. Large value of flux density can be produced in Iron core

138. At off-resonance frequencies in parallel resonant circuit, the pahse angle is greater than
(a) 0° (b) 30°
(c) 60° (d) 90°

138. Ans: (a)

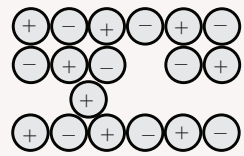
Sol: At resonance frequency $\overline{V}, \overline{I}$ are in phase then phase angle is $\phi = 0°$

At off resonance (or) not resonance frequency $\phi > 0°$

139. Which one of the following defects might be through of as being formed by a cation leaving its normal position and moving into an interstitial sire?
(a) Schottky defect
(b) Frenkel defect
(c) Crystallographic defect
(d) Stoichiometric defect

139. Ans: (b)

Sol: Frankel defect: This defect is formed by moving an ion from its original position to an interstitial position



140. Which of the following classifications are correct with reference to the various types of imperfections in a semi conductor?
1. Substitutional
2. Vacancies
3. Interstitial

Select the correct answer using the code given below.
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1,2 and 3

140. Ans: (d)

Sol: The imperfections present in semiconductors
* Vacancy defect
* Interstitial defect
* Substitutional defect

141. Which one of the following statements is not correct regarding superconductivity of material?
(a) Superconducting compounds and alloys do not necessarily have compounds which are themselves superconducting.
(b) The metals which are very good conductors at room temperature do not exhibit super conducting properties.
(c) The metals and compounds which are superconducting are rather bad conductors ar ordinary temperature.
(d) Monovalent metals, ferromagnetic and anti-ferromagnetic metals are superconducting.

141. Ans: (d)

Sol: Good conductors like C_u, A_g, A_u and ferro magnetic material (F_e,C_o,N_i) are not becoming superconductor due to weak cooper pairs.

142. According to Bragg's law, if an electromagnetic wave is diffracted when it is passed through a series of small slits spaced a distance d apart and order of diffraction is n and if the angle between the diffracted beam and incident beam is 2θ, then the relationship between the wavelength λ and this angle of diffraction is

(a) $n\lambda = 2d \sin\theta$ (b) $\lambda = 2dn\sin\theta$

(c) $\lambda d = n\sin 2\theta$ (d) $n\lambda = d\sin 2\theta$

142. Ans: (a)

Sol: Bragg's Law

$n\lambda = 2d \sin\theta$

n = order of diffraction

λ = wave length of electro magnetic wave

d = Inter-planar spacing

θ = Brags's angle

143. What is the approximate diameter of a copper wire of length 100m, if it is to be used as winding material in a transformer such that the resistance of the whole wining is 2Ω? (Take resistivity of copper as 1.7×10^{-8} Ω-m)

(a) 0.25 mm (b) 1.05 mm

(c) 2.25 mm (d) 3.05 mm

143. Ans: (b)

Sol: $l = 100$m

$R = 2\Omega$

$\rho = 1.7\times10^{-8}$ Ω-m

$$\rho = \frac{R.A}{l} = \frac{2\times\pi r^2}{100} = 1.7\times10^{-8}$$

$r^2 = 27.052\times10^{-8}$

r = 0.52 mm

Diameter = d = 2r = 1.04 mm

144. The temperature above which the ferromagnetic materials lose their magnetic properties is called

(a) Saturation point (b) breakdown point

(c) Curie point (d) peak point

144. Ans: (c)

Sol: Curie point : At this point of temperature ferromagnetic material lose their magnetic properties.

145. There are some metals and chemical compounds whose resistivity becomes zero when their temperature is brought near 0K (–273°C). Such metals or compounds are said to have attained

(a) piezoelectricity (b) Superconductivity

(c) semi conductivity (d) electromagnetism

145. Ans: (b)

146. A blue lamp emits light of mean wavelength of 4500 Å The lamp is rated at 150W and 8% of the energy appears as emitted light. How many photons are emitted by the lamp per second? (Take $h = 6.625\times10^{-34}$ J-sec and $c = 3\times10^8$ m/sec)

(a) 10.55×10^{18} (b) 13.62×10^{18}

(c) 27.15×10^{18} (d) 33.25×10^{18}

146. Ans: (c)

Sol: Mean wavelength, of light, $\lambda = 4500\ \overset{0}{A}$

Rating of the lamp = 150W

Percentage of energy which appears as light = 8%

Power which is transmitted as light

$$\frac{150\times8}{100} = 12W$$

Light energy emitted/sec = 12J

Energy carried by an electron

= hf

$\because f = \frac{C}{\lambda}$ C, λ being velocity of light and wavelength respectively

$$= h.\ \frac{C}{\lambda} \qquad \left[\because h = 6.625\times10^{-34}\,J-sec.,\ C = 3\times10^8\ m/sec\right]$$

$$= \frac{6.625\times10^{-34}\times3\times10^8}{4500\times10^{-10}}$$

$= 44.2\times10^{-20}$ J

∴ Number of photons emitted by the lamp/sec.

$$= \frac{12}{44.2\times10^{-20}} = 27.15\times10^{18}$$

147. What is the energy lost per hour in a specimen of iron subjected to magnetization at 50 c/s, if the specimen weighs 50kg and the hysteriesis loop is equivalent in area to 250 J/m^3 and the density of irion is 7500 kg/m^3 ?

(a) 3×10^5J (b) 4×10^5J

(c) 5×10^5 J (d) 6×10^5 J

147. Ans: (a)

Sol: f = 50 c/sec

m = 50 kg

Hysteresis loss = 250 J/m^3

$$\text{Hysteresis losses per cycle} = \frac{250\times50}{7500}$$

$$\text{Hysteresis losses per second} = \frac{250\times50}{7500}\times50$$

Hysteresis losses per hour

$$= \frac{250\times50}{7500}\times50\times60\times60$$

$$= 3\times10^5 \text{ J}$$

148. A good insulating material should possess which of the following characteristics?

1. High dielectric strength
2. Low permittivity
3. Low thermal strength

select the correct answer using the code given below.

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

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

148. Ans: (a)

Sol: Characteristics of good insulator

1. High dielectric strength
2. Low permitivity
3. High temperature strength
4. High resistivity
5. Low water absorption
6. High chemical stability

149. Most substances are not magnets, because

(a) they do not have sufficient energy to produce magnetic behavior

(b) their electrons do not move truly

(c) the electrons usually pair up with their spins opposite to each other, so that their fields cancel each other

(d) their electrons strongly bind to the nucleus as they have more number of protons than electrons

149. Ans: (c)

Sol: In non-magnetic materials, the electrons are paired up with their spins opposite to each other, so that magnetic dipole moments cancel each other.

150. Whenever a particle has angular momentum, it will contribute to permanent dipole moment. Which one of the following does not contribute to the angular momentum of an atom?

(a) Orbital angular momentum of electron

(b) proton spin angular momentum

(c) Electron spin angular momentum

(d) Nuclear spin angular momentum

150. Ans: (b)

Sol: 3 types of angular momentum

1. Orbital angular momentum of electron
2. Electron Spin angular momentum
3. Nuclear spin angular momentum

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AIR 10th XE
D KUMAR PATIL

AIR 10th XE
R SHIVAJI NALE

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