ACE
Engineering Academy
Leading Institute for ESE/GATE/PSUs

Hyderabad | Delhi | Ahmedabad | Bhopal | Pune | Bhubaneswar | Bengaluru
Lucknow | Patna | Chennai | Vijayawada | Vizag | Tirupathi | Kukatpally | Kolkata

ESE – 2019
(PRELIMS)
Questions with Detailed Solutions

ELECTRICAL ENGINEERING

SET – C

All Queries related to **ESE - 2019 PRELIMS** Solutions are to be sent to the following email address
hyderabad@aceenggacademy.com | Contact Us : 040-23234418,19,20

Electrical Engineering
ESE Prelims Examination weightage-2019

S.No.	Name of the Subject	No. of Questions	Marks
01	Engineering Mathematics	12	24
02	Electrical Materials	14	28
03	Electric Circuits & Fields	13	26
04	Electrical & Electronic Measurements	11	22
05	Computer Fundamentals	13	26
06	Basic Electronics Engineering	11	22
07	Analog & Digital Electronics	14	28
08	Systems & Signal Processing	12	24
09	Control Systems	12	24
10	Electrical Machines	16	32
11	Power Systems	12	28
12	Power Electronics & Drives	10	20
Total		**150**	**300**

ESE-2019 Prelims
Electrical Engineering

01. The defining equations for V_1 and V_2 analyzing a two-port network in terms of its impedance parameters are respectively

(a) $Z_{12}I_1 + Z_{12}I_2$ and $Z_{21}I_1 + Z_{21}I_2$
(b) $Z_{11}I_1 + Z_{12}I_2$ and $Z_{21}I_2 + Z_{22}I_2$
(c) $Z_{21}I_1 + Z_{21}I_2$ and $Z_{12}I_1 + Z_{12}I_2$
(d) $Z_{12}I_1 + Z_{12}I_2$ and $Z_{22}I_1 + Z_{22}I_2$

01. Ans: (b)

Sol: The impedance parameter matrix may be written as

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} \text{ or,}$$

$$V_1 = Z_{11}I_1 + Z_{12}I_2$$
$$V_2 = Z_{21}I_1 + Z_{22}I_2$$

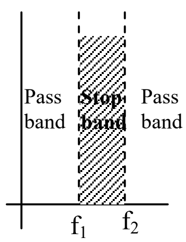
End of Solution

02. A filter that allows high and low frequencies to pass but attenuates any signals with a frequency between two corner frequencies is a

(a) Notch filter
(b) Band pass filter
(c) Band stop filter
(d) Multiband filter

02. Ans: (c)

Sol: Band stop or Band rejection filter



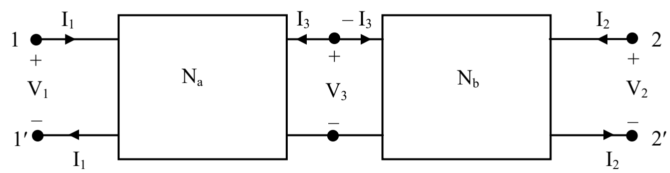
End of Solution

03. When a number of two-port networks are cascaded then

(a) z-parameters are added up
(b) y-parameters are added up
(c) h-parameters are multiplied
(d) ABCD-parameters are multiplied

03. Ans: (d)

Sol:



Both networks are cascaded. The individual T parameters are multiplied

$\Rightarrow (T) = (T_a)(T_b)$

End of Solution

04. A 3-phase star-connected 1000 volt alternator supplies power to a 500 kW delta-connected induction motor. If the motor power factor is 0.8 lagging and its efficiency 0.9, then the current in each alternator and motor phase respectively are nearly

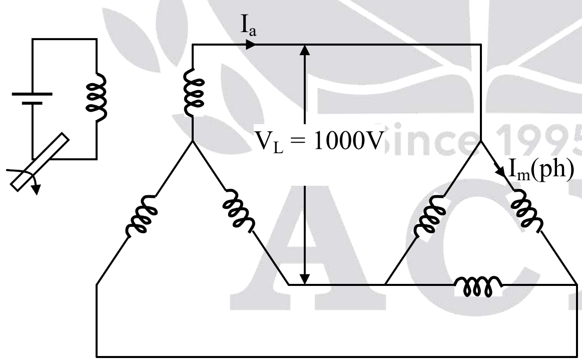
(a) 321 A and 231.5 A (b) 401 A and 231.5 A

(c) 321 A and 185.4 A (d) 401 A and 185.4 A

04. Ans: (b)

Sol: Given data: V_L (alternator) = 1000 V

Induction motor: 500 kW, pf = 0.8 lag and η = 0.9



Power output of induction motor $= \dfrac{P_{out}}{\eta} = \dfrac{500}{0.9} = 555.55$ kW

Power input of alternator = Power input of induction motor

$$\Rightarrow \quad \sqrt{3}V_L I_L \cos\phi = 555.55 \times 10^3$$

$$\Rightarrow \quad \sqrt{3} \times 1000 \times I_L \times 0.8 = 555.55 \times 10^3$$

$\Rightarrow \qquad I_L = \dfrac{555.55\times10^3}{\sqrt{3}\times1000\times0.8}$

$= 400.93\text{ A} \approx 401\text{ A} = I_a\text{ (ph)}$

Phase current of induction motor, $I_m\text{(ph)} = \dfrac{401}{\sqrt{3}} = 231.5\text{ A}$

End of Solution

05. Consider the following statements:

1. Mutual inductance describes the voltage induced at the ends of a coil due to the magnetic field generated by a second coil.
2. The dot convention allows a sign to be assigned to the voltage induced due to mutual inductance term.
3. The coupling coefficient is given by $k = \dfrac{M}{\sqrt{L_1 + L_2}}$

Which of the above statements are correct?

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

05. Ans: (c)

Sol: Statements one and two are correct but given statement 3 is wrong.

The actual coefficient of coupling is

$\Rightarrow k = \dfrac{M}{\sqrt{L_1L_2}}$

End of Solution

06. Consider the following statements:

1. The rules for series and parallel combinations of capacitors are opposite to those for resistors.
2. The rules for series and parallel combinations of inductors are same as those for resistors.
3. An inductor is a short circuit to dc currents.

Which of the above statements are correct?

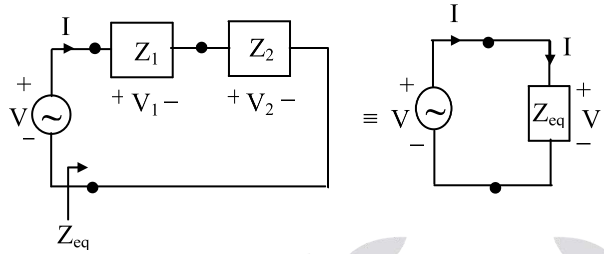
(a) 1 and 2 only (b) 1 and 3 only

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

06. Ans: (d)

Sol: Both statement one and two are correct

For series circuit



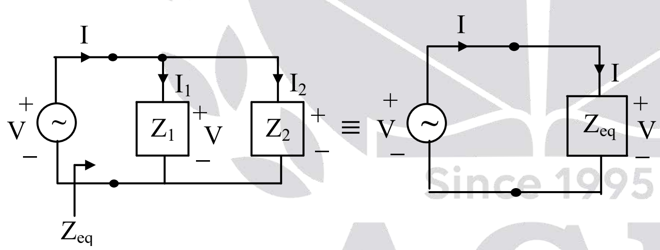
$Z_{eq} = Z_1 + Z_2$

$R: \; R_{eq} = R_1 + R_2$

$L: \; L_{eq} = L_1 + L_2$

$C: \dfrac{1}{C_{eq}} = \dfrac{1}{C_1} + \dfrac{1}{C_2};$

For parallel circuit



$R: \dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2};$

$L: \; \dfrac{1}{L_{eq}} = \dfrac{1}{L_1} + \dfrac{1}{L_2}$

$C: \quad C_{eq} = C_1 + C_2$

$\Rightarrow$ For DC currents An inductor act a short circuit .

End of Solution

07. The standard resistor is a coil of wire of some alloys having the properties of

(a) Low electrical resistivity and high temperature coefficient of resistance

(b) High electrical resistivity and high temperature coefficient of resistance

(c) Low electrical resistivity and low temperature coefficient of resistance

(d) High electrical resistivity and low temperature coefficient of resistance

07. Ans: (D)

Sol: High electrical resistivity and low temperature coefficient.

End of Solution

08. Which one of the following materials is used for the swamping resistance of moving coil instruments?

(a) Carbon (b) Manganin (c) Silver (d) Brass

08. Ans: (b)

Sol: Swamping resistance made by manganin and is almost zero temperature coefficient material (0.00015 Ω/°C)

End of Solution

09. In a PMMC instrument, the swamping resistor is used to

(a) Increase the damping of the instrument

(b) Reduce the current within safe limits

(c) Compensate for temperature variations

(d) Increase the full-scale sensitivity

09. Ans: (c)

Sol: The temperature error can be reduced by providing a swamping resistor in the basic meter.

Swamping resistor is a alloy of manganin and copper in the ratio of 20 : 1.

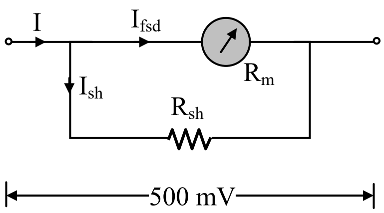
End of Solution

10. A moving coil ammeter has a fixed shunt of 0.02 Ω. With a coil resistance of R = 1000 Ω and a potential difference of 500 mV across it, full scale deflection is obtained. The current through the moving coil to give full scale deflection will be

(a) 25 A (b) 0.5×10^{-2}A (c) 0.25×10^{-3}A (d) 0.5×10^{-3}A

10. Ans: (d)

Sol: Given data: $R_{sh} = 0.02\ \Omega$, $R_m = 1000\ \Omega$ and V = 500 mV



$I_{fsd} = \dfrac{500\times10^{-3}}{1000} = 0.5$ mA.

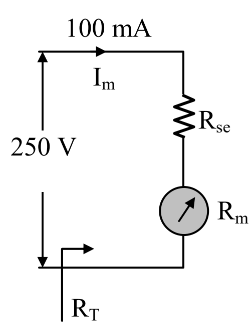
End of Solution

11. A moving iron instrument has full scale current of 100 mA. It is converted into a 250 V voltmeter by using a series resistance made of a material having negligible resistance temperature coefficient. The meter has a resistance of 320 Ω at 20°C. After carrying a steady current of 100 mA for a long time, the resistance of the coil increases to 369 Ω due to self heating. When a voltage of 250 V is applied continuously, the error due to self-heating will be nearly

(a) –1.1% (b) –1.9% (c) –2.5% (d) –3.3%

11. Ans: (b)

Sol:



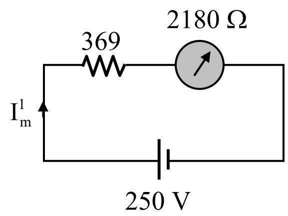
Total resistance, $R_T = \dfrac{250}{100\text{mA}} = 2500\ \Omega$

Now, series resistance $R_{se} = 2500 - 320$

$= 2180\ \Omega$

Due to self heating, 320 Ω resistance is increased to 369 Ω.

So, total resistance after self heating is 2180 + 369 = 2549 Ω



Now, $I_m^1 = \dfrac{250}{369+2180} = 98 \text{ mA}$

$$\text{Error} = \frac{98-100}{98}\times 100\% = -2\% \approx -1.9\%$$

End of Solution

12. There will be serious errors if power factor of non-sinusoidal waveform is measured by electrodynamometer power factor meter. This is true for

(a) Single-phase meters alone (b) 3-phase meters only

(c) Both Single-phase meters and 3-phase metes (d) 3-phase meters with balanced loads

12. Ans: (a)

End of Solution

13. The ramp type digital voltmeter can measure accurately with

(a) A positive going ramp voltage only

(b) A negative or positive going linear ramp voltage

(c) A negative going ramp voltage only

(d) An asymptotic ramp voltage only

13. Ans: (b)

Sol: Ramp type DVM can measure accurately with either a negative or positive going linear ramp voltage.

End of Solution

14. The self-capacitance of a coil is measured by the resonating capacitor. The measurement gives the value of tuning capacitor as C_1 = 460 pF at a frequency, f_1 = 2 MHz. The second measurement at f_2 = 4 MHz yields a new value of tuning capacitor, C_2 = 100 pF. The distributed capacitance C_d will be

(a) 10 pF (b) 20 pF (c) 30 pF (d) 40 pF

14. Ans: (b)

Sol: Given data: $C_1 = 460$ pF, $f_1 = 2$ MHz

$C_2 = 100$ pF, $f_2 = 4$ MHz

$$\left(\frac{f_2}{f_1}\right)^2 = \frac{C_1 + C_d}{C_2 + C_d}$$

$$\Rightarrow \left(\frac{4}{2}\right)^2 = \frac{460 + C_d}{100 + C_d}$$

$\Rightarrow 400 + 4C_d = 460 + C_d$

$\Rightarrow C_d = 20$ pF

End of Solution

15. Vertical delay line in CRO

(a) Gives proper time for thermionic emission of electrons

(b) Delays the signal voltage by 200 ns

(c) Allows the horizontal sweep to start prior to vertical deflection

(d) Delays the generation of sweep voltage

15. Ans: (b)

Sol: A delay line in vertical section is used to delay sensed signal voltage by an amount of time (equal to time taken in all electronic circuits in horizontal section) such that both vertical signal and horizontal signal reach to their respective inputs simultaneously.

End of Solution

16. A 0 - 150 V voltmeter has a guaranteed accuracy of 1% full scale reading. The voltage measured by this instrument is 83 V. The limiting error will be nearly

(a) 1.2% (b) 1.8% (c) 2.4% (d) 3.2%

16. Ans: (b)

Sol: Given data: 0-150 V, guarateed accuracy of 1% full scale reading

$$LE = \frac{\pm 1}{100} \times 150 = \pm 1.5 \text{ V}$$

$$\%LE = \frac{\pm 1.5}{83} \times 100 = 1.8\%$$

End of Solution

17. The variations in the measured quantity due to sensitivity of transducer to any plane other than the required plane is

(a) Cross sensitivity (b) Sensitivity (c) Interference (d) Distributed sensitivity

17. Ans: (a)

Sol: Cross sensitivity can be referred as cross-talk also.

End of Solution

18. A resistance strain gauge with a gauge factor of 2 fastened to a steel member subjected to a stress of 1050 kg/cm^2. The modulus of elasticity of steel is 2.1×10^6 kg/cm^2. The change in resistance ΔR of the strain gauge element due to the applied stress will be

(a) 0.1% (b) 0.2% (c) 0.3% (d) 0.4%

18. Ans: (a)

Sol: Given data: $G_f = 2$

Stress = 1050 kg/cm^2

$Y_{steel} = 2.1 \times 10^6$ kg/cm^2

$\Delta R = ?$

$$G_f = \frac{\Delta R / R}{\Delta \ell / \ell}$$

$$100 \times G_f \times \frac{\Delta \ell}{\ell} = \frac{\Delta R}{R} \times 100$$

$$100 \times G_f \times \frac{1}{Y} \times \text{stress} = \frac{\Delta R}{R} \times 100$$

$$100 \times 2 \times \frac{1}{2.1 \times 10^6} \times 1050 = \frac{\Delta R}{R} \times 100$$

$$\frac{\Delta R}{R} \times 100 = 0.1\%$$

End of Solution

19. In which one of the following classes of computers, is the relationship between architecture and organization very close?

(a) Micro computers (b) Mini computers

(c) Mainframe computers (d) Super computers

19. Ans: (a)

Sol: In a class of computers called microcomputers, the relationship between architecture and organization is very close.

20. The decimal equivalent of binary number 1001.101 is

(a) 9.750 (b) 9.625 (c) 10.750 (d) 10.625

20. Ans: (b)

Sol: 1001.101

$$\Rightarrow (1\times2^3) + (0 \times 2^2) + (0\times2^1) + (1\times2^0)\ .\ (1\times2^{-1}) + (0\times2^{-2}) + (1\times2^{-3})$$

$$\Rightarrow 8 + 1.\ \frac{1}{2}+\frac{1}{8}$$

$$\Rightarrow 9\ .\ \frac{1}{2}+\frac{1}{8}$$

$$\Rightarrow 9\ .\ \frac{4+1}{8}$$

$$\Rightarrow 9.\frac{5}{8} = (9.625)_{10}$$

End of Solution

21. Convert decimal 41.6875 into equivalent binary:

(a) 100101.1011 (b) 100101.1101 (c) 101001.1011 (d) 101001.1101

21. Ans: (c)

Sol: From option (c)

$$(1 \times2^5) + (0\times2^4) + (1\times2^3) + (0\times2^2) + (0\times2^1) + (1\times2^0)\ .\ (1\times2^{-1}) + (0\times2^{-2})+ (1\times2^{-3})+ (1\times2^{-4})$$

$$32 + 8 + 1\ .\ \frac{1}{2}+\frac{1}{8}+\frac{1}{6}$$

$$41.\ \frac{8+2+1}{16}$$

$$41.\frac{11}{6}$$

$$\Rightarrow (41.6875)_{10}$$

End of Solution

22. The Central Processing Unit (CPU) consists of

(a) ALU and Control unit only

(b) ALU, Control unit and Registers only

(c) ALU, Control unit and System bus only

(d) ALU, Control unit, Registers and Internal bus

22. Ans: (d)

Sol: Inside CPU ALU, CU, Register memory and internal bus for data transfer inside the CPU. Internal bus for data transfer is in/from register file.

End of Solution

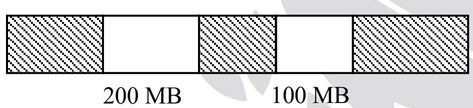
23. When enough total memory space exists to satisfy a request, but it is not continuous, then this problem is known as

(a) Internal Fragmentation (b) External Fragmentation

(c) Overlays (d) Partitioning

23. Ans: (b)

Sol: Assume memory scenario as follows



2 free partitions are available of size 200 MB and 100 MB. If new process arrives with size 250 MB; in contiguous memory management technique it can not be stored because 250 MB space is not available contiguously. It is known as external fragmentation.

End of Solution

24. The total average read or write time T_{total} is

(a) $T_s + \frac{1}{2r} + \frac{b}{N}$ (b) $T_s + \frac{1}{2r} + \frac{b}{rN}$ (c) $\frac{T_s}{rN} + \frac{b}{N}$ (d) $T_s + 2r + \frac{b}{rN}$

Where,

T_s = average seek time

b = number of bytes to be transferred

N = number of bytes on a track

r = rotation speed, in revolutions per second

24. Ans: (b)

Sol: Revolution speed = **r** revolutions per sec

$$\text{one revolution time } = \frac{1}{r}\text{sec}$$

$$\text{Average rotational latency } = \frac{\text{one revoltuion time}}{2}$$

$$= \frac{1}{2r}\text{sec}$$

$$\text{Data Transfer Rate} = \frac{\text{one track size}}{\text{one revolution time}} = \frac{\text{N bytes}}{\frac{1}{r}\text{sec}}$$

= Nr bytes/sec

$$\text{Data transfer time} = \frac{\text{b bytes}}{\text{Nr bytes/sec}} = \frac{b}{Nr}\text{sec}$$

T_{total} = Avg. seek time + Avg. Rotational + Data Transfer time

$$= \left(T_S + \frac{1}{2r} + \frac{b}{Nr}\right)\text{sec}$$

End of Solution

25. If a cache has 64-byte cache lines, how long does it take to fetch a cache line if the main memory takes 20 cycles to respond to each memory request and returns 2 bytes of data in response to each request?

(a) 980 cycles (b) 640 cycles

(c) 320 cycles (d) 160 cycles

25. Ans: (b)

Sol: In one request, 2 Bytes of data can be accessed from main memory.

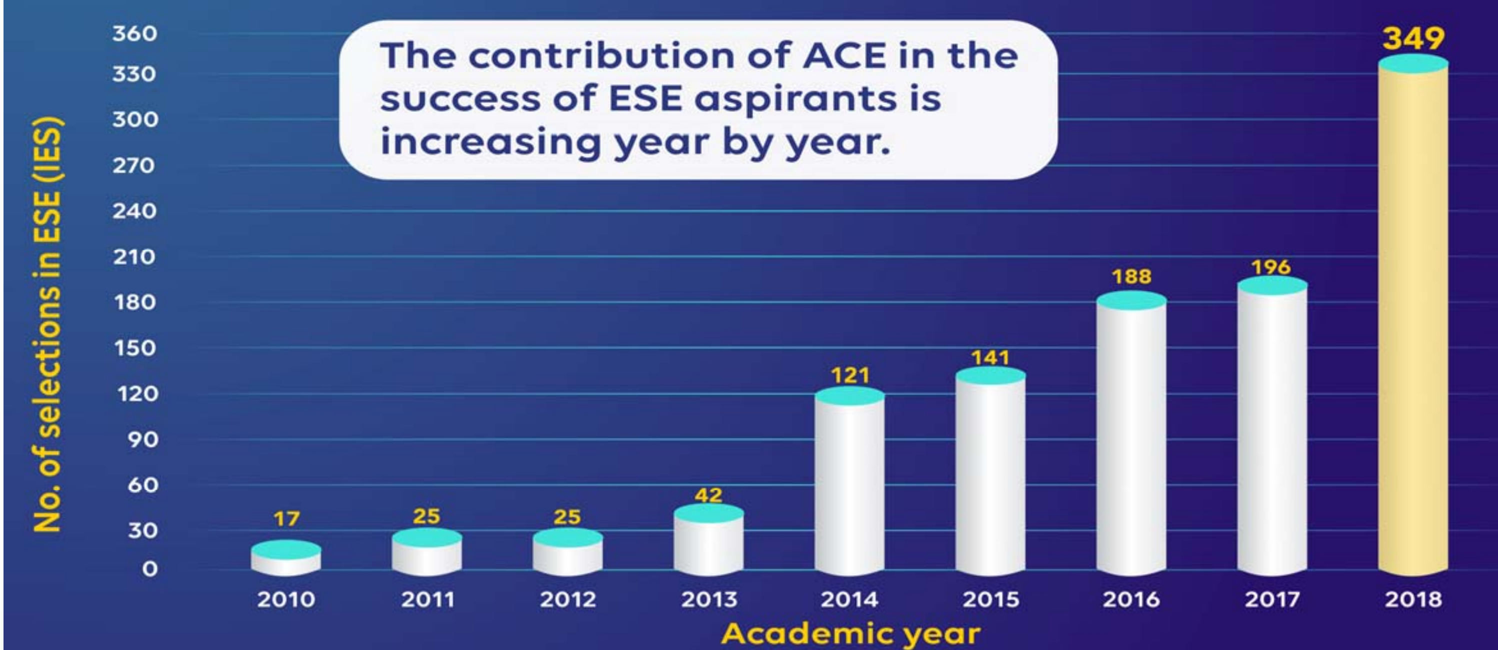
Number of requests needed to access a cache line of size $64B = \frac{64B}{2B} = 32$

1 request time = 20 cycles

32 requests time = 32×20

= 640 cycles

End of Solution



The contribution of ACE in the success of ESE aspirants is increasing year by year.
No. of selections in ESE (IES)
360
330
300
270
240
210
180
150
120
90
60
30
0
17
25
25
42
121
141
188
196
349
2010
2011
2012
2013
2014
2015
2016
2017
2018
Academic year

26. Which of the following statements are correct about SRAM?

1. It provides faster access as compared to DRAM.
2. It is cheaper than DRAM.
3. It is more expensive than DRAM.
4. It has higher bit density than DRAM.

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

26. Ans: (b)

Sol: In DRAM higher bit density than SRAM

End of Solution

27. Features of solid state drives (SSDs) are

1. High-performance in input/output operations per second
2. More power consumption than comparable size HDDs
3. Lower access times and latency rates
4. More susceptible to physical shock and vibration

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

27. Ans: (c)

Sol: → SSDs are faster than HDDs, hence take less access time and provides High-performance.
→ SSDs are more resistant to physical shock and vibrations, so are not susceptible.
→ SSDs have less power consumption.

End of Solution

28. The decimal value of signed binary number 11101000 expressed in 1's complement is

(a) – 223 (b) –184 (c) –104 (d) –23

28. Ans: (d)

Sol: 1110 1000

MSB = 1 so number is negative

1's complement of 1110 1000 is 0001 0111

Magnitude = $(1\times2^4) + (0\times2^3) + (1\times2^2) + (1\times2^1) + (1\times2^0)$

Magnitude = $16 + 4 + 2 + 1 = 23$

So decimal equivalent of 1's compliment representation

1110 1000 is $(-23)_{10}$

End of Solution

29. The memory management function of virtual memory includes

1. Space allocation
2. Program relocation
3. Program execution
4. Code sharing

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

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

29. Ans: (b)

Sol: Program execution is part of process management unit of OS, rest 3 are functions of memory management unit.

End of Solution

30. Which of the following instructions of 8085 are the examples of implied addressing?

1. CMA
2. IN byte
3. RET

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

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

30. Ans: (d)

Sol: CMA and RET instructions are the examples of implied addressing mode.

End of Solution

31. Consider the discrete-time sequence $x(n) = \cos\left(\frac{n\pi}{8}\right)$. When sampled at frequency $f_s = 10$ kHz, then f_0, the frequency of the sampled continuous time signal which produced this sequence will at least be

(a) 625 Hz (b) 575 Hz

(c) 525 Hz (d) 475 Hz

31. Ans: (a)

Sol: $x(n) = \cos\left[\frac{n\pi}{8}\right]$

$f_s = 10$ kHz

Digital frequency $W = \frac{2\pi f_0}{f_s}$

$\frac{\pi}{8} = \frac{2\pi f_0}{10K}$

$f_0 = \frac{10000}{16}$

$= 625$ Hz

End of Solution

32. How many bits are required in an A/D converter with a B+1 quantizer to get a signal-to-quantization noise ratio of at least 90 dB for a Gaussian signal with range of $\pm 3\sigma_x$?

(a) B + 1 = 12 bits (b) B + 1 = 14 bits (c) B + 1 = 15 bits (d) B + 1 = 16 bits

32. Ans: (d)

Sol: Signal to quantization noise ratio $= \frac{\sigma_x^2}{\left(\frac{\Delta^2}{12^2}\right)} = 12\left(\frac{\sigma_x}{\Delta}\right)^2$

$\Delta = \frac{3\sigma_x - (-3\sigma_x)}{L}$

$\Rightarrow \left(\frac{\sigma_x}{\Delta}\right) = \frac{L}{6}$

Signal to quantization noise ratio $= 12\left(\frac{L}{6}\right)^2$

$= \frac{1}{3}L^2$

For B+1 bit quantizer

Signal to quantization noise ratio $= \frac{1}{3}2^{2(B+1)}$

$(SQNR)_{dB} = -4.76 + 6(B+1)$

$90 = -4.76 + 6(B+1)$

B +1 = 16 bits

End of Solution

33. Let x(n) be a left-sided sequence that is equal to zero for n > 0. If $X(z)=\dfrac{3z^{-1}+2z^{-2}}{3-z^{-1}+z^{-2}}$, then x(0) will be

(a) 0 (b) 2 (c) 3 (d) 4

33. Ans: (b)

Sol: $x(z)=\dfrac{3z^{-1}+2z^{-2}}{3-z^{-1}+z^{-2}}$

Signal is left sided

$$\begin{array}{r|l} z^{-2}-z^{-1}+3) & \begin{array}{l} 2z^{-2}+3z^{-1} \\ \underline{2z^{-2}+2z^{-1}+b} \\ 5z^{-1}-6 \end{array} \end{array} (2+5z+----$$

Signal is left sided so x(0) = 2

End of Solution

34. The noise variance σ_ε^2 at the output of $H(z)=\dfrac{0.5z}{z-0.6}$ with respect to input will be nearly

(a) 40% (b) 50% (c) 60% (d) 70%

34. Ans: (a)

Sol: noise variance at the output w.r.t input is

$$\sigma_Y^2=\sigma_X^2 E_{h(n)}$$

$$E_{h(n)}=\sum_{n=0}^{\infty}0.25(0.6)^{2n}$$

$$=0.25\sum_{n=0}^{\infty}(0.36)^n$$

$$=0.25[1+0.36+(0.36)^2.......]$$

$$=\frac{0.25}{1-0.36}=\frac{0.25}{0.64}$$

$$=\frac{25}{64}\cong 40\%$$

End of Solution

35. If the complex multiply operation takes 1 μs, the time taken to compute 1024-point DFT directly will be nearly

(a) 3.45 s (b) 2.30 s (c) 1.05 s (d) 0.60 s

35. Ans: (c)

Sol: Time taken for each CM = 1μ sec

Time taken to compute 1024 pt. DFT

Directly for number of complex multiplications = $(N)^2$ (1μ sec)

$= (1024)^2$ μ sec

= 1.05 sec

36. Consider the following data to design a low-pass filter

Cut-off frequency $\omega_c = \frac{\pi}{2}$,

Stop band ripple $\delta_s = 0.002$,

Transition bandwidth no larger than 0.1 π. Kaiser window parameters β and N respectively are

(a) 2.99 and 45 (b) 4.99 and 45 (c) 2.99 and 65 (d) 4.99 and 65

36. Ans: (d)

Sol: Cut-off frequency $\omega_C = \pi/2$

S.B ripple $\delta_s = 0.002$

Transition bandwidth no larger than 0.1π

$$\text{order } N = \frac{A-8}{2.285\Delta\omega}$$

$$A = -20\log\frac{2\times10^{-3}}{10} = 52$$

B = 0.1102 (A–8.7)

= 0.1102(52–8.7)

= 4.77166

End of Solution

37. A transfer function $G(s) = \frac{1-sT}{1+sT}$ has a phase angle of $(-2\tan^{-1}\omega T)$ which varies from 0° to –180° as ω is increased from 0 to ∞. It is the transfer function for

(a) All pass system (b) Low pass system (c) High pass system (d) Band pass system

37. Ans: (a)

Sol: At all frequencies magnitude is one. Hence system is all pass system.

End of Solution

38. The open-loop and closed-loop transfer functions of a system are respectively given by

$$G(s) = \frac{K}{j\omega\tau + 1}; \text{ (open loop)},$$

$$G(s) = \frac{\frac{K}{(1+K)}}{j\omega\tau_c + 1}; \text{ (closed loop)}.$$

The ratio of the bandwidth of closed loop to open loop system is

(a) K (b) (1 + K) (c) $(1 + K)^2$ (d) $\frac{K^2}{(1+K)}$

38. Ans: (b)

Sol: OLTF $G(s) = \frac{K}{s\tau + 1}$

Open loop bandwidth $= \frac{1}{\tau}$

$$\text{CLTF} = \frac{K}{s\tau + 1 + K}$$

$$\text{Closed loop bandwidth} = \left(\frac{1+K}{\tau}\right)$$

$$\text{Ratio} = \frac{\text{CL BW}}{\text{OL BW}} = \frac{\left(\frac{1+K}{\tau}\right)}{\frac{1}{\tau}} = (1+K)$$

End of Solution

39. The system sensitivity of open loop and closed loop system are respectively

(a) 1 and $\frac{1}{1+GH}$ (b) $\frac{1}{1+GH}$ and 1 (c) $\frac{1}{GH}$ and 1 (d) 1 and $\frac{1}{GH}$

39. Ans: (a)

Sol: Open loop system $S_G^T = 1$ where $T = G$

Closed loop system $S_G^T = \frac{1}{1+GH}$

Where $T = \frac{G}{1+GH}$

End of Solution

40. The steady state error of a type-1 system to a unit step input is

(a) $\frac{1}{(1+K_p)}$ (b) 0

(c) ∞ (d) $\frac{1}{K_v}$

40. Ans: (b)

Sol: Steady state error $e_{ss} = \frac{1}{1+K_p} = \frac{1}{1+\infty} = 0$

End of Solution

41. The direction of the net encirclements of the origin of Real-Imaginary plane in a Nyquist plot for the system to be stable is

(a) Clockwise of the origin

(b) Counter-Clockwise of the origin

(c) Left hand side s-plane

(d) Right hand side s-plane

41. Ans: (a) & (b)

Sol: Nyquist contour direction is not mentioned. If Nyquist contour is defined in the clockwise, then option (b) is correct. Else if Nyquist contour in clockwise direction, then option (a) is correct

42. A unity negative feedback control system has an open-loop transfer function as $G(s)=\dfrac{K(s+1)(s+2)}{(s+0.1)(s-1)}$. The range of values of K for which the closed loop system is stable will be

(a) $0 < K < 0.3$ (b) $K > 0.3$ (c) $K > 3$ (d) $K < 0.3$

42. Ans: (b)

Sol: $\xrightarrow{CE} 1+G(s)=0$

$$\xrightarrow{CE} 1+\frac{K(s+1)(s+2)}{(s+0.1)(s-1)}=0$$

$$\xrightarrow{CE} (s^2-0.9s-0.1)+K(s^2+3s+2)=0$$

$$\xrightarrow{CE} s^2(K+1)+s(3K-0.9)+(2K-0.1)=0$$

$$\begin{array}{c|cc} s^2 & (K+1) & 2K-0.1 \\ s^1 & (3K-0.9) & \\ s^0 & (2K-0.1) & \end{array}$$

$K+1 > 0 \Rightarrow K > -1$

$3K-0.9 > 0 \Rightarrow K > 0.3$

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

Valid condition is $K > 0.3$

End of Solution

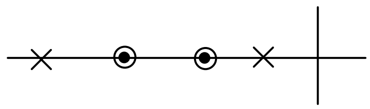
43. The lag system of a 'lag-lead compensator' has one pole and one zero. Then pole and zero are

(a) Real and pole is to the left of zero (b) Real and pole is to the right of zero

(c) Imaginary and pole is above zero (d) Imaginary and pole below zero

43. Ans: (b)

Sol: Lag – Lead compensator pole – zero plot is given below



Poles is Real &right to the zero

End of Solution

44. A system with characteristic equation $F(s) = s^4 + 6s^3 + 23s^2 + 40s + 50$ will have closed loop poles such that

(a) All poles lie in the left half of the s-plane and no pole lies on imaginary axis

(b) Two poles lie symmetrically on the imaginary axis of the s-plane

(c) All four poles lie on the imaginary axis of the s-plane

(d) All four poles lie in the right half of the s-plane

44. Ans: (a)

Sol: $\xrightarrow{CE} s^4 + 6s^3 + 23s^2 + 40s + 50 = 0$

$$\begin{array}{c|cc} s^4 & 1 & 23 \\ s^3 & 6 & 40 \\ s^2 & \dfrac{(6x23-40)}{6} & 50 \\ s^1 & +Ve & \\ s^0 & 50 & \end{array}$$

All poles lies left half s – Plane & no pole on Imaginary axis.

End of Solution

45. A unity feedback (negative) system has open loop transfer function $G(s) = \dfrac{K}{s(s+2)}$. The closed loop system has a steady-state unit ramp error of 0.1. The value of gain K should be

(a) 20 (b) 30 (c) 40 (d) 50

45. Ans: (a)

Sol: $G(s) = \dfrac{K}{s(s+2)}, H(s) = 1$

$$e_{ss} = \frac{A}{K_V} \Rightarrow e_{ss} = \frac{1}{\frac{K}{2}}$$

$$0.1 = \frac{2}{K}$$

$$K = 20$$

End of Solution

46. Transfer function of discrete time system derived from state model is given by

(a) $C(zI - A)^{-1} B + D$ (b) $C(zI - A)^{-1} D + B$

(c) $B(zI - A)^{-1} D + C$ (d) $D (zI - A)^{-1} B + C$

46. Ans: (a)

Sol: $TF = C [ZI - A]^{-1} B + D$

End of Solution

47. The closed-loop response of a system subjected to a unit step input is

$c(t) = 1 + 0.2 e^{-60 t} - 1.2 e^{-10 t}$.

The expression for the closed loop transfer function is

(a) $\frac{100}{(s+60)(s+10)}$ (b) $\frac{600}{(s+60)(s+10)}$

(c) $\frac{60}{(s+60)(s+10)}$ (d) $\frac{10}{(s+60)(s+10)}$

47. Ans: (b)

Sol: $TF = \frac{L[c(t)]}{L[u(t)]} = \frac{L[1+0.2e^{-60t} - 1.2e^{-10t}]}{L[u(t)]}$

$= \frac{600}{(s+60)(s+10)}$

End of Solution

48. If it is possible to transfer the system state $x(t_0)$ to any desired state $x(t)$ in specified finite time by a control vector $u(t)$, then the system said to be

(a) completely observable

(b) Completely state controllable

(c) Random state system

(d) Steady state controlled system

48. Ans: (b)

Sol: A system is said to be state controllable, if it is possible to transform initial state $x(t_0)$ to the desire state $x(t)$ by applying input in a finite interval of time.

End of Solution

49. Consider the following statements regarding parallel connection of 3-phase transformers:

1. The secondaries of all transformers must have the same phase sequence.
2. The phase displacement between primary and secondary line voltages must be the same for all transformers which are to be operated in parallel.
3. The primaries of all transformers must have the same magnitude of line voltage.

Which of the above statements are correct?

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

49. Ans: (a)

Sol: Necessary conditions for possible parallel operation:

1. Voltage ratings mentioned on the name plate of transformers to be connected in parallel must be same.
2. The transformers must be connected in parallel with correct polarity
3. The phase sequence of 3-phase transformers to be connected in parallel must be same.
4. Apart from phase sequence matching, the phase displacement between the secondaries of both transformers must be zero. This condition can be fulfilled if the two transformers belong to same phasor group.

End of Solution

50. A 500 kVA transformer has an efficiency of 95% at full load and also at 60% of full load, both at upf. The efficiency η of the transformer at $\frac{3}{4}^{\text{th}}$ full load will be nearly

(a) 98% (b) 95% (c) 92% (d) 87%

50. Ans: (b)

Sol: $\eta_{FL(Upf)} = \dfrac{500\times 1}{500\times 1 + W_{cu} + W_i} = 0.95$

$$W_{cu} + W_i = 26.31 \text{ kW}$$

$$\eta_{60\%FL(Upf)} = \frac{300\times 1}{300\times 1 + (0.6)^2 W_{cu} + W_i} = 0.95$$

$$(0.6)^2 W_{cu} + W_i = 15.78 \text{ kW}$$

$$0.36 W_{cu} + W_i = 15.78 \text{ kW}$$

$$W_{cu} + W_i = 26.31$$

$$0.36W_{cu} + W_i = 15.78$$

$$0.64W_{cu} = 10.53$$

$$W_{cu} = \frac{10.53}{0.64} = 16.45\text{ kW}$$

$$W_i = 26.31 - 16.45 = 9.86\text{ kW}$$

$$\eta_{\frac{3}{4}FL(Upf)} = \frac{375\times1}{375\times1+(0.75)^2\times16.45+9.86}$$

$$= \frac{375}{394}\times100 = 95\%$$

End of Solution

51. What is the condition of retrogressive winding in dc machines?

(a) $Y_b > Y_f$ (b) $Y_b < Y_f$ (c) $Y_b = Y_f$ (d) $Y_b = 0.5\ Y_f$

51. Ans: (b)

Sol: For progressive winding, $Y_b > Y_f$

For retrogressive winding, $Y_b < Y_f$

End of Solution

52. What is the useful flux per pole on no load of a 250 V, 6-pole shunt motor having a wave connected armature winding with 110 turns, armature resistance of 0.2 and armature current 13.3 A at no load speed of 908 rpm?

(a) 12.4 mWb (b) 22.6 mWb (c) 24.8 mWb (d) 49.5 mWb

52. Ans: (c)

Sol: Given data: 250 V, 6-pole, T = 110, $R_a = 0.2$, $I_a = 13.3$ A and N = 908 rpm

$E_b = V_t - I_aR_a$

$= 250 - (13.3) \times 0.2$

$= 247.5$

$\therefore E_b \approx V_t$

$$E_b = \left(\frac{Z}{A}\right)\left(\frac{P\phi N}{60}\right)$$

$$250 = \left(\frac{110\times 2}{2}\right)\left(\frac{6\times\phi\times 900}{60}\right) \quad \text{(approximate substitution)}$$

ϕ = 25.25 mWb (approximately)

Near by answer is 24.8 mWb

End of Solution

53. The cross-magnetizing effect of the armature reaction can be reduced by

(a) Making pole shoes flat faced

(b) Making the main field ampere-turns larger compared to the armature-ampere turns

(c) Increasing the flux density under one half of the pole

(d) Keeping the direction of rotation of generator in the same direction as motor

53. Ans: (b)

Sol: Cross-magnetizing effect can be reduced using the following techniques

1. using inpterpoles
2. making main field mmf more stronger

End of Solution

54. A 500 kW, 500 V, 10-pole, dc generator has a lap wound armature with 800 conductors. If the pole face covers 75% of pole pitch, the number of pole-face conductors in each pole of a compensating winding will be

(a) 12 (b) 10 (c) 8 (d) 6

54. Ans: (d)

Sol: Given data: 500 kW, 500 V, P = 10, A = 10, Z = 800 and $\frac{\text{Pole arc}}{\text{Pole pitch}} = 0.75$

MMF required for compensated winding per pole is

$$(\text{MMF})_{\text{comp. wdg}} = \left(\frac{\text{Pole arc}}{\text{Pole shoe}}\right)\left(\frac{Z}{2P}\right)\frac{I_a}{A} \text{ AT/pole}$$

$$= (0.75)\left(\frac{800}{2\times 10}\times\frac{1000}{10}\right)$$

$$= 3000 \text{ AT/pole}$$

As compensated winding carries armature current through it, the no. of turns required will be

turns/pole = $\frac{3000}{1000}$ = 3 turns/pole

$\therefore$ Conductors/pole = 6.

End of Solution

55. Cogging in an induction motor is caused

(a) If the number of stator slots are unequal to number of rotor slots

(b) If the number of stator slots are an integral multiple of rotor slots

(c) If the motor is running at fraction of its rated speed

(d) Due to 5^{th} harmonic

55. Ans: (b)

Sol: When S_1 (stator slots) are equal to S_2 (rotor slots) or when S_1 is an integral multiple of S_2, cogging is sure to occur.

End of Solution

56. A 500 hp, 6-pole, 3-phase, 440V, 50 Hz induction motor has a speed of 950 rpm on full-load. The full load slip and the number of cycles the rotor voltage makes per minute will be respectively

(a) 10% and 150 (b) 10% and 125

(c) 5% and 150 (d) 5% and 125

56. Ans: (c)

Sol: Rotor N_r = 950 rpm

$$N_s = \frac{120 \times 50}{6} = 1000 \text{ rpm}$$

$$S = \frac{N_s - N_r}{N_s} = \frac{1000 - 950}{1000} = 0.05 = 5\%$$

f_2 (rotor frequency) = sf

= 0.05 × 50

= 2.5 Hz (or cycles/sec)

No. of cycles the rotor voltage makes per minute will be 2.5 × 60 = 150 cycles/minute

End of Solution

ACE ENGINEERING ACADEMY
Since 1995
ACE
HEARTY CONGRATULATIONS TO OUR
ESE 2018 RANKERS
AIR 1 SHASHANK E&T
AIR 1 CHIRAG JHA EE
AIR 1 VINAY PRAKASH CE
AIR 1 AMAN JAIN ME
AIR 2 CHERUKURI SAIDEEP E&T
AIR 2 SHADAB AHAMAD EE
AIR 2 PUNIT SINGH CE
AIR 2 CHIRAG SINGLA ME
AIR 3 RAMESH KAMULLA E&T
AIR 3 SRIJAN VARMA EE
AIR 3 PRAVEEN KUMAR CE
AIR 3 MAYUR PATIL ME
AIR 4 JAPJIT SINGH E&T
AIR 4 ANKIT GARG EE
AIR 4 AMIT KUMAR ME
AIR 5 NARENDRA KUMAR E&T
AIR 5 KARTHIK KOTTURU EE
AIR 5 RISHABH DUTT CE
AIR 5 VITTHAL PANDEY ME
AIR 6 KUMUD JINDAL E&T
AIR 6 RATIPALLI NAGESWAR EE
AIR 7 KARTIKEYA DUTTA E&T
AIR 7 TEKCHAND DESHWAL EE
AIR 7 ROHIT KUMAR CE
AIR 8 SURYASH GAUTAM E&T
AIR 8 RAVI TEJA MANNE EE
AIR 8 VIJAYA NANDAN CE
AIR 8 ROHIT BANSAL ME
AIR 9 SHANAVAS CP E&T
AIR 9 SOUVIK DEB ROY EE
AIR 9 ROOPESH MITTAL CE
AIR 10 PRATHAMESH E&T
AIR 10 MILAN KRISHNA EE
AIR 10 SRICHAND POONIYA CE
TOTAL SELECTIONS in Top 10 34
E&T TOP 10 10
EE TOP 10 10
CE TOP 10 8
ME TOP 10 6
and many more...

57. Effective armature resistance R_a (eff) of a synchronous machine is

(a) $\dfrac{\text{Short circuit load loss (per phase)}}{(\text{Short circuit armature current})^2}$ (b) $\dfrac{\text{Short circuit load loss (per phase)}}{(\text{Short circuit load current})}$

(c) $\dfrac{\text{Total short circuit load loss}}{\text{Short circuit armature current}}$ (d) $\dfrac{\text{Total short circuit load loss}}{\text{Short circuit load current}}$

57. Ans: (a)

Sol: Effective armature resistance $R_a = \dfrac{\text{Copper losses per phase under short circuit condition}}{(\text{Short circuit armature current per phase})^2}$

End of Solution

58. A 3-phase synchronous motor has 12-poles and operates from 440 V, 50 Hz supply. If it takes a line current of 100 A at 0.8 power factor leading its speed and torque are nearly

(a) 500 rpm and 1165 N-m (b) 1000 rpm and 2330 N-m

(c) 500 rpm and 2330 N-m (d) 1000 rpm and 1165 N-m

58. Ans: (a)

Sol: A 3-phase synchronous motor no. of poles, P = 12

Line voltage, $V_L = 440$ V

Frequency, f = 50 Hz

Line current, $I_L = 100$ A at 0.8 pf lead

N = ?

T = ?

$$N = \frac{120f}{P} = \frac{120\times50}{12} = 500 \text{ rpm}$$

$$P_{out} = \sqrt{3}V_L I_L \cos\phi$$

$$= \sqrt{3}\times440\times100\times0.8$$

$$\text{Torque, } T = \frac{P_{out}}{\frac{2\pi N}{60}} = \frac{\sqrt{3}\times440\times100\times0.8\times60}{2\pi\times500}$$

$$= 1164.5 \text{ N-m}$$

$$\approx 1165 \text{ N-m}$$

Ans: 500 rpm and 1165 N-m

End of Solution

59. Which of the following are the advantages of using a stepper motor?

(a) Compatibility with transformers and sensors needed for position sensing

(b) Compatibility with digital systems and sensors are not required for position and speed sensing

(c) Resonance effect often exhibited at low speeds and decreasing torque with increasing speed

(d) Easy to operate at high speed speeds and compatible with analog systems

59. Ans: (b)

Sol: Advantages of stepper motors:

Compatibility with digital system

Suitable for open loop position control applications

∴ Sensors are not required for position and speed sensing

End of Solution

60. The disadvantage of hunting in synchronous machines is

(a) Fault occurs in the supply system

(b) Causes sudden change in inertia

(c) Causes large mechanical stresses and fatigue in the rotor shaft

(d) Causes harmonics

60. Ans: (c)

Sol: The disadvantages of hunting in synchronous machine are

1. Causes large mechanical stresses and fatigue in the rotor shaft.
2. Fluctuations in generated voltage of alternator
3. Unwanted copper losses, heating effect
4. Rotor oscillations may causes fall out of synchronism

End of Solution

61. Consider the following statements for a large national interconnected grid:

1. Better load frequency control
2. Same total installed capacity can meet lower demands
3. Better hydro/thermal/nuclear/renewable co-ordination and energy conservation

Which of the above statements are correct?

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

61. Ans: (d)

Sol: S1: A large national interconnected grid will be developed to increase the grid strength by which one can maintain frequency within the limits (or) one can achieve better load frequency control. So statement 1 is correct.

S2: With the interconnected grid as the demand decreases generation can be regulated by only operating base load plants for lower demand and higher demands can be met by operation both base load and peak load plants.

S3: With the interconnected grid, all different types of power plants are interconnected by which a good coordination can be achieved between these plants and the cost of power generation can be optimized and losses in the system can also be reduced.

So, statement 3 is correct.

End of Solution

62. A single-phase transformer is rated 110/440 V, 2.5 kVA. Leakage reactance measured from the low-tension side is 0.06 Ω. The per unit leakage reactance will be

(a) 0.0062/unit (b) 0.0124/unit

(c) 0.0496/unit (d) 0.1983/unit

62. Ans: (b)

Sol: Given data: 110/440 V, 2.5 kVA transformer.

$$X = 0.06\ \Omega$$

$$Z_{base}\,(LV) = \frac{V^2}{(VA)} = \frac{110\times110}{2500}$$

$$X_{PU} = \frac{0.06\times2500}{110\times110} = 0.0123/\text{unit}.$$

End of Solution

63. A concentric cable has a conductor diameter of 1 cm and an insulation thickness of 1.5 cm. When the cable is subjected to a test pressure of 33 kV, the maximum field strength will be nearly

(a) 41,000 V (b) 43,200 V

(c) 45,400 V (d) 47,600 V

63. Ans: (d)

Sol: Radius of core, r = 0.5 cm

Insulation thickness = 1.5 cm

Inner radius of sheath, R = 1.5 + 0.5 = 2 cm

$$g_{max} = \frac{V}{r\ln(R/r)} = \frac{33{,}000}{0.5\ln\left(\frac{2}{0.5}\right)} = 47{,}608 \text{ V/cm}$$

End of Solution

64. Radio influence voltage (RIV) generated on a transmission line conductor surface is **not** affected by

(a) System voltage
(b) Corona discharges on the conductors
(c) Rain
(d) Nearby radio receivers

64. Ans: (d)

Sol: Radio Influence Voltage (RIV): Radio interference/influence is an adverse effect of corona on wireless broad casting. The corona discharge emits radiation which introduces noise in the communication lines, radio and television receivers.

Radio influence voltage is the field measured at any point from transmission line and generally given in terms of μV/m. Corona is affected by system voltage and atmospheric conditions (e.g: rain, snow, fog, pressure etc). Hence the same factors will affect the value of RIV also.

From given options, option (d) is not going to affect the RIV generated on transmission lines.

Where as RIV generated an transmission lines will cause interference on radio receivers.

End of Solution

65. Consider the following prosperities regarding insulation for cables:

1. A low specific resistance
2. High temperature withstand
3. High dielectric strength

Which of the above prosperities of insulation are correct while using cables?

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

65. Ans: (c)

Sol: A cable Insulation should have

High insulation resistance

High temperature strength

High Dielectric strength

End of Solution

66. Which one of the following faults occurs more frequently in a power system?

(a) Grounded star-delta (b) Double line faults

(c) LLG faults (d) Single line-to-ground (LG) faults

66. Ans: (d)

Sol: Most occurring faults in power system is LG faults.

End of Solution

67. The maximum permissible time of de-energization of the faulty circuit is dependent on

(a) Voltage of the system

(b) The number of conductors involved

(c) Load carried by the faulty circuit

(d) Fault current and its duration

67. Ans: (d)

Sol: The maximum permissible time of fault depends on

$\rightarrow$ Location of faults

$\rightarrow$ Magnitude of fault current fault duration.

End of Solution

68. Which one of the following is used for communication with the aim of achieving high figure of merit in HVDC circuit breakers?

(a) Oil interrupter (b) Air interrupter (c) Vacuum interrupter (d) SF_6 interrupter

68. Ans: (c)

Sol: In HVDC circuit breaker artificial current zero will be achieved with the help of LC circuit at the time when it is required to open the breaker. During this artificial commutation a steep surge of restriking voltage appears across the circuit breaker contact. Because of the fact that extremely fast interruptions are required and breaker need to with strand high restriking voltage, vacuum interrupter unit/circuit breaker is an ideal device for HVDC circuit breaking.

End of Solution

69. Which of the following buses are used to form bus admittance matrix for load flow analysis?

1. Load bus
2. Generator bus
3. Slack bus

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

69. Ans: (a)

Sol: The question is about formation of bus admittance matrix for load flow analysis.

In the bus admittance matrix formation

(i) Generator will be represented as a current source in parallel with its internal impedance or admittance.

(ii) Load represented as current injection (may be a negative current)

While framing the primitive impedance or admittance network, current sources in the network will be removed. So it is not required to consider the load but at all in bus admittance matrix formation. As slack bus is also one of the generator bus, it is required to consider slack bus and remaining generator buses to form bus admittance matrix of the network.

End of Solution

70. In a 3-phase, 60 Hz, 500 MVA, 15 kV, 32-pole hydroelectric generating unit, the values of ω_{syn} and ω_{msyn} will be nearly

(a) 754 rad/s and 47.6 rad/s

(b) 377 rad/s and 46.7 rad/s

(c) 377 rad/s and 23.6 rad/s

(d) 754 rad/s and 23.6 rad/s

70. Ans: (c)

Sol: $\omega_{syn} = 2\pi f = 2\pi \times 60 = 377$ rad/sec

$$\omega_{m\,syn} = \frac{2}{P} \times \omega_{syn}$$

$$= \frac{2}{32} \times 377$$

$$= 23.56 \text{ rad/sec}$$

End of Solution

71. The methods adopted for improving the steady state stability of power system are

1. Quick response excitation system
2. Higher excitation voltages
3. Maximum power transfer by use of series capacitor or reactor

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

71. Ans: (c)

Sol: $P_{SSS2} = \dfrac{V_1V_2}{X}$

Steady state stability improved by

(i) Higher operating voltages

(ii) Using of series capacitors

(iii) using of parallel lines

$$P_{SSSL} = \frac{V_1\,V_2}{X}$$

End of Solution

72. The HVDC system uses

(a) Rectifier station at sending end and inverter station at receiving end

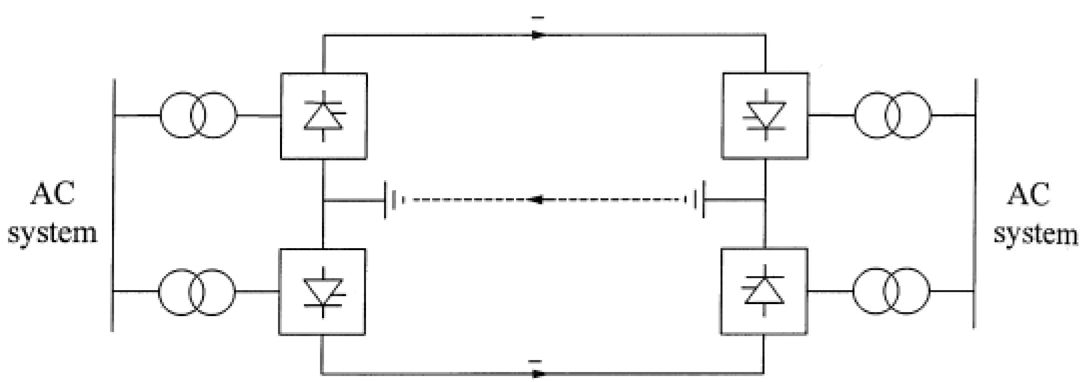
(b) Inverter station at sending as well as at the receiving end

(c) Rectifier station at sending end as well as at the receiving end

(d) Inverter station at sending end and rectifier station at receiving end

72. Ans : (a)

Sol: Typical layout of HVDC transmission line:



Rectifier station at sending end and Inverter station at receiving end.

End of Solution

73. Which one of the following is **not** required for Power diode ?

(a) High speed operation (b) Fast communication

(c) Small recovery time (d) Low on-state voltage drop

73. Ans : (b)

Sol: For power diode, High speed of operation or less recovery time are required properties.

Low on state voltage drop will ensure less conduction loss.

Hence, option B can be selected.

End of Solution

74. The reverse recovery time of a diode is t_{rr} = 3 μs and the rate of fall of the diode current is $\frac{di}{dt}$ = 30 A/μs. The storage charge Q_{RR} and the peak inverse current I_{RR} will be respectively

(a) 135 μC and 90 A (b) 270 μC and 90 A

(c) 270 μC and 60 A (d) 135 μC and 60 A

74. Ans : (a)

Sol: Give data: $t_{rr} = 3\,\mu s$ and $\frac{di}{dt} = 30\,A/\mu s$.

Stored charge, $Q_{rr} = \frac{1}{2}\frac{di}{dt}t_{rr}^2 = \frac{1}{2}\times 30\times 3 = 135\,\mu C$

Peak inverse current, $I_{rr} = \frac{di}{dt}\frac{t_{rr}}{1+S} = 30\times 3 = 90\,A$, neglect Softness factor

End of Solution

75. The i_g-v_g characteristics of a thyristor is a straight line passing through origin with a gradient of 2.5×10^3. If P_g = 0.015 watt, the value of gate voltage will be nearly

(a) 5.0 V (b) 6.1 V (c) 7.5 V (d) 8.5 V

75. Ans : (b)

Sol: Given data: $\frac{V_g}{I_g} = 2.5\times 10^3$ or $V_g = 2500\times I_g$ -------- (1)

And $P_g = V_g I_g = 0.015$ W, by using equation 1, $(2500 I_g)\times I_g = 0.015$ or $I_g = \sqrt{\frac{0.015}{2500}} = 2.45\,mA$

$\therefore V_g = 2.5\times 10^3 \times 2.45\times 10^{-3} = 6.125\,V$

End of Solution

76. A single-phase 220 V, 1 kW heater is connected to half wave controlled rectifier and is fed from a 220 V, 50 Hz ac supply. When the firing angle α = 90°, the power absorbed by the heater will be nearly

(a) 1000 W (b) 750 W (c) 500 W (d) 250 W

76. Ans : (d)

Sol: Given data:

Heater ratings are 220 V, 1 kW and hence, $R = \frac{220 \times 220}{1000}\,\Omega$

Source voltage: $V_m = 220\sqrt{2}$ V, 50 Hz and $\alpha = 90°$

Power delivered to the load, $P_o = \frac{V_{or}^2}{R} = \frac{V_m^2}{4\pi R}\left[(\pi - \alpha) + \frac{1}{2}\sin 2\alpha\right]$

And hence, $P_o = \frac{220 \times 220 \times 2}{4 \times \pi \times \frac{220 \times 220}{1000}}\left[\left(\pi - \frac{\pi}{2}\right) + 0\right] = \frac{1000}{4} = 250\text{ W}$

End of Solution

77. When we compare the half bridge converter and full bridge converter

1. The maximum collector current of a full bridge is only double that of the half bridge.
2. Full bridge uses 4-power switches instead of 2, as in the double bridge
3. Output power of a full bridge is twice that of a half bridge with the same input voltage and current

Which of the above statements are correct?

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

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

77. Ans : (b)

Sol: Statements are not clear because in question, half bridge is given. But in the options double bridge is given. I will suggest to challenge this question.

But from the given options, I can select option B by considering the given circuits are full bridge and half bridge inverter circuits.

End of Solution

78. A single-phase fully controlled bridge converter is connected with RLE load where R = 5Ω, L = 4 mH and E = 50 V. This converter circuit is supplied from 220 V, 50 Hz ac supply. When the firing angle is 60°, the average value of the load current will be nearly

(a) 12.2 A (b) 9.8 A (c) 6.4 A (d) 4.2 A

78. Ans : (b)

Sol: Given data:

Single phase full converter, $R = 5\ \Omega$, E = 50 V.

Source voltage: $V_m = 220\sqrt{2}$ V, 50 Hz and $\alpha = 60°$

Assume load current is constant and hence, $V_o = \frac{2V_m}{\pi}\cos\alpha$

$$= \frac{2\times 220\sqrt{2}}{22}\times 7\times\frac{1}{2}$$

$$= 70\sqrt{2} = 98.99\ \text{V}$$

And output current, $I_o = \frac{V_o - E}{R}$

$$= \frac{98.99 - 50}{5} = 9.8\ \text{A}$$

End of Solution

79. Consider the following statements regarding ac drives:

1. For the same kW rating, ac motors are 20% to 40% light weight as compared to dc motors.
2. The ac motors are more expensive as compared to same kW rating dc motors.
3. The ac motors have low maintenance as compared to dc motors.

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

79. Ans: (c)

Sol: Statements 1 and 3 are the basic advantages of ac drives over dc drives.

Ac motors are less expensive as compared to same kW rating of dc motors, and hence statement 2 is not correct.

End of Solution

80. A 3-phase induction motor drives a blower where load torque is directly proportional to speed squared. If the motor operates at 1450 rpm, the maximum current in terms of rated current will be nearly

(a) 2.2 (b) 3.4 (c) 4.6 (d) 6.8

80. Ans: (a)

Sol: $T_{em} = KI_2^2\frac{R_2}{s}$

$T_L \propto N_r^2 \propto [N_s(1-s)]^2 \propto (1-s)^2$

$\frac{I_2^2R_2}{s} \propto (1-s)^2$

$I_2 = K\sqrt{s}(1-s)$

Neglecting stator impedance and no-load current

$I_1 \propto I_2$

$I_1 \propto \sqrt{s}\,(1-s)$

For slip at maximum current, $\frac{dI_1}{ds} = 0$

$\Rightarrow \frac{d}{ds}\left[\sqrt{s}(1-s)\right] = 0$

$s = \frac{1}{3}$ (slip at maximum current)

Given rotor speed, $N_r = 1450$ rpm

Assuming f = 50 Hz, synchronous speed closer to 1450 rpm

$s = \frac{1500-1450}{1500} = 0.0333$

$$\therefore \frac{I_{max}}{I_{1fl}} = \frac{\sqrt{\frac{1}{3}}\left(1-\frac{1}{3}\right)}{\sqrt{0.0333}(1-0.0333)}$$

$$= 2.1814 \approx 2.2$$

End of Solution

ESE / GATE / PSUs - 2020 ADMISSIONS OPEN

CENTER	COURSE	BATCH TYPE	DATE
HYDERABAD - DSNR	GATE + PSUS – 2020	Regular Batches	26th April, 11th, 25th May, 09th, 24th June, 8th July 2019
HYDERABAD - DSNR	ESE + GATE + PSUs - 2020	Regular Batches	21st March, 26th April, 11th, 25th May, 09th, 24th June, 8th July 2019
HYDERABAD - DSNR	GATE + PSUs - 2020	Short Term Batches	29th April, 6th, 11th, 18th May 26th May, 2nd June, 2019
HYDERABAD - DSNR	GATE + PSUs - 2020	Morning/Evening Batch	21st Jan 2019
HYDERABAD - DSNR	ESE – 2019 STAGE-II (MAINS)	Regular Batch	17th Feb 2019
HYDERABAD - Abids	GATE + PSUS – 2020	Regular Batches	26th April, 11th, 25th May, 09th, 24th June, 8th July 2019
HYDERABAD - Abids	GATE + PSUs - 2020	Short Term Batches	29th April, 6th, 11th, 18th May 26th May, 2nd June, 2019
HYDERABAD - Abids	ESE + GATE + PSUs - 2020	Morning Batch	21st Jan 2019
HYDERABAD - Abids	ESE – 2019 STAGE-II (MAINS)	Regular Batch	17th Feb 2019
HYDERABAD - Abids	GATE + PSUs - 2020	Weekend Batch	19th Jan 2019
HYDERABAD - Abids	ESE+GATE + PSUs - 2020	Spark Batches	11th May, 09th June 2019
HYDERABAD - Kukatpally	GATE + PSUs - 2020	Morning/Evening Batch	21st Jan 2019
HYDERABAD - Kukatpally	GATE + PSUS – 2020	Regular Batches	17th May, 1st, 16th June, 1st July 2019
HYDERABAD - Kukatpally	GATE + PSUs - 2020	Short Term Batches	29th April, 6th, 11th, 18th May 26th May, 2nd June, 2019
HYDERABAD - Kothapet	ESE + GATE + PSUS – 2020	Regular Batches	21st March, 26th April, 11th, 25th May, 09th, 24th June, 8th July 2019
HYDERABAD - Kothapet	ESE+GATE + PSUs - 2020	Spark Batches	11th May, 09th June 2019
DELHI	ESE+GATE+PSUs - 2020	Weekend Batches	13th Jan, 2nd Feb 2019
DELHI	ESE+GATE+PSUs - 2020	Regular Evening Batch	18th Feb 2019
DELHI	ESE+GATE+PSUs - 2020	Regular Day Batch	11th May 2019
DELHI	ESE+GATE+PSUs - 2020	Spark Batch	11th May 2019
DELHI	ESE+GATE+PSUs - 2021	Weekend Batch	13th Jan 2019
DELHI	GATE+PSUs - 2020	Short Term Batches	11th, 23rd May 2019
BHOPAL	ESE + GATE+PSUs - 2020 & 21	Evening Batch	09th Jan 2019
BHOPAL	ESE+GATE+PSUs - 2020	Regular Day Batch	01st Week of June 2019
PUNE	GATE+PSUs - 2020	Weekend Batch	19th Jan 2019
PUNE	ESE+GATE+PSUs - 2021	Weekend Batch	26th Jan 2019
BHUBANESWAR	GATE+PSUs - 2020 & 21	Weekend Batch	12th Jan 2019
BHUBANESWAR	GATE+PSUs - 2020	Regular Batch	02nd Week of May 2019

FOR BATCH DETAILS VISIT : www.aceenggacademy.com

81. Consider the following statements:

1. SMPS generates both the electromagnetic and radio frequency interference due to high switching frequency.
2. SMPS has high ripple in output voltage and its regulation is poor.
3. The output voltage of SMPS is less sensitive with respect to input voltage variation

Which of the above statements are correct?

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

81. Ans: (a)

Sol: Statement 1 is basic drawback and statement 3 is the basic advantage of SMPS circuits.

Another feature of SMPS is to have less ripple in output voltage with better regulation. And hence, statement 2 is not correct.

End of Solution

82. Consider the following features with respect to the flyback converters:

1. It is used mostly in application below 100 W.
2. It is widely used for high-output voltage.
3. It has low cost and is simple.

Which of the above statements are correct?

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

82. Ans: (c)

Sol: Fly-back converters are preferable for power ratings around 100 – 200 W or below it. Fly-back converter topology is simple and less in cost.

It is preferable in low power range. And hence, statement 2 is not correct.

End of Solution

83. Consider the following statements regarding the function of dc-dc converter in a dc motor:

1. It acts as regenerative brake.
2. It controls the speed of motor
3. It controls the armature voltage of a dc motor

Which of the above statements are correct?

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

83. Ans: (d)

Sol: All the given statements are correct in associated with chopper based dc drives.

End of Solution

84. The power supplies which are used extensively in industrial applications are required to meet

1. Isolation between the source and the load
2. High conversion efficiency
3. Low power density for reduction of size and weight
4. Controlled direction of power flow

Which of the above specifications are correct?

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

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

84. Ans: (c)

Sol: Statement 1, 2 and 4 are basic advantages of power electronic circuits.

For reduction of size and weight of power supply, the power density (which means power rating divided by volume of the package) should be high.

End of Solution

Directions: Each of the next six (06) items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below:

Codes:

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

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

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

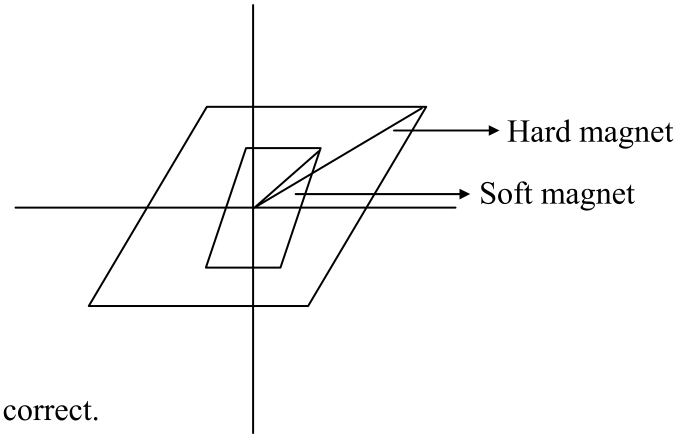
(d) Statement (I) is false, but Statement (II) is true.

85. **Statement (I):** Soft iron does not retain magnetism permanently.

Statement (II): Soft iron does not retentivity.

85. Ans: (c)

Sol: Soft iron is a soft magnetic material with small hysteresis loop. These materials are easily magnetised and easily demagnetized with high permeability and susceptibility and these materials also process retentivity.



Statement I is correct.

Statement II is incorrect and hence answer is c.

End of Solution

86. **Statement (I):** Reaction turbines are generally used for sites with high head and low flow.

Statement (II): Kaplan and Francis turbines are reaction turbines.

86. Ans: (d)

Sol: Reaction turbines are used for low head and high discharge. So statement (I) is wrong. Kaplan and Francis turbines are reaction turbines. So statement (II) is correct.

End of Solution

87. **Statement (I):** One can formulate problems more efficiently in a high-level language and need not have a precise knowledge of the architecture of the computer

Statement (II): High level languages permit programmers to describe tasks in a form which is problem oriented than computer oriented.

87. Ans: (a)

Sol: High-level languages are independent of computer architecture in terms of describing the solution of any problem. Hence a programmer always tries to solve the problem irrespective of knowing the computer architecture.

End of Solution

88. **Statement (I):** Sign magnitude representation is generally used in implementing the integer portion of the ALU.

Statement (II): In sign magnitude representation there are two representations of 0.

88. Ans: (d)

Sol: In ALU we prefer to use 2's complement representation

In signed magnitude representation, we have two representation

End of Solution

89. **Statement (I):** When a non-linear resistor, in series with a linear resistor, both being non-inductive, is connected to a voltage source, the current in the circuit cannot be determined by using Ohm's law.

Statement (II): If the current-voltage characteristic of the non-linear resistor is known, the current-voltage characteristic of the series circuit can be obtained by graphical solution.

89: Ans (b)

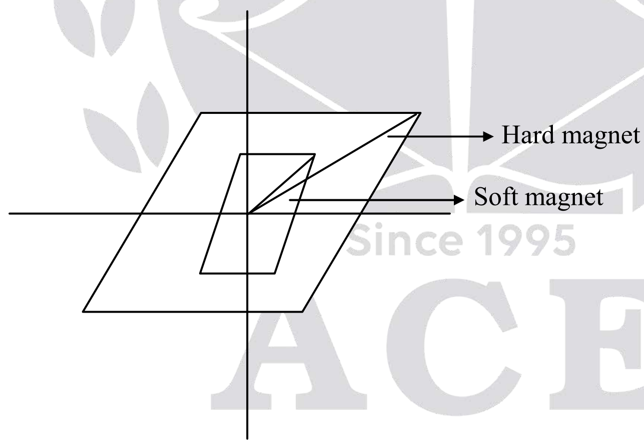
End of Solution

90. **Statement (I):** Soft magnetic materials, both metallic and ceramic are used for making transformers core, whereas, hard magnetic materials both metallic and ceramic are used for making permanent magnets.

Statement (II): Magnetic materials, both metallic and ceramic are classified as soft or hard according to the magnetic hysteresis loop being narrow or broad.

90. Ans: (a)

Sol: Soft magnetic materials: These are easily magnetized and easily demagnetized with small applied magnetic field. The hysteresis loop is narrow and hence it is used in transformer core.



Eg: (1) pure iron (2) Fe–Ni–alloy

Hard magnetic material: There are difficult to magnetized and very difficult to demagnetize and that require more applied magnetic field to magnetize the material. The hysteresis is broad and hence it is used in making permanent magnets.

End of Solution

91. The important fact about the collector current is

(a) It is greater than emitter current

(b) It equals the base current divided by the current gain

(c) It is small

(d) It approximately equals the emitter current

91. Ans: (d)

Sol: the general relation among I_E, I_C and I_B in a BJT is $I_E = I_C + I_B$

Where, I_B is the base recombination current,

I_E is the current injected through emitter junction

And I_C is the current reaching the collector junction.

NOTE: Since the base recombination current is generally very small, the collector current, I_C will be less than or equal to I_E

i.e., $I_C \le I_E$

End of Solution

92. What is Shockley's equation of a semiconductor diode in the forward bias regions?

(a) $I_D = I_S\left(e^{V_D^2/nV_T} - 1\right)$ (b) $I_D = I_S\left(e^{V_D/nV_T} - 1\right)$

(c) $I_D = I_S\left(e^{nV_D/V_T} - 1\right)$ (d) $I_D = I_S\left(e^{V_T/nV_D} - 1\right)$

Where

I_S is reverse saturation current

V_D is applied forward-bias voltage across the diode

V_T is thermal voltage

n is an ideality factor

92. Ans: (b)

Sol: The Schockley's equation of a semiconductor diode in forward bias

$$I_D = I_0\left[\exp\left[\frac{V_0}{\eta V_T}\right] - 1\right],$$

Where $I_0 \rightarrow$ scale current $= I_s$

End of Solution

93. The thermal voltage V_T of a semiconductor diode at 27° C temperature is nearly

(a) 17 mV (b) 20 mV (c) 23 mV (d) 26 mV

93. Ans: (d)

Sol: Since, Thermal voltage, $V_T = \frac{KT}{q} = \frac{T}{11,600}$

$T = 300°K$, $V_T = 26$ mV

End of Solution

94. The disadvantage of a typical MOSFET as compared to BJT is

(a) Increased power-handling levels (b) Reduced power-handling levels

(c) Increased voltage-handling levels (d) Reduced voltage-handling levels

94. Ans: (d)

Sol: The disadvantage of a typical MOSFET as compared to BJT is reduced voltage handling levels.

End of Solution

95. Which one of the following conditions will be satisfied for an impedance matched system?

(a) The decibel power gain is equal to twice the decibel voltage gain

(b) The decibel power gain is equal to the decibel voltage gain

(c) The decibel power gain is half to the decibel voltage gain

(d) The decibel power gain is equal to the thrice the decibel voltage gain

95. Ans: (b)

Sol: The general formula for descibel power gain is, $10\log\frac{P_o}{P_i}$.

Decibel power gain, $$10\log\frac{P_o}{P_i} = 10\log\left(\frac{V_0 I_0}{V_i I_i}\right) = 10\log\left(\frac{V_o\frac{V_o}{R}}{V_i\frac{V_i}{R}}\right)$$

$$= 10\log\left(\frac{V_0}{V_i}\right)^2$$

$$= 20\log\left(\frac{V_0}{V_i}\right) \quad \text{(Decibel voltage gain)}$$

End of Solution

96. For most FET configurations and for common-gate configurations, the input impedances are respectively

(a) High and high (b) High and low (c) Low and low (d) Low and high

96. Ans: (b)

Sol: In common source and common-drain configuration of FET,

$R_i = r_g = \infty$ ………. (1) very high

In common-Gate configuration of FET, $R_i = \dfrac{1}{g_m}$ …………… (2) Low

End of Solution

97. The dB gain of cascaded systems is simply

(a) The square of the dB gains of each stage

(b) The sum of the dB gains of each stage

(c) The multiplication of the dB gains of each stage

(d) The division of the dB gains of each stage

97. Ans: (b)

Sol: If n-stages of amplifiers are cascaded, the overall gain becomes, $A = A_1 \times A_2 \times$ …….. A_n

$\Rightarrow (20\log A)_{dB} = \{20\log(A_1 \times A_2 \text{ …….. } A_n)\}_{dB}$

$\therefore$ dB gain = dB gain of A_1 + dBgain of A_2 + …….. + dB gain of A_n.

End of Solution

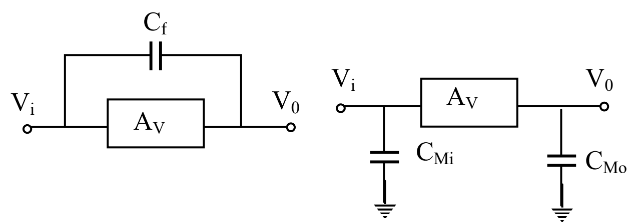
98. The Miller effect input capacitance C_{M_i} is

(a) $(1-A_V^2)C_f$ (b) $(1-A_V)C_f$ (c) $(1-C_f)A_V$ (d) $(1-C_f^2)A_V$

Where, C_f = feedback capacitance; $A_V = \dfrac{V_0}{V_i}$

98. Ans: (b)

Sol:



C_{Mi} = Miller effect input capacitance = $C_f(1 - A_V)$

C_{Mo} = Miller effect output capacitance = $C_f\left(\dfrac{A_V - 1}{A_V}\right)$

End of Solution

99. For an op-amp having a slew rate of 2 V/μs, if the input signal varies by 0.5 V in 10 μs, the maximum closed-loop voltage gain will be

(a) 50 (b) 40 (c) 22 (d) 20

99. Ans: (b)

Sol: Given Op amp slew rate, SR = 2V/μsec

$V_I = 0.5$ V →varied in 10 μsec

As, SR = $\dfrac{dV_0}{dt}/\max \Rightarrow dV_0 = SR \times dt = 20$ V

$\therefore$ Gain = $\dfrac{dV_0}{dV_i} = \dfrac{20}{0.5} = 40$

End of Solution

100. A negative feedback amplifier where an input current controls an output voltage is called

(a) Current amplifier (b) Transconductance amplifier

(c) Transresistance amplifier (d) Voltage amplifier

100. Ans: (c)

Sol: An amplifier in which input current control an output voltage i.e., input I_i and output = V_o

$\therefore$ Gain A = $\dfrac{\text{output}}{\text{input}} = \dfrac{V_o}{I_i}$ = R_m = Trans Resistance gain

Such an amplifier is called as trans resistance amplifier.

End of Solution

101. In emergency lighting system, the component used for maintaining the charge on the battery is

(a) LED (b) Shockley diode (c) Thermistor (d) SCR

101. Ans: (a)

Sol: In most of the commercial emergency lighting systems, 12 volt LED strip battery packs are used. The use of LED's provide adequate lighting for a longer period before draining the battery.

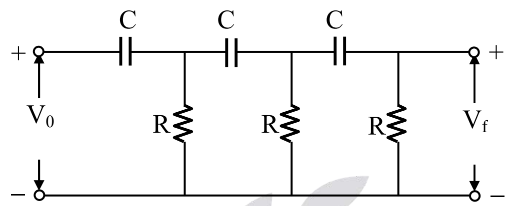
End of Solution

102. For RC phase shift oscillator using FET, the gain of the amplifier stage must be practically somewhat greater than

(a) 27 (b) 28 (c) 29 (d) 30

102. Ans: (c)

Sol:



In RC phase shift oscillator using FET, the phase shift network is shown in figure.

From the circuit,

$$\beta = \frac{V_f}{V_o} = \frac{1}{(1-5\alpha^2)+j(\alpha^3-6\alpha)}$$

Where $\alpha = \dfrac{1}{\omega RC}$

Case (i): By considering imaginary part = 0, $f = \dfrac{1}{2\pi RC\sqrt{6}}$

Case (ii): Barkhansen criterion, AVf = $A_v \dfrac{1}{1-5\alpha^2} = 1$, but $\alpha^2 = 6$

$\therefore |A_V| > 29$

End of Solution

103. The time delay in a look-ahead carry adder is independent of

(a) Number of operands only

(b) Propagation delay only

(c) Number of bits in the operation only

(d) Bits in the operand, number of operands and propagation delay

103. Ans: (c)

Sol: It is independent of number bits in the operand.

End of Solution

104. The time delay Δt introduced by a SISO shift register in digital signals is given by

(a) $N^2 \times \frac{1}{f_e}$ (b) $N^2 \times f_c$ (c) $\frac{f_c}{N}$ (d) $N \times \frac{1}{f_c}$

Where

N is the number of stages

F_c is the clock frequency

104. Ans: (d)

Sol: The data is delayed by ‘N’ clock cycle’s the data is applied at SI port will arrive SO port after ‘N’ clock cycle’s

The delay introduced is $\Delta t = N \times T_C$

$$= N \times \frac{1}{f_c}$$

End of Solution

105. An analog output voltage for the input 1001 to a 4 bit D/A converter for all possible inputs assuming the proportionality factor K = 1 will be

(a) 9 (b) 6 (c) 3 (d) 1

105. Ans: (a)

Sol: $(1001)_2$

V_0 = K(decimal equivalent of binary)

$= 1(1\times2^3+0\times2^2+0\times2^1+1\times2^0)$

= 9

End of Solution

106. In microprocessor interface, the concept of detecting some error condition such as no match found’ is called

(a) Syntax error (b) Semantic error (c) Logical error (d) Error trapping

106. Ans: (d)

End of Solution

107. The maximum number of input or output devices that can be connected to 8085 microprocessor are

(a) 8 (b) 16 (c) 40 (d) 256

107. Ans: (d)

Sol: The maximum number of I/O devices that can be interfaced to 8085 microprocessor are 2^8, i.e. 256 since 8 bit port address is used in IN and OUT instructions.

End of Solution

108. The contents of the accumulator and register C are 2EH and 6CH respectively. The instruction ADD C is used. The values of AC and P flags are

(a) 0 and 0 (b) 1 and 1 (c) 0 and 1 (d) 1 and 0

108. Ans: (b)

Sol: (A) = 2EH = 0010 1110

(C) = 6 CH = 0110 1100

(A) = 9 AH = 1001 1010

Cy = 0, P = 1, AC = 1, Z = 0, S = 1

Ans is AC = 1 and P =1

End of Solution

109. When an information signal is multiplied by an auxiliary sinusoidal signal to translate its frequency, the modulation is called

(a) Phase modulation (b) Frequency modulation

(c) Amplitude modulation (d) Quadrature amplitude modulation

109. Ans: (c)

Sol: $\underset{\substack{\text{information}\\\text{signal}}}{\overset{x(t)}{\downarrow}} \quad \underset{\substack{\text{auxiliary}\\\text{sinusoidal signal}}}{\overset{(\cos 2\pi f_c t)}{\downarrow}} \rightarrow$ DSBSC (Double side band suppressed carrier) signal which is amplitude modulation signal

End of Solution

110. The transmission power efficiency for a tone modulated signal with modulated index of 0.5 will be nearly

(a) 6.7% (b) 11.1% (c) 16.7% (d) 21.1%

110. Ans: (b)

Sol: $\mu = 0.5$

$$\eta = \frac{\mu^2}{2+\mu^2}\times 100$$

$$\eta = \frac{(0.5)^2}{2+(0.5)^2}\times 100$$

$\eta = 11.11\%$

End of Solution

111. For practical purposes, the signal to noise ratio for acceptable quality transmission of analog signals and digital signals respectively are

(a) 10 – 30 dB and 05 – 08 dB (b) 40 – 60 dB and 10 –12 dB

(c) 60 – 80 dB and 20 – 24 dB (d) 70 – 90 dB and 30 – 36 dB

111. Ans: (b)

Sol: In analog communication, the signal to noise power ratio required for qualitative reception of the signal is 40-50 dB whereas in digital communication, the signal to noise power ratio required for qualitative reception is 10-15 dB.

In analog communication, the signal power required to be transmitted is very high compared to digital communication because the SNR required at the receiver is very high for analog communication (40-50 dB) compared to digital communication (10-15 dB)

End of Solution

112. The discrete samples of an analog signal are to be uniformly quantized for PCM system. If the maximum value of the analog sample is to be represented within 0.1% accuracy, then minimum number of binary digits required will be nearly

(a) 7 (b) 9 (c) 11 (d) 13

112. Ans: (c)

Sol: $(Q_e)_{max} \leq 0.1\%$ of A_m

$$\frac{A_m}{2^n} \leq \frac{0.1}{100}\times A_m$$

$2^n \geq 1000$

End of Solution

113. A signal:

$m(t) = 2 \cos\ 6000\ \pi t + 4 \cos 8000\ \pi t\ 6 \cos 10000\ \pi t$

is to be truthfully represented by its samples. The minimum sampling rate using band pass consideration will be

(a) 5,000 Hz (b) 10,000 Hz (c) 15,000 Hz (d) 20,000Hz

113. Ans: (a)

$$m(t) = 2\cos 6000\pi t + 4\cos 8000\pi t + 6\cos 10000\pi t$$

Sol:

$$\downarrow \qquad \downarrow \qquad \downarrow$$

$$f_{m_1} = 3\text{kHz} \quad f_{m_2} = 4\text{kHz} \quad f_{m_3} = 5\text{kHz}$$

$$f_L = 3\text{kHz}$$

$$f_H = 5\text{kHz}$$

$$\min .f_s = \frac{2f_H}{K}$$

$$K = \frac{5}{5-3} = \frac{5}{2} = 2.5$$

Largest integer not exceeding

For $K = 2 \Rightarrow (f_s)_{min} = \frac{2(5K)}{2} = 5\text{kHz}$

End of Solution

114. If 'N' signals are multiplexed using PAM band limited to f_M, the channel bandwidth need not be larger than

(a) $N.\frac{f_M}{2}$ (b) $N.f_M$ (c) $2N.\ f_M$ (d) $N^2.\ f_M$

114. Ans: (b)

Sol: For each signal B.W = f_m

For N-signals = Nf_m

End of Solution

115. A linear discrete- time system is characterized by its response $h_k(n) = (n - k)u\ (\ n - k)$ to a delayed unit sample $\delta(n - k)$. The system will be

(a) Shift invariant (b) Shift variant (c) Scale invariant (d) Scale variant

115. Ans: (a)

Sol: $S(n) \to nu(n)$

$S(n-k) \to (n-k)\, u(n-k)$

116. Consider the analog signal $x_a(t) = 3 \cos 100\pi t$.

The minimum sampling rate F_s required to avoid aliasing will be

(a) 100 Hz (b) 200 Hz (c) 300 Hz (d) 400 Hz

116. Ans: (a)

Sol: $x(t) = 3\cos 100\pi t$

Highest analog frequency $f_m = 50$ Hz

Min.f_s required to avoid aliasing will be $2 f_m = 100$ Hz

117. The response of the system $y(n) = x(n)$ to the following input signal

$$X(n) = \begin{cases} |n|, & -3 \le n \le 3 \\ 0, & \text{otherwise} \end{cases}$$

(a) Is delayed from input (b) Is exactly same as the input

(c) Leads the input (d) Varies with signal

117. Ans: (b)

Sol: The system must be identity system to make input as output

End of Solution

118. The complex exponential Fourier representation for the signal $x(t) = \cos \omega_0 t$ is

(a) $\sum_{k=-\infty}^{\infty} c_k e^{-jk\omega_0 t}$ (b) $\sum_{k=-\infty}^{\infty} c_k e^{-j\omega_0 t}$

(c) $\sum_{k=-\infty}^{\infty} c_k e^{2jk\omega_0 t}$ (d) $\sum_{k=-\infty}^{\infty} c_k e^{jk\omega_0 t}$

118. Ans: (d)

Sol: $x(t) = \cos\omega_0 t$

EFS form $\sum_{k=-\infty}^{+\infty} C_K e^{jk\omega_0 t}$

End of Solution


OUR GATE - 2018 TOP RANKERS
AIR 1 AKASH CHOUKSEY CE
AIR 1 ARNAB ADHIKARY EC
AIR 1 NAMITA KALRA CSIT
AIR 1 NAMAN JASWANI IN
AIR 2 JIJO JOSE EC
AIR 2 ASHWANI KUMAR IN
AIR 2 MAINUL HAQUE IN
AIR 3 PINAKI MONDAL EE
AIR 3 NAVNEET KAUR EC
AIR 3 SOUVIK SAHA CE
AIR 3 SAHIL PANDEY CSIT
AIR 3 DIVYANSHU PI
AIR 4 ALOK SHAKTI CE
AIR 4 SIRAZ AHMAD ME
AIR 4 ADITYA DHOLAKIA EE
AIR 4 RAMESH KAMULLA IN
AIR 4 AMIT SHAKYA IN
AIR 5 ANKUSH AGARWAL CE
AIR 5 PRAVEEN KUMAR CE
AIR 5 SOUMIL SUNIL EC
AIR 5 DEVENDRA EE
AIR 5 PIYUSH KUMAR EE
AIR 5 ANMOL BAJPAI PI
AIR 6 SHASHI BHUSHAN EC
AIR 6 SWYAM PRAKASH CSIT
AIR 6 SOMYA BHATNAGAR IN
AIR 6 SABHASACHI POBI IN
AIR 7 ABHISHEK BIRLA EC
AIR 7 AJAY KUMAR EC
AIR 7 SHASHANK TIWARI ME
AIR 7 ROHIT TRIPATHI EE
AIR 7 SHREYA ALVA CSIT
AIR 7 PAARTH GUPTA CSIT
AIR 7 GAUTHAM VIGNESWAR PI
AIR 7 HIMANSHU SHARMA PI
AIR 8 PRAKASH TIWARI EE
AIR 8 ZAMBRE KAPIL ME
AIR 8 TARUN GUPTA IN
AIR 9 VIKRAM GARG CE
AIR 9 YADAGIRI SHASHANK CE
AIR 9 SAIDEEP C EC
AIR 9 CHANDRASHIS M CSIT
AIR 9 D AJAY KUMAR EE
AIR 9 AMAN SINGH ME
AIR 9 SNEHA PANDEY IN
AIR 9 SOMIT SRIVASTAVA PI
AIR 10 DHEERAJ KUMAR EC
AIR 10 VIPIN CHANDR IN
AIR 10 ANIKET MUKHERJEE IN
and many more...
EC TOP 10 9 TOP 100 74
EE TOP 10 7 TOP 100 69
CE TOP 10 7 TOP 100 42
ME TOP 10 4 TOP 100 54
CSIT TOP 10 6 TOP 100 31
IN TOP 10 11 TOP 100 78
PI TOP 10 5 TOP 100 50

119. The continuous LTI system is described by

$$\frac{dy(t)}{dt} + 2y(t) = x(t)$$

Using the Fourier transform, for $x(t) = e^{-t}\,u(t)$, the output y(t) will be

(a) $(e^{-t} – e^{2t})\,u(t)$ (b) $(e^{t} + e^{-2t})\,u(t)$ (c) $(e^{-t} – e^{-2t})\,u(t)$ (d) $(e^{t} + e^{2t})\,u(t)$

119. Ans: (c)

Sol: $$\frac{dy(t)}{dt} + 2y(t) = x(t)$$

Apply F.T

$(j\omega+2)\,Y(\omega) = X(\omega)$

$$H(\omega) = \frac{Y(\omega)}{X(\omega)} = \frac{1}{j\omega+2}$$

If output $x(t) = e^{-t}\,u(t) \Rightarrow Y(\omega) = X(\omega)H(\omega)$

$$= \frac{1}{(j\omega+2)(j\omega+1)}$$

$$= \frac{1}{(j\omega+2)} + \frac{1}{(j\omega+1)}$$

I.F.T

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

End of Solution

120. The discrete Fourier series representation for the following sequence

$x(n) = \cos\frac{\pi}{4}n$ is

(a) $\frac{1}{2}e^{j\Omega_0 n} + \frac{1}{2}e^{-j\Omega_0 n}\text{and}\,\Omega_0 = \frac{\pi}{8}$ (b) $\frac{1}{2}e^{-j\Omega_0 n} + \frac{1}{2}e^{-2j\Omega_0 n}\text{and}\,\Omega_0 = \frac{\pi}{4}$

(c) $\frac{1}{2}e-^{j\Omega_0 n} + \frac{1}{2}e^{-j\Omega_0 n}\text{and}\,\Omega_0 = \frac{\pi}{6}$ (d) $\frac{1}{2}e^{j\Omega_0 n} + \frac{1}{2}e^{j7\Omega_0 n}\text{and}\,\Omega_0 = \frac{\pi}{4}$

120. Ans: (d)

Sol: $x(n) = \sum_{k=0}^{N-1} C_k e^{jk\Omega_0 n}$

$$x(n) = \cos\left(\frac{\pi n}{4}\right)$$

$$N = \frac{2\pi}{\Omega_0} = \frac{2\pi}{\pi/4} = 8$$

$$= \frac{1}{2}e^{j\Omega_0 n} + \frac{1}{2}e^{j(-\Omega_0)n} \text{ with } \Omega_0 = \pi/4$$

$$= \frac{1}{2}e^{j\Omega_0 n} + \frac{1}{2}e^{j(7\Omega_0)n}$$

As $C_k = C_{k+N}$

$C_{-1} = C_{-1+8} = C_7$

End of Solution

121. What are the values of k for which the solution of equations

$(3k - 8)x + 3y + 3z = 0$

$3x + (3k - 8)y + 3z = 0$

$3x + 3y + (3k - 8)z = 0$

has a non – trivial solution?,

(a) $k = \frac{2}{3}, \frac{11}{3}, \frac{10}{3}$ (b) $k = \frac{2}{3}, \frac{10}{3}, \frac{11}{3}$ (c) $k = \frac{11}{3}, \frac{11}{3}, \frac{11}{3}$ (d) $k = \frac{2}{3}, \frac{11}{3}, \frac{11}{3}$

121. Ans: (d)

Sol: Let $A = \begin{bmatrix} 3k-8 & 3 & 3 \\ 3 & 3k-8 & 3 \\ 3 & 3 & 3k-8 \end{bmatrix}$

For non-trivial solution, we have $|A| = 0$

$$\begin{vmatrix} 3k-8 & 3 & 3 \\ 3 & 3k-8 & 3 \\ 3 & 3 & 3k-8 \end{vmatrix} = 0$$

$C_1 \to C_1 + C_2 + C_3$

$$\begin{vmatrix} 3k-2 & 3 & 3 \\ 3k-2 & 3k-8 & 3 \\ 3k-2 & 3 & 3k-8 \end{vmatrix} = 0$$

$R_2 - R_1$ and $R_3 - R_1$

$$\begin{vmatrix} 3k-2 & 3 & 3 \\ 0 & 3k-11 & 0 \\ 0 & 0 & 3k-11 \end{vmatrix} = 0$$

$\Rightarrow (3k-2)(3k-11)^2 = 0$

$\Rightarrow k = \dfrac{2}{3}, \dfrac{11}{3}, \dfrac{11}{3}$

End of Solution

122. If $A = \begin{bmatrix} 2+i & 3 & -1+3i \\ -5 & i & 4-2i \end{bmatrix}$ then AA* will be (where, A* is the conjugate transpose of A)

(a) Unitary matrix
(b) Orthogonal matrix
(c) Hermitian matrix
(d) Skew Hermitian matrix

122. Ans: (c)

Sol: $A = \begin{bmatrix} 2+i & 3 & -1+3i \\ -5 & i & 4-2i \end{bmatrix}$

$$\overline{A} = \begin{bmatrix} 2-i & 3 & -1-3i \\ -5 & -i & 4+2i \end{bmatrix}$$

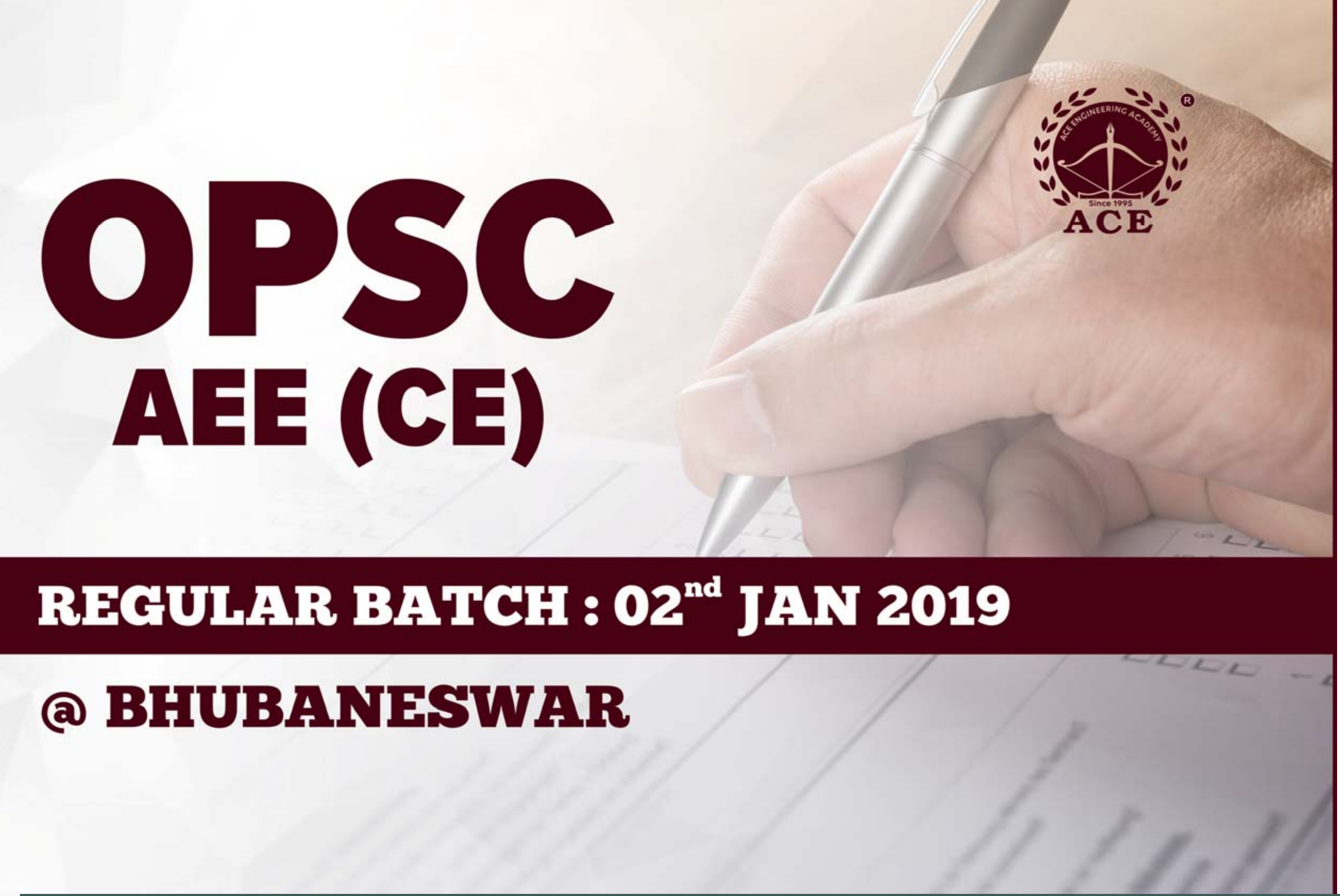
$$A^* = \left(\overline{A}\right)^T = \begin{bmatrix} 2-i & -5 \\ 3 & -i \\ -1-3i & 4+2i \end{bmatrix}$$

$$AA^* = \begin{bmatrix} 2+i & 3 & -1+3i \\ -5 & i & 4-2i \end{bmatrix} \begin{bmatrix} 2-i & -5 \\ 3 & -i \\ -1-3i & 4+2i \end{bmatrix}$$

$$= \begin{bmatrix} 24 & -20+2i \\ -20-2i & 46 \end{bmatrix}$$

It is Hermitian matrix

End of Solution


OPSC
AEE (CE)
ACE ENGINEERING ACADEMY
Since 1995
ACE
REGULAR BATCH : 02nd JAN 2019
@ BHUBANESWAR


ESE|GATE|PSUs – 2020 & 21
@ Delhi
ACE ENGINEERING ACADEMY
Since 1995
ACE
Weekend Batch Start on
13th January 2019
Early Bird Discount Rs. 5000/- Off
on Registration Before 31st Dec, 2018
Call: 7838971777, 9205282120, 23

123. If $y = 2x^3 - 3x^2 + 3x - 10$, the value of $\Delta^3 y$ will be

(where, Δ is forward difference operator)

(a) 10 (b) 11 (c) 12 (d) 13

123. Ans: (c)

Sol: $y = 2x^3 - 3x^2 + 3x - 10$

By synthetic division

$$
\begin{array}{cccc}
2 & -3 & 3 & -10 \\
 & 0 & 0 & 0 \\
\hline
2 & -3 & \multicolumn{1}{c|}{3} & -10 \\
 & 2 & \multicolumn{1}{c|}{-1} & \\
\cline{1-3}
2 & \multicolumn{1}{c|}{-1} & 2 & \\
 & \multicolumn{1}{c|}{4} & & \\
\cline{1-2}
\multicolumn{1}{c|}{2} & 3 & & \\
\end{array}
$$

$f(x) = y = 2x^3 - 3x^2 + 3x - 10$

$= 2x^{(3)} + 3x^{(2)} + 2x^{(1)} - 10$ (By Factorial notation)

where $x^{(3)} = x(x-1)(x-2)$, $x^{(2)} = x(x-1)$ and $x^{(1)} = x$

$\Delta y = 6x^{(2)} + 6x^{(1)} + 2$

$\Delta^2 y = 12x^{(1)} + 2$

$\Delta^3 y = 12$

$\therefore$ Option (c) is correct.

End of Solution

124. The solution of the differential equation

$$x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \log x \text{ is}$$

(a) $y = (c_1 + c_2x)\log x + 2\log x + 3$

(b) $y = (c_1 + c_2x^2)\log x + \log x + 2$

(c) $y = (c_1 + c_2x)\log x + \log x + 2$

(d) $y = (c_1 + c_2\log x)x + \log x + 2$

124. Ans: (d)

Sol: $x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \log x$ ....(1)

It is in Euler-Cauchy's form

Let $x = e^z \Rightarrow z = \log x$ & $D = \frac{d}{dz}$

(1) becomes

$D(D-1)y - Dy + y = z$

$(D^2 - 2D + 1)y = z$

Auxiliary equation has roots 1,1

The complementary function = $y_c = (C_1 + C_2z)e^z$

$y_p = \frac{z}{(D-1)^2} = (1-D)^{-2}(z)$

$= (1 + 2D)\, z = z + 2$

$\therefore\ y = y_c + y_p$

$= (C_1 + C_2 \log x)x + \log x + 2$

End of Solution

125. The area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ is

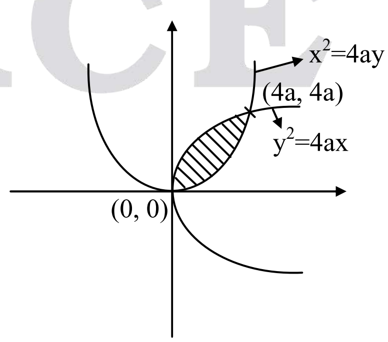
(a) $\frac{2}{3}a^2$ (b) $\frac{14}{3}a^2$ (c) $\frac{16}{3}a^2$ (d) $\frac{17}{3}a^2$

125. Ans: (c)

Sol: $y^2 = 4ax$ …….(1)

$x^2 = 4ay$ …….(2)

Substituting (2) in (1),



$\frac{x^4}{16a^2} = 4ax$

$x\,(x^3 - 64a^3) = 0$

$\Rightarrow x = 0, 4a$

$\Rightarrow y = 0, 4a$

$\therefore$ The curves are intersecting at (0, 0) & (4a, 4a) x varies from 0 to 4a and y varies from $\frac{x^2}{4a}$ to $2\sqrt{ax}$

$\therefore$ The required area $= \int_0^{4a}\int_{\frac{x^2}{4a}}^{2\sqrt{ax}} dy\,dx$

$$= \int_0^{4a} (y)_{\frac{x^2}{4a}}^{2\sqrt{ax}} dx$$

$$= \int_0^{4a}\left(2\sqrt{ax} - \frac{x^2}{4a}\right)dx$$

$$= \left[2\sqrt{a}\left(\frac{2}{3}x^{3/2}\right) - \frac{1}{4a}\left(\frac{x^3}{3}\right)\right]_0^{4a}$$

$$= \frac{4}{3}\sqrt{a}(4a)^{3/2} - \frac{1}{12a}\left(64a^3\right)$$

$$= \frac{32}{3}a^2 - \frac{16a^2}{3}$$

$$= \frac{16a^2}{3}$$

End of Solution

126. The volume of the solid surrounded by the surface

$$\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} + \left(\frac{z}{c}\right)^{2/3} = 1$$

is

(a) $\frac{4\pi abc}{35}$ (b) $\frac{abc}{35}$ (c) $\frac{2\pi abc}{35}$ (d) $\frac{\pi abc}{35}$

126. Ans: (a)

Sol: Changing the variables x, y, z in to X, Y, Z

where

$$\left(\frac{x}{a}\right)^{1/3} = X,\quad \left(\frac{y}{b}\right)^{1/3} = Y,\quad \left(\frac{z}{c}\right)^{1/3} = Z$$

Required volume $= \iiint dx\,dy\,dz = 27\ abc \iiint X^2Y^2Z^2\ dX\ dY\ dZ$

taken through the sphere $X^2 + Y^2 + Z^2 = 1$

Now, changing X, Y, Z in to spherical planer coordinate r, θ, ϕ so that

$X = r\sin\theta \cos\phi$,

$Y = r\sin\theta \sin\phi$,

$Z = r \cos\theta$ and

$\frac{\partial(X, Y, Z)}{\partial(r, \theta, \phi)} = r^2\sin\theta$ to describe the positive

Octant of the sphere r varies from 0 to 1

θ from 0 to $\frac{\pi}{2}$ and ϕ from 0 to $\frac{\pi}{2}$

$$V = 27\,abc \times 8\int_0^1 \int_0^{\pi/2} \int_0^{\pi/2} r^2\sin^2\theta \cos^2\phi \times r^2\sin^2\theta\sin\phi \times r^2\cos^2\theta\, r^2\sin\theta\, dr\, d\theta\, d\phi$$

$$= 216abc\int_0^1 r^8 dr \int_0^{\pi/2} \sin^5\theta \cos^2\theta\, d\theta \int_0^{\pi/2} \sin^2\phi \cos^2\phi\, d\phi$$

$$= \frac{4\pi abc}{35}$$

End of Solution

127. The solution of the partial differential equation

$x^2\frac{\partial z}{\partial x} + y^2\frac{\partial z}{\partial y} = (x + y)z$ is

(a) $f\left(\frac{1}{x} - \frac{1}{y}, \frac{xy}{z}\right) = 0$

(b) $f\left(\frac{1}{xy}, \frac{xy}{z}\right) = 0$

(c) $f\left(\frac{1}{x} - \frac{1}{y}, xyz\right) = 0$

(d) $f\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}, \frac{xy}{z}\right) = 0$

127. Ans: (a)

Sol: $x^2\frac{\partial z}{\partial x} + y^2\frac{\partial z}{\partial y} = (x + y)z$

The equation in Lagrange's linear form. The subsidiary equations are

$$\frac{dx}{x^2} = \frac{dy}{y^2} = \frac{dz}{(xz + yz)} \quad .... (1)$$

Consider, $\frac{dx}{x^2} = \frac{dy}{y^2}$

Integrating, $\frac{1}{x} - \frac{1}{y} = c_1$ .... (2)

Again from (1)

$$\frac{\frac{1}{x}dx}{x} = \frac{\frac{1}{y}dy}{y} = \frac{\frac{dz}{z}}{(x+y)}$$

$$\Rightarrow \frac{\frac{1}{x}dx + \frac{1}{y}dy - \frac{1}{z}dz}{x+y-x-y}$$

$$\therefore \frac{1}{x}dx + \frac{1}{y}dy - \frac{1}{z}dz = 0$$

log x + log y – log z = log b

$$\therefore \frac{xy}{z} = b \quad \text{..........(3)}$$

From (2) and (3)

$$f\left(\frac{1}{x} - \frac{1}{y}, \frac{xy}{z}\right) = 0$$

$\therefore$ Option (a) is correct.

End of Solution

128. The complex number $\left(\frac{2+i}{3-i}\right)^2$ is

(a) $\frac{1}{2}\left(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4}\right)$ (b) $\frac{1}{2}\left(\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}\right)$

(c) $\frac{1}{2}(\cos\pi + i\sin\pi)$ (d) $\frac{1}{2}\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$

128. Ans: (b)

Sol: $\left(\frac{2+i}{3-i}\right) = \frac{(2+i)(3+i)}{9+1} = \frac{1}{10}(5+5i) = \frac{(1+i)}{2}$

$(1+i) = \sqrt{2}\, e^{i\frac{\pi}{4}}$

$$\therefore \left(\frac{2+i}{3-i}\right)^2 = \frac{2e^{i\frac{\pi}{2}}}{4} = \frac{1}{2}\left(\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}\right)$$

End of Solution

129. If n is a positive integer then $\left(\sqrt{3}+i\right)^n + \left(\sqrt{3}-i\right)^n$ is

(a) $2^n \sin\frac{n\pi}{6}$ (b) $2^n \cos\frac{n\pi}{6}$ (c) $2^{n+1}\cos\frac{n\pi}{6}$ (d) $2^{n+1}\sin\frac{n\pi}{6}$

129. Ans: (c)

Sol: $\sqrt{3}+i = 2e^{i\frac{\pi}{6}}$

$\sqrt{3}-i = 2e^{-i\frac{\pi}{6}}$

$$\therefore \left(\sqrt{3}+i\right)^n + \left(\sqrt{3}-i\right)^n = 2^n e^{\frac{in\pi}{6}} + 2^n e^{-\frac{in\pi}{6}}$$

$$= 2^n\left(e^{\frac{in\pi}{6}} + e^{-\frac{in\pi}{6}}\right)$$

$$= 2^n\left(2\cos\frac{n\pi}{6}\right)$$

$$= 2^{n+1}\cos\left(\frac{n\pi}{6}\right)$$

End of Solution

130. The nature of singularity of function

$f(z) = \frac{1}{\cos z - \sin z}$ at $z = \frac{\pi}{4}$ is

(a) Removable singularity (b) Isolated singularity

(c) Simple pole (d) Essential Singularity

130. Ans: (c)

Sol: $f(z) = \frac{1}{\cos z - \sin z}$

$\cos z - \sin z = 0$

cosz = sinz

$\Rightarrow z = n\pi + \frac{\pi}{4}, n\in I$

For n = 0, $z = \frac{\pi}{4}$ is a singular point.

$\therefore Z = \frac{\pi}{4}$ is a simple pole.

End of Solution

131. If X is a discrete random variable that follows Binomial distribution, then which one of the following response relations is correct?

(a) $P(r+1) = \frac{n-r}{r+1} P(r)$

(b) $P(r+1) = \frac{p}{q} P(r)$

(c) $P(r+1) = \frac{n+r}{r+1}\frac{p}{q} P(r)$

(d) $P(r+1) = \frac{n-r}{r+1}\frac{p}{q} P(r)$

131. Ans: (d)

Sol: $P(r) = n_{c_r} p^r q^{n-r}$

$P(r+1) = n_{C_{r+1}} p^{r+1} q^{n-(r+1)}$

$$\frac{P(r+1)}{P(r)} = \frac{n_{C_{r+1}} p^{r+1} q^{n-(r+1)}}{n_{c_r} p^r q^{n-r}}$$

$$= \frac{n_{c_{r+1}}}{n_{c_r}}\left(\frac{p}{q}\right)$$

$$= \frac{n!}{\angle(n-(r+1)).\angle r+1} \times \frac{(n-r)!r!}{n!}\left(\frac{p}{q}\right)$$

$$= \left(\frac{n-r}{r+1}\right)\left(\frac{p}{q}\right)$$

$$P(r+1) = \left(\frac{n-r}{r+1}\right)\left(\frac{p}{q}\right) P(r)$$

End of Solution

132. If the probability that an individual suffers a bad reaction from a certain infection is 0.001, what is the probability that out of 2000 individuals, more than 2 individuals will suffer a bad reaction?.

(a) $\frac{1}{2}-\frac{5}{e^2}$ (b) $1.2-\frac{5}{e^2}$ (c) $1-\frac{5}{e^2}$ (d) $\frac{5}{e^2}$

132. Ans: (c)

Sol: Let P = 0.001

n = 2000

Let m = np = 2

$\therefore$ P (x > 2) = 1– P(x ≤ 2) = 1 – (P(x = 0)+ P(x = 1) + P(x = 2))

$$= \left[e^{-m} + me^{-m} + \frac{m^2}{2}e^{-m}\right]$$

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

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

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

End of Solution

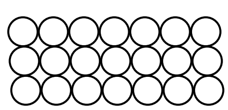
133. Materials in which the atomic order extends uninterrupted over the entirety of the specimen, under some circumstances, they may have flat faces and regular geometric shapes, are called

(a) Anisotropy (b) Crystallography

(c) Single crystals (d) Crystal system

133. Ans: (c)

Sol: **Single crystal:** It is a mono crystalline solid, in which the crystal lattice of the entire sample is continuous, with no grain boundaries.



End of Solution

134. Which material possesses the following properties ?

- Shining white colour with luster
- Soft, malleable and can be drawn into wires
- Poor in conductivity and tensile strength
- Used in making alloys with lead and copper
- Used for fuses and cable sheathing

(a) Silver (b) Tin (c) Nickel (d) Aluminium

134. Ans: (b)

Sol: The properties of tin material

1. White shining colour with lustre
2. Soft, malleable and can be drawn into wires
3. Poor electrical conductivity
4. Good tensile strength

Applications: soldering wires, sheathing, fuses

End of Solution

135. The saturation magnetization for Fe_3O_4, given that each cubic unit cell contains 8 Fe^{2+} and 16Fe^{3+} ions, where Bohr magneton is 9.274×10^{-24} A.m^2 and that the unit cell edge length is 0.839 nm, will be

(a) 1.25×10^5 A/m (b) 5×10^5 A/m (c) 10×10^5 A/m (d) 20×10^5 A/m

135. Ans: (b)

Sol: Given data:

Edge length of unit cell = 0.839×10^{-9} m

Volume of unit cell = $(0.839 \times 10^{-9})^3$ m^3

Magnetic moment per Fe^{2+} ion = 4 Bohr magnetons

Number of Fe^{2+} ions per unit cell = 8

$$M_S = N_{Fe^{2+}} \times 4 \times \mu_B = \left[\frac{8}{(0.839\times10^{-9})^3}\right]\times 4\times(9.27\times10^{-24})$$

$$= 5.0 \times 10^5 \text{ A/m}$$

End of Solution

136. Consider the following applications of the materials:

- Bismuth strontium calcium copper oxide used as a high temperature superconductor
- Boron carbide used in helicopter and tank armour
- Uranium oxide used as fuel in nuclear reactors
- Bricks used for construction

The materials used in these applications can be classified as

(a) Ceramic (b) Constantan (c) Manganin (d) Tantalum

136. Ans: (a)

Sol: **Ceramics:** Ceramics are compounds of metal and non-metals formed by predominantly with ionic bonds.

Examples & uses of ceramics:

(1) Bismuth Strontium calcium copper oxide → high temperature super conductor

(2) Boron carbide → helicopter and tank armour

(3) Uranium oxide → fuel in nuclear reactors

(4) Bricks → construction

End of Solution

137. The saturation flux density for Nickel having density of 8.90 g/cm^3, atomic number 58.71 and net magnetic moment per atom of 0.6 Bohr magnetons is nearly

(a) 0.82 tesla (b) 0.76 tesla (c) 0.64 tesla (d) 0.52 tesla

137. Ans: (c)

Sol: Given data: Ni = 0.60 Bohr magnetron

$\mu_B = 9.27 \times 10^{-24}$ A-m^2, $\mu_0 = 4\pi \times 10^{-7}$ H/m

Density is 8.90 g/ cm^3 = 8.90 × 10^6 g/m^3

$$N_{Ni} = \frac{\rho_{Ni} N_A}{A_{Ni}} = \frac{(8.90\times10^6)\times(6.023\times10^{23})}{58.71}$$

$$= 9.12 \times 10^{28}$$

$$M_S = 0.60.\mu_B.N_{Ni} = 0.60\times(9.27\times10^{-24})\times(9.12\times10^{28})$$

$$= 5.1 \times 10^5 \text{ A/m}$$

$$B_S = \mu_B M_s = (4\pi\times10^{-7})(5.1\times10^5) = 0.64 \text{ Tesla}$$

End of Solution

138. The temperature at which iron ceases to be ferromagnetic and becomes paramagnetic is

(a) Curie –Weiss point (b) Thermo–magnetic point

(c) Ferro-paramagnetic point (d) Curie point

138. Ans: (d)

Sol: The iron is a ferromagnetic material, follows Curie-Weiss law $\chi = \dfrac{C}{T - T_{cw}}$

At Curie-point temperature, the ferromagnetic material convert into paramagnetic material.

Eg: Curie-point temperature of ferromagnetic Iron is 768°C.

End of Solution

139. Fick's laws refer to

(a) Finding whether a semiconductor is *n* or *p* type (b) Diffusion

(c) Crystal imperfections (d) Electric breakdown

139. Ans: (b)

Sol: Fick's law of diffusion:

Diffusion occurs in response to a concentration gradient expressed as the change in concentration due to change in position.

(1) The molecular flux due to diffusion is proportional to the centration gradient.

(2) The rate of change of concentration at a point in space is proportional to the second derivative of concentration with space.

End of Solution

140. A magnetic field applied perpendicular to the direction of motion of a charged particle exerts a force on the particle perpendicular to both the magnetic field and the direction of motion of the particle. This phenomenon results in

(a) Flux effect (b) Hall Effect

(c) Magnetic field effect (d) Field effect

140. Ans: (b)

Sol: Hall effect: A magnetic field applied perpendicular to the direction of motion of charged particle exerts hall voltage perpendicular to both the magnetic field and the direction of motion of particle.

Hall effect method is used to find

1. Type of semiconductor
2. electrical conductors
3. carrier concentration
4. electron mobility

End of Solution

141. An electric kettle is marked 500W, 230V and is found to take 15 minutes to bring 1 kg of water at 15°C to 100°C. If the specific heat of water is 4200 J/kg/°C, the heat efficiency of the kettle will be

(a) 87.3% (b) 83.6% (c) 79.3% (d) 75.6%

141. Ans: (c)

Sol: Heat output $= \dfrac{m \times C_v \times \Delta T}{t}$

C_v = specific heat of water

ΔT = temperature difference

m = mass of water

$\Delta T = 100° - 15° = 85°$

Heat output $= \dfrac{1 \times 4200 \times 85}{15 \times 60}$ J/sec

= 396.66 J/sec

Heat input = 500 W

Heat efficiency $(\eta) = \dfrac{heat\,output}{heat\,input} \times 100$

$= \dfrac{396.66}{500} \times 100 = 0.7933 \times 100 = 79.33\%$

End of Solution

142. With reference to nano materials, the prefix nano stands for

(a) Nano centimetre (b) Nanometre (c) Nano micrometre (d) Nano millimetre

142. Ans: (b)

Sol: **Nanomaterial:** A material having particles (or) constituents of nanoscale dimensions, and at least one dimension of material is in nanorange (or) nonoscale.

Nanoscale = 1 nm to 100 nm

143. Consider the following applications:

- High temperature heat engines
- Nuclear fusion reactors
- Chemical processing industry
- Aeronautical and space industry

Which one of the following materials will be used for these applications?

(a) Zirconia (b) Alumina (c) Ceramic (d) Silicon carbide

143. Ans: (d)

Sol: Applications at silicon carbide :

1. High temperature heat engines
2. Nuclear fussion reactors
3. Chemical processing industry
4. Aeronautical and space industry
5. Metal cutting tools

End of Solution

144. The machine used for the preparation of nano particles of alumina is

(a) Attrition mill (b) Grinding machine

(c) Vending machine (d) Welding machine

144. Ans: (a)

Sol: Attrition Milling Method (or) Ball Milling method is a top-down approach method used to produce nanoparticles from bulk form with a principle of cutting / slicing.

End of Solution

145. If the voltage across an element in a circuit is linearly proportional to the current through it, then it is a

(a) Capacitor (b) Transformer (c) Resistor (d) Inductor

145. Ans: (c)

Sol: $V = IR$

$V \propto R$

In resistor voltage is proportional to current.

End of Solution

146. Thevenin's equivalent circuit consists of

(a) Current source and series impedance (b) Voltage source and series impedance

(c) Voltage source and shunt impedance (d) Current source and shunt impedance

146. Ans: (b)

Sol: Thevenin's theorem states that a linear two-terminal circuit can be replaced by an equivalent circuit consisting of a voltage source V_{th} in series with a resistor R_{th},

End of Solution

147. When the voltage sources are replaced with short circuits and current sources are replaced with open circuits, leaving dependent sources in the circuit, the theorem applied is

(a) Superposition (b) Thevenin (c) Norton (d) Millman

147. Ans: (a)

Sol: In superposition theorem

1. All the ideal voltage sources are eliminated from the network by shorting the sources,
2. All the ideal current sources are eliminated from the network by opening the sources and do not disturb the dependent sources present in the network.

End of Solution

148. The maximum power is delivered from a source to a load when the source resistance is

(a) Greater than the load resistance (b) Equal to zero

(c) Less than the load resistance (d) Equal to the load resistance

148. Ans: (b)

Sol: Maximum power is delivered from a source to a load when the source resistance is minimum. In the given question source resistance is zero.

End of Solution

149. A network delivers maximum power to the load resistance when it is

(a) Greater than Norton's equivalent resistance of the network

(b) Equal to Thevenin's equivalent resistance of the network

(c) Less than source resistance

(d) Less than Norton's equivalent resistance of the network

149. Ans (b)

Sol: A network delivers maximum power to the load resistance when it is Equal to Thevenin's equivalent resistance of the network.

End of Solution

150. The impedance of a parallel circuit is $(10 - j30)\Omega$ at 1 MHz. The values of circuit elements will be

(a) 10Ω and 6.4 mH (b) 100Ω and 4.7 nF

(c) 10Ω and 4.7 mH (d) 100Ω and 6.4 nF

150. Ans (b)

Sol: Given $z = (10 - j30)\ \Omega$

Since parallel circuit

$$y = \frac{1}{z} = \frac{1}{(10-j30)}\frac{(10+j30)}{(10+j30)} = \frac{10+j30}{1000}$$

$$y = \frac{1}{100} + j\frac{3}{100}$$

So, $G = \dfrac{1}{100} \rightarrow R = 100\Omega$

$$B_C = \omega C = \frac{3}{100} \rightarrow C = \frac{3}{100 \times 2\pi \times 1M}$$

$C = 4.7\text{nF}$

End of Solution