ESE - 2020

PRELIMINARY EXAMINATION

Questions with Detailed Solutions

ELECTRONICS & TELECOMMUNICATION ENGINEERING

(SET-C)

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01. Which one of the following is commonly used piezoelectric ceramics?

(a) Yttrium oxide (Y_2O_3) (b) Boron carbide (B_4C)

(c) Barium titanate ($BaTiO_3$) (d) Tungsten carbide (WC)

01. Ans: (c)

Sol: Piezoelectric materials

(1) Barium Titanate ($BaTiO_3$)

(2) Rochelle's salt

(3) Quartz

(4) PVDF

02. The detailed information regarding the mechanism of fracture is available from microscopic examination, normally using scanning electron microscopy, and its study is termed as

(a) Microscopic (b) Fractographic

(c) Atroscopic (d) Nanoscopic

02. Ans: (b)

Sol: Fractography is the study of the fracture surface of material.

03. A transformer core is wound with a coil carrying an alternating current at a frequency of 50Hz. The magnetization is uniform throughout the core volume of 0.01 m^3, the hysteresis loop has an area of 60,000 units when the axes are drawn in units of 10^{-4} Wb m^{-2} and 10^2 A m^{-1} The power loss due to hysteresis will be

(a) 200W (b) 250W (c) 300W (d) 350W

03. Ans: (c)

Sol: Hysteresis loss = Loss/unit × no. of units

Loss/unit = (volume) (f)(B)(H)

$= (0.01)\,(50)(10^{-4})(10^{-2})$

$= 50\times10^{-4}$ watts/unit

Hysteresis loss $= 50\times10^{-4}\times60000$

$= 300$ watts

04. In a 440 V, 50Hz transformer, the total iron loss is 2300 W. When the applied voltage is 220 V at 25 Hz, the total iron loss is 750 W. The eddy current loss at the normal voltage and frequency will be

(a) 1600W (b) 1400W (c) 1200W (d) 1000W

04. Ans: (a)

Sol: 440V, 50Hz, $w_i = 2300w$

220V, 25Hz, $w_i = 750w$

$$B_{max} = \frac{v}{f} = \frac{440}{50} = \frac{220}{25} = \text{const.}$$

$\therefore\ w_i = Af + Bf^2$

$2300 = A(50) + B(50)^2$

$7500 = A(25) + B(25)^2$

$46 = A + 50B$

$30 = A + 25B$

$16 = 25\,B$

$B = 0.64$

$46 = A + 50(0.64)$

$46 = A + 32$

$A = 14$

$\therefore w_i$ at $f\,(50\text{ Hz}) = Af + Bf^2$

$= 14(50) + 0.64)\,(50)^2$

$= 700 + 1600$

$= 2300w$

$w_n = 700w$

$w_e = 1600w.$

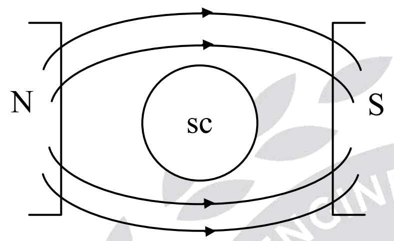
05. Type-I classified superconducting materials on the basis of magnetic response are completely in diamagnetic state where magnetic field is excluded from the body of material due to the phenomenon, known as

(a) Anisotropic effect (b) Meissner effect

(c) Magnetic effect (d) Electrical effect

05. Ans: (b)

Sol: Meissner effect: It is expulsion of magnetic flux lines by the super conductor



06. Which of the following statements are correct for superconductors?

1. A substance losses its electrical resistance below certain temperature.
2. Superconducting elements have greater electrical resistivity at room temperature
3. On adding impurities to superconducting elements its transition temperature is increased

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

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

06. Ans: (a)

Sol: A substance losses its electrical resistance below certain temperature.

Superconducting elements have greater electrical resistivity at room temperature.

On adding impurities to superconducting elements its transition temperature is increased.

So, All statements are correct .

07. Which one of the following is composed of two characteristics: conformity and the unmber of significant figures to which a measurement may be made?

(a) Sensitivity (b) Resolution (c) Accuracy (d) Precision

07. Ans: (a)

Sol: Sensitivity is the only terms which related to both conformity & the number of significant figures.

The most appropriate option is sensitivity.

08. A 1-mA meter movement with an internal resistance of 100Ω is to be converted into a 0-100 mA ammeter. The value of shunt resistance will be

(a) 2.41Ω (b) 2.01Ω (c) 1.41Ω (d) 1.01Ω

08. Ans: (d)

Sol: $I_m = 1\text{mA}$, $R_m = 100\Omega$, $I = 100\text{mA}$

$R_{sh} = ?$

$$R_{sh} = \frac{R_m}{((I/I_m)-1)} = \frac{100}{\left(\frac{100\times10^{-3}}{1\times10^{-3}}-1\right)}$$

$$= \frac{100}{100-1} = \frac{100}{99}$$

$= 1.01\Omega$

09. Which of the following methods are used for producing damping torque in analog instruments?

1. Air friction damping
2. Fluid friction damping
3. Eddy current damping
4. Electromagnetic damping

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

09. Ans: (d)

Sol: In analog Instrument the following dampings are used.

1. Air friction damping
2. Fluid friction damping
3. Eddy current damping
4. Electromagnetic damping

10. Which of the following methods are used for measurement of low resistance?

1. Ammeter voltmeter method
2. kelvin's double bridge method
3. maxwell's bridge method
4. Potentiometer method

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

10. Ans: (b)

Sol: For low Resistance measurement

Kelvin double bridge method and potentiometer is used.

11. A thermometer reads 95.45°C and the static correction given in the correction curve is –0.08°C. The true value of temperature will be

(a) 95.37°C (b) 95.45°C (c) 95.65°C (d) 95.73°C

11. Ans: (a)

Sol: $A_m = 95.45^oC$

$\delta C = -0.08^oC$

$A_t = ?$

$\delta C = A_t - A_m$

$-0.08 = A_t - 95.45$

$A_t = 95.37^oC.$

12. Unit step response of first order system with transfer function $G(s) = \frac{1}{1+\tau s}$ is

(a) $1 - e^{-t/\tau}$ (b) $1 + e^{-t/\tau}$ (c) $1 + e^{t/\tau}$ (d) $1 - e^{t/\tau}$

12. Ans: (a)

Sol: $\frac{C(s)}{R(s)} == G(s) = \frac{1}{1+\tau s}$

$R(s) = 1/s$

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

$C(s) = \frac{1}{s} - \frac{\tau}{\tau(s+1/\tau)}$ Apply $\xrightarrow{\text{ILT}} C(t) = (1 - e^{-t/\tau})u(t)$

13. What are the advantages of resistance potentiometer

1. They are inexpensive

2. They are useful for measurement of large amplitudes of displacement

3. Their electrical efficiency is very high and they provide sufficient output to permit control operations without further amplification

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

13. Ans: (d)

Sol: Resistance potentiometers are cheap & simple to operate

Resistive potentiometers are useful for measurement of large amplitudes of displacement.

Resistive potentiometers have very high electrical efficiency & provide sufficient output to permit control operations without further amplifications.

14. What are the salient features of thermistors?

1. They are compact, rugged and inexpensive

2. They have good stability when properly aged

3. The response time of thermistors can vary from a fraction of a second to minutes, depending on the size of the detecting mass and thermal capacity of the thermistor

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

14. Ans: (d)

Sol: The thermistors are compact, rugged and inexpensive.

Thermistors have good stability when properly aged.

The response time of thermistors depending on the size of the detecting mass & thermal capacity of the thermistor.

15. Which of the following land line telemetry systems are available ?

1. Voltage telemetry systems

2. Current telemetry systems

3. Position telemetry systems

4. Resistive telemetry systems

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

15. Ans: (a)

Sol: The landline telemetry systems available are voltage, current and position.

16. A platinum thermometer has a resistance of 100Ω at 25°C. The resistance at 65°C for its resistance temperature co-efficient of 0.00392/°C will be nearly

(a) 107.3Ω (b) 115.7Ω (c) 123.3Ω (d) 131.7Ω

16. Ans: (b)

Sol: $R_1 = 100\ \Omega$ at $T_1 = 25^oC$

R_2 at $T_2 = 65^oC$

$\alpha = 0.00392(1/^oC)$

$R_2 = R_1(1 + \alpha(T_2 - T_1))$

$= 100\ (1 + 0.00392(65 - 25))$

$= 115.68\ \Omega$

$\cong 115.7$

17. The capacitive transducer works on the principle of change of capacitance which may be caused by change in

1. Dielectric constant
2. Overlapping area of plates
3. Distance between the plates

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

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

17. Ans: (d)

Sol: (i) Capacitance change due to changes in dielectric constant

$C\ \alpha\ \varepsilon$

(ii) Capacitance change due to changes in overlapping area of plates

$C\ \alpha\ A$

(iii) Capacitance change due to changes in distance between the plates

$$C\alpha\frac{1}{d}$$

18. What are the advantages of capacitive transducers?

1. They are extremely sensitive
2. They have a high input impedance and therefore the lading effects are minimum
3. They have a good frequency response

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

18. Ans: (d)

Sol: Advantages of capacitive transducers are

(i) High sensitivity

(ii) Good frequency response

(iii) High input impedance so minimum loading effect.

19. What are the properties of a tree in a network graph?

1. It consists of all the nodes of the graph
2. If the graph as N number of nodes, the tree will have (N–1) branches
3. There will be only one closed path in the tree

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

19. Ans: (c)

Sol: Properties of Tree:

1. It contains all nodes in the graph
2. The number of twigs (branches of tree)

$$= (N - 1)$$

$$N = \text{Number of nodes}$$

3. No closed path shall occur

20. Which one of the following is the property of incidence matrix?

(a) Determinant of the incidence matrix of a closed loop is zero

(b) The number of independent node pair terminal is equal to the number of tree branches

(c) Algebraic sum of the row entries of an incidence matrix is zero

(d) Algebraic sum of the column entries of an incidence matrix is always one

20. Ans: (a)

Sol: Properties of Incidence Matrix (A)

1. The sum of the entries in any column is zero
2. The determinant of the incidence matrix of a closed loop is zero
3. The rank of the incidence matrix of a connected graph is (n – 1)

21. The Laplace transform of a function f(t) is $F(s)=\frac{s+2}{(s+2)^2+10^2}$. The value of f(0) will be

(a) –1 (b) 0 (c) 1 (d) 2

21. Ans: (c)

Sol: $F(s)=\frac{s+2}{(s+2)^2+10^2}$

$$F(s)=\frac{s+2}{s^2+4s+104}$$

$$f(0)=\underset{s\to\infty}{\text{Lt}}\, sF(s)=\underset{s\to\infty}{\text{Lt}}\frac{s(s+2)}{s^2+4s+104}$$

$$=\underset{s\to\infty}{\text{Lt}}\frac{s^2+2s}{s^2+4s+104}=\underset{s\to\infty}{\text{Lt}}\frac{s^2(1+2/s)}{s^2(1+4/s+104/s^2)}=1$$

22. A function, in Laplace domain is given by $F(s)=\frac{2}{s}-\frac{1}{s+3}$

Its value by final value theorem in t domain will be

(a) $\lim_{t\to\infty} f(t)=3$ (b) $\lim_{t\to\infty} f(t)=2$ (c) $\lim_{t\to\infty} f(t)=1$ (d) $\lim_{t\to\infty} f(t)=4$

22. Ans: (b)

Sol: $F(s)=\frac{2}{s}-\frac{1}{s+3}$

Apply ILFT f(t) = $(2-e^{-3t})$

$$\underset{t\to\infty}{\text{Lt}}\, f(t)=\underset{t\to\infty}{\text{Lt}}\left(2-e^{-3t}\right)=2$$

23. Consider the following experimental readings for a two-port network:

	V_1	V_2	I_1	I_2
Output Open	100V	60V	10 A	0
Input Open	30V	40V	0	3A

The values of Z_{11}, Z_{12}, Z_{21}, and Z_{22}, respectively are

(a) 10Ω, 10Ω, 6Ω and 13.33Ω
(b) 6Ω, 10Ω, 10Ω and 6Ω
(c) 10Ω, 6Ω, 10Ω and 13.33Ω
(d) 6Ω, 10Ω, 6Ω and 10Ω

23. Ans: (a)

Sol: For Z-Parameters

$$V_1 = Z_{11}I_1 + Z_{12}I_2$$

$$V_2 = Z_{21}I_1 + Z_{22}I_2$$

When $I_2 = 0$, $Z_{11} = \frac{V_1}{I_1} = \frac{100}{10} = 10\Omega$

$$Z_{21} = \frac{V_2}{I_1} = \frac{60}{10} = 6\Omega$$

When $I_1 = 0$, $Z_{22} = \frac{V_2}{I_2} = \frac{40}{3} = 13.33\Omega$

$$Z_{12} = \frac{V_1}{I_2} = \frac{30}{3} = 10\Omega$$

$Z_{11} = 10\Omega$, $Z_{12} = 10\Omega$, $Z_{21} = 6\Omega$, $Z_{22} = 13.33\Omega$

24. The Laplace transform of $f(t) = 1 - e^{-2t}$ is

(a) $\frac{2}{s(s+2)}$
(b) $\frac{1}{s(s+2)}$
(c) $\frac{2}{s(s-2)}$
(d) $\frac{1}{s(s-2)}$

24. Ans: (a)

Sol: L.T of $f(t) = 1 - e^{-2t}$ is

$$F(s) = \frac{1}{s} - \frac{1}{s+2} = \frac{2}{s(s+2)}$$

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25. For a two-port network, condition of Symmetry in terms of z-parameters is

(a) $z_{12} = z_{21}$ (b) $z_{11} = z_{22}$ (c) $z_{11} = z_{21}$ (d) $z_{12} = z_{22}$

25. Ans: (b)

Sol: Condition for symmetry $z_{11} = z_{22}$

26. For a two-port network, the condition of Reciprocity in terms of h-parameter is

(a) $h_{12} = h_{21}$ (b) $h_{12} = h_{22}$ (c) $h_{12} = -h_{21}$ (d) $h_{12} = -h_{22}$

26. Ans: (c)

Sol: Condition for reciprocity

$h_{12} = -h_{21}$

27. The initial current is $i(0^+)$, clockwise and the circuit current being i(t) and $v(f) = L\frac{di(t)}{dt}$

The above representation in Laplace transform is

(a) $V(s) = [sLI(s) - Li(0^+)]$ (b) $V(s) = [sLI(s)]$

(c) $V(s) = [Li(0^+)]$ (d) $V(s) = [sLI(0^+) + Li(s)]$

27. Ans: (a)

Sol: $V(t) = L\frac{di(t)}{dt}$

Laplace transform

$V(s) = L[sI(s) - i(0^+)]$

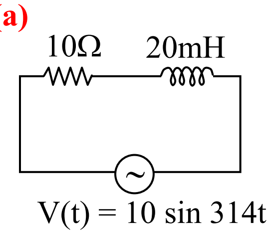
$V(s) = LsI(s) - L\,i(0^+)$

28. In a series R-L circuit, R is 10Ω and L is 20mH, if the circuit current is 10 sin 314 tA, the phase angle θ between v and i will be

(a) $\tan^{-1}(0.2\pi)$ (b) $\tan^{-1}(0.4\pi)$ (c) $\tan^{-1}(0.6\pi)$ (d) $\tan^{-1}(0.8\pi)$

28. Ans: (a)

Sol:



Phase angle $\phi = \tan^{-1}\left(\frac{\omega L}{R}\right) = \tan^{-1}\left(\frac{314 \times 20 \times 10^{-3}}{10}\right)$

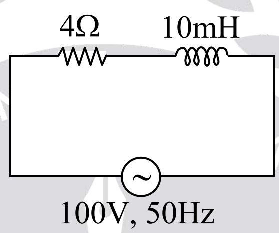
$= \tan^{-1}(0.2 \times 3.14)$

$= \tan^{-1}(0.2\,\pi)$

29. A 4Ω resistor is connected in series with a 10 mH inductor, across a 100V, 50Hz voltage source. The impedance of the circuit will be

(a) 5 – j3.14 (b) 5 + j3.14 (c) 4 – j3.14 (d) 4 + j3.14

29. Ans: (d)



Sol: $X_L = \omega L$

$= 2\pi f L$

$Z = R + jX_L$

$X_L = 2\pi(50)\,(10) \times 10^{-3} = \pi = 3.14$

$Z = (4 + j3.14)\Omega$

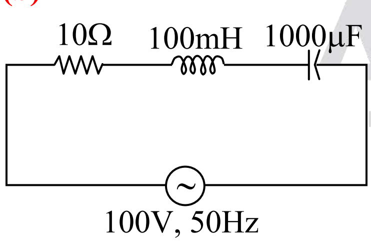
30. A 100V, 50Hz a.c. supply is applied across a series RLC circuit having R = 10Ω, L = 100 mH and C = 1000μF. The current through the circuit will be

(a) 4.33 ∠ –70.5°A (b) 3.33 ∠ –70.5°A

(c) 2.33 ∠ –50.5°A (d) 1.33 ∠ –50.5°A

30. Ans: (b)

Sol:



$Z = R + j(X_L - X_C)$

$X_L = \omega L = 2\pi(50)\,100 \times 10^{-3}$

$= 10\pi\ \Omega$

$X_C = \frac{1}{\omega C} = \frac{10^6}{2\pi(50) \times 1000} = \frac{10}{\pi}\Omega$

$$Z = 10 + j\left(10\pi - \frac{10}{\pi}\right) = 29.9\angle 70.5^\circ$$

$|Z| = 29.9 = 29.9\angle 70.5°$

$$I = \frac{V}{Z} = \frac{100\angle 0°}{29.9\angle 70.5^\circ}$$

$I = 3.33\ \angle{-70.5}^\circ\ A$

31. If any root of the characteristic equation has a positive real part or if there is a repeated root on the jω-axis, then the system is

(a) Limitedly stable (b) Conditionally stable

(c) Stable (d) Unstable

31. Ans: (d)

Sol: For positive real part of roots (or) repeated roots on jω-axis, the system is unstable.

32. The angle of departure from a real open-loop pole and the angle of arrival at a real open-loop zero is always equal to

(a) 0° only (b) 90° only (c) 180° only (d) 0° or 180°

32. Ans: (d)

Sol: The angle of departure of a real pole and the angle of arrival of a real zero is equal to 0° or 180°.

33. The important aspects in the study of feedback systems are to control

1. Sensitivity
2. Effect of an internal disturbance
3. Distortion in a nonlinear system

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

33. Ans: (d)

Sol: Main aim of feedback control system (–ve feedback) is to desensitize the forward path parameter such that the overall output is insensitive to internal disturbance and to improve linearity of the system.

34. In a type-1, second-order system, the first undershoot occurs at a time t (with standard notations) is

(a) $\frac{\pi}{\omega_d}$ (b) $\frac{2\pi}{\omega_d}$ (c) $\frac{\pi}{2\omega_d}$ (d) $\frac{2\omega_d}{\pi}$

34. Ans: (b)

Sol: $t_p = \frac{2\pi}{\omega_d}$ sec

35. The compensator required to improve the steady state response of a system is

(a) Lag (b) Lead (c) LAg-lead (d) Zero

35. Ans: (a)

Sol: Lag compensator improves steady state performance.

36. Which one of the following types of controller is sometimes called automatic reset?

(a) Proportional (b) Integral (c) Derivative (d) PID

36. Ans: (b)

Sol: Integral controller is called reset controller.

37. The transfer time T of the disk is

(a) $\frac{2b}{rN}$ (b) $\frac{rb}{N}$ (c) $\frac{rN}{b}$ (d) $\frac{b}{rN}$

Where: b = Number of bytes to be transferred

N = Number of bytes on a track

r = Rotation speed in rps

37. Ans: (d)

Sol: Rotation speed:

* r Revolutions in one second then one revolution in $\frac{1}{r}$ second

Data Transfer Rate (DTR) = $\left(\frac{\text{Number of bytes on a track}}{\text{one revolution time}}\right)$

$$DTR = \frac{N\,\text{bytes}}{1/r\,\text{second}} = Nr\,\text{bytes/sec}$$

$$\text{Transfer time (T)} = \left(\frac{\text{Number of bytes to be transferred}}{DTR}\right)$$

$$T = \frac{b\,\text{bytes}}{Nr\,\text{bytes/sec}} = \frac{b}{Nr}\,\text{sec}$$

38. A core of processor chip consists of

1. ALU
2. Instruction logic
3. Load/store logic
4. L3 cache
5. L1 data cache

(a) 1, 2, 3 and 4 only (b) 1, 2, 3 and 5 only

(c) 2, 3, 4 and 5 only (d) 1, 4 and 5 only

38. Ans: (b)

Sol: * L_1(Level-1) cache memory usually built onto the microprocessor chip itself

* L_2 and L_3 cache are external cache

39. Which of the following will cause internal interrupt to CPU?

1. Stack overflow
2. Attempt to divide by zero
3. I/O device finished transfer of data
4. Power failure

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

39. Ans: (a)

Sol: Internal interrupts to CPU are called traps or exceptions

Stack overflow and divide by zero are run time exceptions

Power failure and I/O devices causes external interrupt

40. In an assembly language program

END

is a/an

(a) Machine instruction (b) Pseudo instruction

(c) Micro instruction (d) Interrupt

40. Ans: (b)

Sol: END is Pseudo instruction, declare end of an assembly program

Pseudo instructions are special commands to the assembler about the positioning of the program

41. Booth algorithm is associated with

(a) Binary division

(b) Binary integer multiplication

(c) Sorting binary integers

(d) Searching of binary data

41. Ans: (b)

Sol: Booth algorithm is associated with Binary integer multiplication

42. The memory that communicates directly with CPU is called

(a) Auxiliary memory (b) USB storage

(c) Main memory (d) Micro-program memory

42. Ans: (c)

Sol: Main memory communicates directly with CPU

43. Virtual memory is normally implemented by

(a) Demand paging (b) Buses

(c) Device drivers (d) Bus matrix

43. Ans: (a)

Sol: Virtual memory is commonly implemented by demand paging

44. Which of the following are the computer memory performance parameters?

1. Access time (Latency)
2. Memory cycle time
3. Transfer rate

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

44. Ans: (d)

Sol: The computer memory performance parameters are Access time, memory cycle time & Transfer rate

45. What are the components of a memory management unit

1. A facility for dynamic storage relocation
2. Provision for preventing users for sharing programs stored in memory by different users
3. Protection of information against unauthorized access
4. Provision for users for changing operating system functions

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

45. Ans: (a)

46. Which one of the following makes permanently recorded transaction in the database?

(a) View (b) Commit (c) Roll back (d) Flash back

46. Ans: (b)

Sol: Commit is used to commit the transaction

47. The advantage of optimistic locking is

(a) The lock is obtained only after the transaction has processed

(b) The lock is obtained only before the transaction has processed

(c) The lock never needs to the obtained

(d) The lock transaction are best suited with a lot of activity

47. Ans: (a)

Sol: The advantage of optimistic locking is the lock is obtained only after the transaction has processed

48. The ability to query information from the database, insert, delete and modify the tuples is

(a) Data Definition Language (DDL) (b) Data Manipulation Language (DML)

(c) Storage Definition Language (SDL) (d) Relational Schema

48. Ans: (b)

Sol: Insert, delete & modify tuples comes under Data manipulation language

49. In a pair of straight parallel bus bars of circular cross-section spaced 23 cm between centres, each carry a current of 70,000 A. The force required to withstand will be nearly

(a) 4,800 N/m (b) 4,620 N/m (c) 4,440 N/m (d) 4260 N/m

49. Ans: (d)

Sol: Force between two parallel conductors,

$$F = \frac{\mu_0}{2\pi} \times \frac{I_1 I_2}{d}$$

$$= \frac{4\pi \times 10^{-7}}{2 \times \pi} \times \frac{70000 \times 70000}{23 \times 10^{-2}}$$

= 4260.86 N/m

50. Consider the following two points

M (2, 5, –3) and N (–3, 1, 4)

The distance from the origin to the mid-point of the line MN will be nearly

(a) 3.1 units (b) 2.3 units (c) 1.5 units (d) 0.7 units

50. Ans: (a)

Sol: Given: M(2, 5, –3) to N (–3, 1, 4)

$$\text{midpoint} \left(\frac{2-3}{2}, \frac{5+1}{2}, \frac{-3+4}{2}\right) = (-0.5, 3, 0.5)$$

distance from (0,0,0) to (–0.5, 3, 0.5)

$$d = \sqrt{(-0.5)^2 + (3)^2 + (0.5)^2}$$

$d \approx 3.1$ units

51. Consider $\vec{D} = 10x\bar{a}_x - 4y\bar{a}_y + kz\bar{a}_z \mu C/m^2$ and $\vec{B} = 2\vec{a}_y \, mT$, to satisfy the Maxwell's equation for region $\sigma = 0$ and $\rho_v = 0$, the value of k will be

(a) $-8\ \mu C/m^3$ (b) $-6\ \mu C/m^3$ (c) $-4\ \mu C/m^3$ (d) $-2\ \mu C/m^3$

51. Ans: (b)

Sol: Given: $\vec{D} = 10x\hat{a}_x - 4y\hat{a}_y + kz\hat{a}_z \ \mu C/m^2$

For the charge-free ($\rho_v = 0$) medium,

Maxwell's equation , $\nabla.\vec{D} = 0$

$$\frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z} = 0$$

$\Rightarrow 10 - 4 + k = 0$

$\therefore\ k = -6\ \mu C/m^3$

52. A 4-pole, wave wound armature having 45 slots with 18 conductors/slot is driven at 1200 rpm. If the flux per pole is 0.016 Wb, the generated emf will be

(a) 534.4 V (b) 526.8 V (c) 518.4 V (d) 502.8 V

52. Ans: (c)

Sol: P = 4, S = 45 } Z = 45×18 = 810

(wave) Z = 18rad/slot

N = 1200 rpm

$\phi = 0.016$ Wb

$$Eg = \frac{\phi ZNP}{60A} = \frac{(0.016)(810)(1200)4}{60 \times 2}$$

$= 518.4V.$

53. For a terminated uniform transmission line, the impedance Z_x at a distance x from the load will be

(a) $Z_0 \dfrac{Z_L + Z_0 \tanh \gamma x}{Z_0 + Z_L \tanh \gamma x} \Omega$ (b) $Z_L \dfrac{Z_L + Z_0 \tanh \gamma x}{Z_0 + Z_L \tanh \gamma x} \Omega$

(c) $Z_0 \dfrac{Z_L + jZ_0 \tanh \gamma x}{Z_0 + jZ_L \tanh \gamma x} \Omega$ (d) $Z_L \dfrac{Z_L + jZ_0 \tanh \gamma x}{Z_0 + jZ_L \tanh \gamma x} \Omega$

Where: Z_0 = Characteristic impedance of line, Ω

Z_L = Load impedance, Ω

γ = Propagation constant = α + jβ, m^{-1}

α = Attenuation constant, Np m^{-1}

β = Phase constant, rad m^{-1}

53. Ans: (a)

Sol: On a long transmission line the impedance at any position 'x' from the load is given by

$$Z(x) = Z_0\left(\frac{Z_L + Z_0 \tan h\gamma x}{Z_0 + Z_L \tan h\gamma x}\right)\Omega$$

54. The depth of penetration δ of a plane electromagnetic wave incident normally on a good conductor is

(a) $\frac{1}{\sqrt{2\pi f\mu\sigma}}$

(b) $\frac{1}{\sqrt{\pi f\mu\sigma}}$

(c) $\frac{2}{\sqrt{3\pi f\mu\sigma}}$

(d) $\frac{2}{\sqrt{\pi f\mu\sigma}}$

Where: f = Frequency in Hz

σ = Conductivity in Siemens per meter

54. Ans: (b)

Sol: In a good conductor, the attenuation constant 'α' is given by

$$\alpha = \sqrt{\frac{\omega\mu\sigma}{2}}$$

Skin depth (or) depth of penetration is of plane em wave is given by

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

(or)

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

55. A rectangular waveguide is 5.1 cm by 2.4 cm (inside measurement). The cutoff frequency of the dominant mode will be nearly

(a) 5.38 GHz (b) 4.54 GHz

(c) 3.78 GHz (d) 2.94 GHz

55. Ans: (d)

Sol: Given: wave guide dimension,

$a = 5.1$ cm

$b = 2.4$ cm

Cut off frequency of dominant mode is given by

$$f_c(TE_{10}) = \frac{c}{2a} = \frac{3\times10^{10}}{2\times5.1}$$

≈ 3 GHz (or) 2.94 GHz

56. If aperture efficiency is 70%, the directivity D of a parabolic dish antenna as a function of its radius is

(a) $20\left(\frac{r}{\lambda}\right)^2$ (b) $28\left(\frac{r}{\lambda}\right)^2$

c) $36\left(\frac{r}{\lambda}\right)^2$ (d) $44\left(\frac{r}{\lambda}\right)^2$

56. Ans: (b)

Sol: $G = \frac{4\pi}{\lambda^2}\eta A$

$$= \frac{4\pi}{\lambda^2}\times0.7\times\pi r^2$$

$$= 4\times0.7\times\pi^2\times\left(\frac{r}{\lambda}\right)^2$$

$$\approx 28\left(\frac{r}{\lambda}\right)^2$$

57. An antenna radiates isotropically over a half-space above a perfectly conducting flat ground plane. If E = 50 mV m^{-1} rms at a distance of 1 km and the antenna terminal current I = 3.5 A, the radiation resistance will be

(a) 3.4 Ω (b) 4.3 Ω (c) 5.2 Ω (d) 6.1 Ω

57. Ans: (a)

Sol: Given :

E_{rms} = 50 mV/m

r = 1km

I = 3.5A

Average poynting vector $S_{avg} = \frac{E_{rms}^2}{\eta_0} = \frac{(50\times10^{-3})^2}{120\pi}$

Power radiated above the conducting flat ground plane is

$$P_{rad} = \oiint \overline{S}_{avg}.\overline{dA}$$

$$\therefore\ P_{rad} = \int_{\theta=0}^{\pi/2}\int_{\phi=0}^{2\pi} S_{avg} r^2 \sin\theta d\theta d\phi$$

$$= \int_{\theta=0}^{\pi/2}\int_{\phi=0}^{2\pi} \frac{(50\times10^{-3})^2}{120\pi}\times(1\times10^3)^2 \sin\theta d\theta d\phi$$

$$= \frac{(50)^2}{120\pi}\left(-\cos\theta\Big|_0^{\pi/2}\right)\left(\phi\Big|_0^{2\pi}\right)$$

$$= \frac{(50)^2}{120\pi}\times(1)\times(2\pi)$$

$$P_{rad} = \frac{(50)^2}{60}$$

∴ Power radiated $P_{rad} = I^2 R_{rad}$

$$\therefore\ R_{rad} = \frac{P_{rad}}{I^2}$$

$$\therefore R_{rad} = \frac{(50)^2}{60(3.5)^2} = 3.4\Omega$$

58. Which one of the following is the correct relationship between an antenna gain G and an effective area A_e?

(a) $G = \frac{4\pi f^2 A_e}{c^2}$ (b) $G = \frac{3\pi f^2 A_e}{c^2}$ (c) $G = \frac{2\pi f^2 A_e}{c^2}$ (d) $G = \frac{0.5\pi f^2 A_e}{c^2}$

Where: f = Carrier frequency

c = Speed of light

58. Ans: (a)

Sol: The directive gain 'G' and effective area of antenna is given by

$$G = \left(\frac{4\pi}{\lambda^2}\right) A_e$$

Let $\lambda = \frac{c}{f}$

$$G = \frac{4\pi f^2}{c^2} A_e$$

59. The signal-to-noise ratio $\frac{S}{N}$ for isotropic antenna is

(a) $\frac{\lambda^2}{16\pi^2 r^2 kT_{sys} B}$ (b) $\frac{\lambda^2}{14\pi^2 r^3 kT_{sys} B}$ (c) $\frac{\lambda^2}{12\pi^2 r^4 kT_{sys} B}$ (d) $\frac{\lambda^2}{10\pi^2 r^4 kT_{sys} B}$

Where: λ = Wavelength, m

r = Distance from transmitter to receiver, m

T_{sys} = System temperature, K

B = Bandwidth, Hz

k = Boltzmann's constant

59. Ans: (a)

Sol: The SNR for an isotropic antenna is given as

$$SNR = \frac{\text{power received}}{kT_{sys} B} = \frac{P_t G_t G_r \lambda^2}{(4\pi R)^2 kT_{sys} B} = \frac{\lambda^2}{(4\pi R)^2 kT_{sys} B}$$

For isotropic antenna P_t=1, G_t=1, G_r=1

$$\therefore \; SNR = \frac{\lambda^2}{16\pi R^2 kT_{sys} B}$$

60. Consider a cube defined by

x, y, z = [1, 3]

If vector, $A = 2x^2ya_x + 3x^2y^2a_y$,

$V.\vec{A}$ at the centre of the cube will be

(a) 72 (b) 64 (b) 60 (c) 48

60. Ans: (b)

Sol: Given: $\vec{A} = 2x^2y\hat{a}_x + 3x^2y^2\hat{a}_y$

Cube: $x,y,z \in [1,3]$

$\nabla.\vec{A} = 4xy + 6x^2y$

$\nabla.\vec{A}$ at the center of the cube i.e. at x,y,z=2

$\nabla.\vec{A} = 4(2)(2) + 6(2)^2(2) = 16 + 48 = 64$

61. Which of the following steps are followed by HIS during synthesis?

1. Data model generation
2. Data flow analysis
3. Scheduling and allocation
4. Data path optimization
5. Control optimization

(a) 1, 3 and 5 only

(b) 2, 4 and 5 only

(c) 1, 2, 3 and 4 only

(d) 1, 2, 3, 4, and 5

61. Ans: (a)

Sol: The steps followed by HIS during synthesis are

1. Data Model generation

3. Scheduling and allocation

5. Control optimization

62. Pipelining

1. Reduces clock period of long combinational operations

2. Allows large combinational functions to be broken down into pieces whose delays are balanced with the rest of the system components

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

62. Ans: (c)

Sol: Pipelining reduces clock period of long combinational operations & allows large combinational functions to be broken down into pieces whose delays are balanced with the rest of the system components

63. Superscalar processor consists of

(a) Single pipeline for instruction execution

(b) Multiple-instruction pipelines for instruction execution

(c) No pipelines for instruction execution

(d) Multiple combination of hardware for execution

63. Ans: (b)

Sol: Superscalar processors consists of multiple-instruction pipeline for instruction execution

64. Which of the following statements is/are correct ?

1. In hybrid parameter representation, both short and open circuit terminal conditions are utilized.

2. The voltage of output port and the current of input port are expressed in terms of current of output and voltage of input port.

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

64. Ans:(a)

Sol: 1. Hybrid parameters

Independent variables (I_1, V_2)

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

$$I_2 = h_{21}I_1 + h_{22}V_2$$

Dependent variables (V_1, I_2)

2. g-parameters

Independent variables

$I_1 = g_{11}V_1 + g_{12}I_2$

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

Dependent variables

65. Consider the following measurements on a two terminal network:

1. When a voltage of $100\angle 0°$ volts applied at input port with output port open, $I_1 = 20\angle 0°$ A and $V_2 = 25\angle 0°$ V

2. When a voltage of $100\angle 0°$ volts applied at output port with input port open, $I_2 = 10\angle 0°$ A and $V_1 = 50\angle 0°$ V

The driving point impedances Z_{11}, Z_{22} and transfer impedances Z_{21}, Z_{12} respectively are

(a) 5 Ω, 10 Ω and 1.25 Ω, 5 Ω

(b) 10 Ω, 5 Ω and 1.25 Ω, 5 Ω

(c) 5 Ω, 1.25 Ω and 5 Ω, 10 Ω

(d) 10 Ω, 1.25 Ω and 5 Ω, 5 Ω

65. Ans: (a)

Sol: 1. $V_1 = 100\angle 0°$, $I_1 = 20\angle 0°$A, $V_2 = 25\angle 0°$ when $I_2 = 0$

$$Z_{11} = \frac{V_1}{I_1} = \frac{100}{20} = 5\Omega$$

$$Z_{21} = \frac{V_2}{I_1} = \frac{25}{20} = 1.25\Omega$$

2. $V_2 = 100\angle 0°$, $I_2 = 10$A, $V_1 = 50\angle 0°$ when $I_1 = 0$

$$Z_{22} = \frac{100\angle 0°}{10\angle 0°} = 10\Omega\left(\frac{V_2}{I_2}\right)$$

$$Z_{12} = \frac{V_1}{I_2} = \frac{50\angle 0^\circ}{10\angle 0^\circ} = 5\Omega$$

$Z_{11} = 5\Omega$, $Z_{22} = 10\Omega$, $Z_{21} = 1.25\Omega$, $Z_{12} = 5\Omega$

66. In a second order digital notch filter having notch frequency of 60 Hz and a 3-dB notch bandwidth of 6 Hz and sampling frequency employed is 400 Hz. The normalized angular notch frequency ω_0 and the normalized angular 3-dB bandwidth $\Delta\omega_{3dB}$ are

(a) 0.3π and 0.03π (b) 0.6π and 0.03π

(c) 0.3π and 0.06π (d) 0.6π and 0.06π

66. Ans: (a)

Sol: notch frequency = 60Hz 3dB notch BW = 6Hz

f_0 $f_s = 400\text{Hz}$

Normalised angular notch frequency $\omega_0 = \frac{2\pi f_0}{f_s} = \frac{2\pi(60)}{400}$

$$= \frac{120\pi}{400} = \frac{3\pi}{10} = 0.3\pi$$

normalised angular 3-dB B.W

$$\Delta\,\omega_{3dB} = \frac{2\pi(6)}{400} = \frac{12\pi}{400} = \frac{3\pi}{100} = 0.03\pi$$

67. The two channel bank with multirate digital filter structure that employs two decimators in the signal analysis section and two interpolators in the signal synthesis section is called

(a) Multirate signal processing bank

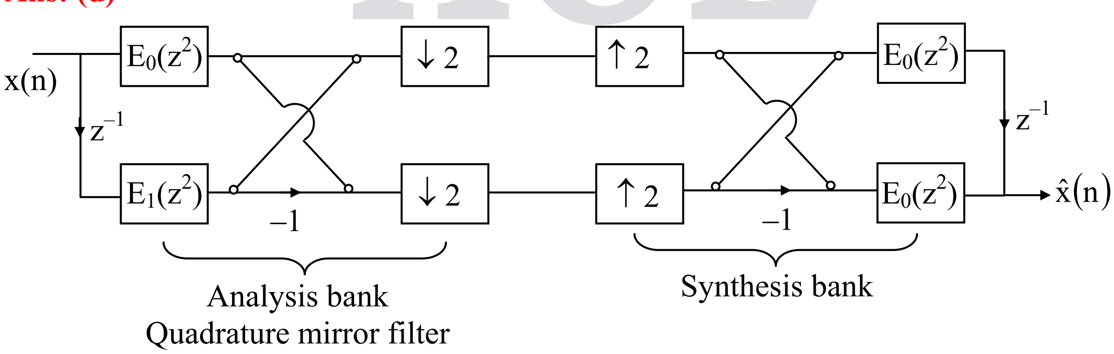
(b) Sub-coding and analysis bank

(c) Sub-band speech coder bank

(d) Quadrature mirror filter bank

67. Ans: (d)

Sol:



68. Which of the following are the advantages of digital filters over analog filters ?

1. Highly flexible
2. Portable
3. Negligible noise interference
4. Lumped RLC components

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

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

68. Ans: (a)

69. The realization of a length M FIR filter for a linear phase structure, the number of multipliers required is

(a) $\left[\frac{M+1}{2}\right]$ (b) 2M (c) M (d) M – 1

69. Ans: (a)

Sol: To realise a length M FIR filter for a linear phase structure, the number of multipliers required is

$\frac{M+1}{2}$ for odd length

$\frac{M}{2}+1$ for even length

70. Which one of the following statements is not correct regarding a usage of virtual memory ?

(a) To free user programs from the need to carryout storage allocation and to permit efficient sharing of the available memory space among different users

(b) To make program independent of the configuration and capacity of the physical memory for their execution.

(c) to achieve higher CPU performance

(d) To achieve the very low access time and cost per bit that is possible with a memory hierarchy

70. Ans: (c)

Sol: Virtual memory is not used to improve CPU performance. It is used for memory management to run larger programs with small memory.

71. In the 8051 microcontroller, direct addressing mode is used in

(a) Internal data memory
(b) External data memory
(c) Internal program memory
(d) External program memory

71. Ans: (a)

Sol: Direct addressing mode is only used for internal RAM [i.e., internal data memory]

Eg:- MOV A, 30H

72. PUSH and POP operations are performed by

(a) Program counter register
(b) General purpose register
(c) Stack pointer register
(d) Link register

72. Ans: (c)

Sol: PUSH and POP operations are performed by stack pointer register.

73. Network Interface Card (NIC) has a unique six-byte permanent address as

(a) IP address
(b) MAC address
(c) DNS address
(d) Local address

73. Ans: (b)

Sol: The MAC address is a six-byte number or 12-digit hexadecimal number that is used to uniquely identity a host on a network.

74. The data-link layer is responsible for

(a) Incoming bit stream and simply repeats to other devices connected
(b) An error free communication across the physical link connecting primary and secondary stations within a network
(c) An end-to-end integrity of data message propagated through the network between two devices
(d) Logical connection at application layer

74. Ans: (b)

Sol: In HDLC, primary to secondary using Hub polling. HDLC is an example for data link layer

75. The transmit carrier frequency f_t and receive carrier frequency f_r for AMPS channels-3 are nearly

(a) 875 MHz and 870 MHz (b) 825 MHz and 870 MHz

(c) 875 MHz and 830 MHz (d) 825 MHz and 830 MHz

75. Ans: (b)

Sol: The mobile transmit frequency $f_t = (0.03N + 825)$ MHz

$f_t = (0.09 + 825)$ MHz

$f_r = f_t + 45$MHz

for channel 3

$f_t = 825.09$MHz

$f_r = 870.09$MHz

76. Which one of the following mode is called a two-way simultaneous, communication between two stations ?

(a) Simplex (SX)

(b) Half duplex (HDX)

(c) Full duplex (FDX)

(d) Full/Full duplex (F/FDX)

76. Ans: (c)

Sol: In full duplex mode, both stations can transmit and receive simultaneously.

77. Blocked calls may be handled in one of two ways. First blocked calls can be put in a queue awaiting a free channel. This is termed as

(a) Lost Calls Cleared (LCC)

(b) Lost Calls Delayed (LCD)

(c) Lost Calls Held (LCH)

(d) Lost Calls Hand off

77. Ans: (b)

Sol: Blocked calls may be handled in one of two ways. First blocked calls can be put in a queue awaiting a free channel is called as lost calls delayed. Although, in fact the call is not lost merely delayed. Second it can be rejected & dropped

78. Satellite communication among stations in different areas can be achieved if the satellite has the ability to switch time slots from one beam to another. This is known as satellite switched

(a) TDMA (b) TSMA (c) FAMA (d) SCPC

78. Ans: (a)

79. A coherent binary phase shift keyed (BPSK) transmitter operates at a bit rate of 20 Mbps. For a probability of error P(e) of 10^{-4}, the ratio $\frac{C}{N} = 8.8\text{dB}$, the minimum theoretical $\frac{E_b}{N_0}$ ratio for a receiver bandwidth equal to the minimum double-sided Nyquist bandwidth will be

(a) 4.8 dB (b) 6.4 dB

(c) 8.8 dB (d) 10.4 dB

79. Ans: (c)

Sol: With BPSK, the minimum BW is equal to the bit rate 20 MHz. The minimum $\frac{C}{N}$ is 8.8dB for a

$P_e = 10^{-4}$

$$\left(\frac{E_b}{N_0}\right)\text{dB} = \left(\frac{C}{N}\right)\text{dB} + \left(\frac{BW}{R_b}\right)\text{dB}$$

$$\left(\frac{E_b}{N_0}\right)\text{dB} = \left(\frac{C}{N}\right)\text{dB} = 8.8\text{dB}.$$

80. For a total transmit power (P_t) of 1000W and for a transmission rate of 50 Mbps, the energy per bit (E_b) will be

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

80. Ans: (b)

Sol: $P_t = 1000\text{W}$

$R_b = 50$ Mbps

$$E_b = \frac{1000}{50 \times 10^6} = 20\mu\text{J}$$

81. A combination of direct sequence and frequency hopping is called

(a) Direct sequence hopping

(b) Hybrid direct frequency hopping

(c) Direct sequence frequency hopping

(d) Hybrid direct sequence frequency hopping

81. Ans: (d)

Sol: Combination of direct sequence and frequency hopping is called as Hybrid Direct sequence frequency hopping

82. Each earth station's transmission is encoded with a unique binary word called

(a) Station code (b) Chip code (c) Access code (d) Gold code

82. Ans: (b)

Sol: Each station has a unique chip code. To receive a particular earth stations transmission, a receiver station must know the chip code for that station.

83. For a 300 m optical fibre cable with BLP of 600 MHz-km, the bandwidth will be

(a) 8 GHz (b) 6 GHz (c) 4 GHz (d) 2 GHz

83. Ans: (d)

Sol: $BLP = 600\times10^6$ Hz–Km.

$L = 300m = 0.3Km$

$$BW = \frac{BLP}{L} = \frac{600\times10^6}{0.3} = 2GHz$$

84. Numerical aperture (NA) in optical fibre transmission is used to describe

(a) Light spreading ability

(b) Light gathering or light collecting ability

(c) Light output from external shield

(d) Light leakage ability

84. Ans: (b)

Sol: Numerical aperture indicates the light gathering capacity of a optical fibre.

Directions:

Each of the next Six(06) items consists of two statements, one labelled as the '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):** Channel vocoder (voice coder) is an analysis synthesis system

Statement (II): For voiced signal, the excitation is a white noise and for an unvoiced signal, the excitation is a periodic signal.

85. Ans: (c)

Sol: Channel vocoder is an analysis synthesis system (TRUE)

Voice signal $\rightarrow$ excitation is periodic signal

unvoiced signal $\rightarrow$ random noise generator

$S_1 \rightarrow$ TRUE

$S_2 \rightarrow$ FALSE

86. **Statement (I):** Control logic in CMOS is constructed using two-level SOP logic and multilevel logic.

Statement (II): Typical PLA uses multilevel logic.

86. Ans: (c)

Sol: Statement I is true

Many functions in control logic have two-level implementation, and no. of levels grow with the number of inputs of the function.

Statement II is false

PLA is implemented as AND-OR logic which is a two-level logic.

87. **Statement (I):** ABCD parameters are widely used in analysis of power transmission engineering and termed as circuit parameters.

Statement (II): ABCD parameters are called as transmission parameters.

87. Ans: (a)

Sol: Statement (I): ABCD parameters are used in analysis of power transmission lines

Statement (II): ABCD parameters are also called transmission parameters.

88. **Statement (I):** Non-stationary signals such as an image require time-frequency analysis.

Statement (II): The short time Fourier transform (STFT) can map a one dimensional function f(t) into the two-dimensional function, STFT (f)

88. Ans: (a)

Sol: Statement I: TRUE

Statement II: TRUE

In the continuous case, the function to be transformed is multiplied by a window function which is non-zero for only a short period of time. The F.T. of 1D function of the resulting signal is taken as window is slide of along the time axis, resulting in a 2D representation of signal

$$\text{STFT}\{x(t)\}(\tau,\omega) = X(\tau,\omega) = \int_{-\infty}^{+\infty} x(t)\omega(t-\tau)e^{-j\omega t}dt$$

$\omega(\tau) \rightarrow$ window function

89. **Statement (I):** PCM requires a very complex encoding and quantization circuitry.

Statement (II): PCM requires a less bandwidth compared to analog systems.

89. Ans:(c)

Sol: PCM requires more bandwidth compared to analog systems.

90. **Statement (I):** For an unstable feed-back system, the gain margin is negative or the phase margin is positive.

Statement (II): For a stable feedback system, both gain margin and phase margin must be positive.

90. Ans: (d)

Sol: For closed loop stable system, both gain margin and phase margin must be positive.

91. A three-phase full wave rectifier with resistive load has ripple factor

(a) 0.482 (b) 1.000 (c) 0.055 (d) 0.500

91. Ans: (c)

Sol: In order to calculate the ripple factor we must extract the ac component from V_0 using the relationship: $V_{0(ac)} = \sqrt{V_{0(rms)}^2 - V_0^2}$

The Ripple factor $= \dfrac{V_{0(ac)}}{V_0} = \dfrac{\sqrt{V_{0(rms)}^2 - V_0^2}}{V_0} = \sqrt{\dfrac{V_{0(rms)}^2}{V_0^2} - 1} = \sqrt{\dfrac{1}{0.998} - 1} = 0.04$ (rectification ratio = 0.998)

92. If $T_A = 50°C$, $T_J = 200°C$ and $\theta_{J\text{-}A} = 100°C/W$, the power that a transistor, 2N1701 can safely dissipate in free air will be

(a) 0.5 W (b) 1.5 W

(c) 2.5 W (d) 3.5 W

92. Ans: (b)

Sol: $T_A = 50°C$

$T_j = 200°C$

$Q_{jA} = 100°C/W$

$T_j - T_A = Q_{JA}\,P_D$

$200 - 50 = 100°C/W\ P_D$

$\dfrac{150}{100} = P_D$

1.5Watts

93. In a differential amplifier, there are two sets of input signals. In first set, $v_1 = +50\mu V$ and $v_2 = -50\mu V$ and in second set, $v_1 = 1{,}050\mu V$ and $v_2 = 950\mu V$. If the common mode rejection ratio is 100, the percentage difference in the output voltage for the two sets of input signals will be

(a) 10% (b) 15%

(c) 20% (d) 25%

93. Ans: (a)

Sol: Case (i)

$V_1 = 50\mu V$, $V_2 = -50\mu V$

CMRR = 100

Error in the output, $V_{01} = \frac{1}{CMRR}\left[\frac{V_C}{V_{id}}\right]$ ______(1)

$$= \frac{1}{100}\left[\frac{\frac{V_1+V_2}{2}}{V_1-V_2}\right] \text{______(2)}$$

$$= \frac{1}{100}[0] \text{____(3)}$$

$$= 0V \text{______(4)}$$

Case (ii): $V_1 = 1050\mu V$, $V_2 = 950\mu V$ & CMRR = 100

Error in the output, $V_{02} = \frac{1}{100}\left[\frac{1000\mu V}{100\mu V}\right] = 0.1V$ ______(5)

$\therefore$ % difference in the output voltage = (0.1V–0V) × 100 = 10 % ______(6)

94. A linear ramp ADC uses a 10 bit counting register and a 15kHz clock frequency. The register output is 1111111111 when the input voltage is 100mV. The required ramp rate-of-change and the ADC conversion time are nearly

(a) 1.5 V/s and 75 ms
(b) 2.5 V/s and 90 ms
(c) 1.5 V/s and 90 ms
(d) 2.5 V/s and 75 ms

94. Ans: (a)

Sol: Given counter type ADC, N = 10bit; f = 15 kHz; $T = \frac{1}{15\times10^3}$.

The time taken to reach 1111111111 for V_{in} = 100mV = $(2^N - 1).T$

i.e, Rate of change $= \frac{100\times10^{-3}}{(2^{10}-1).T} = \frac{100\times10^{-3}}{1023}\times15\times10^3 = 1.5$ V/s

Conversion time = $(2^N-1).T = (2^{10}-1).T$ = 68.2ms ≈ 75ms.

95. An 8-bit DAC produces V_{out} = 0.05V for a digital input of 00000001. The full scale output will be nearly

(a) 12.8V (b) 17.8V

(c) 22.8V (d) 27.8V

95. Ans: (a)

Sol: 8-bit ADC, step size = 0.05V

Full scale output = $(2^N-1) \times$ step size

$= (2^8-1) \times 0.05 = 255 \times 0.05$

≈ 12.8V

96. Master Slave flip-flop is also called

(a) Pulse triggered flip-flop (b) Latch

(c) Level triggered flip-flop (d) Buffer

96. Ans: (a)

Sol: Master-slave flip-flop is also called as pulse triggered flip-flop

97. The resolution of 6-bit DAC will be nearly

(a) 4.6% (b) 3.2% (c) 1.6% (d) 1.2%

97. Ans: (c)

Sol: $\rightarrow$ resolution $= \dfrac{1}{2^N-1}\times 100 = \dfrac{1}{2^6-1}\times 100$

$= 1.587\% \approx 1.6\%$

98. An expression $f = \overline{\overline{AB}+\overline{A}+AB}$ can be reduced to

(a) A (b) B (c) 0 (d) 1

98. Ans: (c)

Sol: $f = \overline{\overline{AB}+\overline{A}+AB} = \overline{\overline{A}+\overline{B}+\left(\overline{A}+A\right)\left(\overline{A}+B\right)}$

$= \overline{\overline{A}+\overline{B}+\overline{A}+B} = \overline{\overline{A}+\overline{B}+B} = \overline{1} = 0$

99. K-map is used to minimize the number of

(a) Flip-flops in digital circuits

(b) Layout spaces in digital circuits for fabrication

(c) Functions of 3,4,5 or 6 variables

(d) Registers in CPU

99. Ans: (c)

Sol: K-map is used to minimize the number of functions of 3, 4, 5 or 6 variables.

100. A finite state machine

(a) is same as that of abstract model of sequential circuit

(b) consists of combinational logic circuits only

(c) contains infinite number of memory devices

(d) does not exist in practice

100. Ans: (a)

Sol: A FSM is computational model that can be used to simulate sequential logic and control execution flow. So, FSM is same as that of abstract model of sequential circuit.

101. A logic circuit that accepts several data inputs and allows only one of them at a time to get through to the output is called

(a) Multiplexer (b) De-multiplexer

(c) Transmitter (d) Receiver

101. Ans: (a)

Sol: Multiplexer is a logic circuit that accepts several data inputs and allows only one of them at a time to get through to the output

102. The memory technology which needs the least power is

(a) ECL (b) MOS

(c) CMOS (d) TTL

102. Ans: (c)

Sol: CMOS memory technology needs the least power

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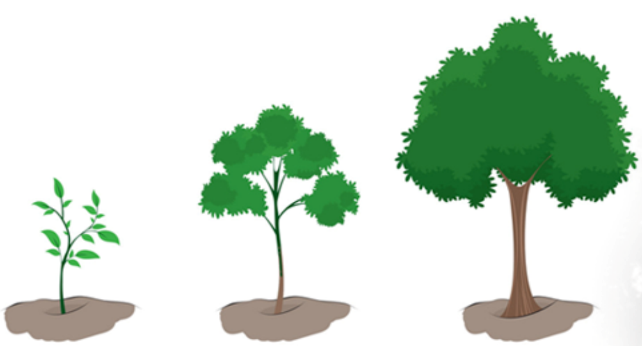

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103. The mapping function that assigns a number to each outcome is called

(a) Sample space (b) Random variable (c) Discrete variable (d) Event

103. Ans:(b)

Sol: A function whose domain is sample space and whose range is a set of real numbers is called as random variable of the experiment.

104. A device has 200 Ω equivalent noise resistance, 300Ω input resistor and the bandwidth of the amplifier being 6 MHz. If the operating temperature of the amplifier is 290°K, the noise voltage at the input of a television RF amplifier will be nearly

(a) 7 μV (b) 5 μV (c) 3 μV (d) 1 μV

104. Ans (a)

Sol: $R_{eq} = 200 + 300 = 500\ \Omega$

$$V_n = \sqrt{4kTBR}$$

$k = 1.38\times10^{-23}$ J/K

$T = 290$ K

$B = 6$ MHz

$V_n = 6.93\times10^{-6} \approx 7\ \mu V.$

105. When unmodulated carrier alone is transmitted, the antenna current is 9A. When sinusoidal modulation is present, the antenna current is 11A. The modulation index used will be nearly

(a) 0.994 (b) 0.764 (c) 0.546 (d) 0.326

105. Ans: (a)

Sol: $I_C = 9A$

$I_t = 11A$

$$I_t = I_C\sqrt{1+\frac{\mu^2}{2}}$$

$$11 = 9\sqrt{1+\frac{\mu^2}{2}}$$

$$\sqrt{1+\frac{\mu^2}{2}}=\frac{11}{9} \text{ or } 1+\frac{\mu^2}{2}=\left(\frac{11}{9}\right)^2$$

$$\frac{\mu^2}{2}=\left(\frac{11}{9}\right)^2-1$$

$$\mu^2=2\left[\left(\frac{11}{9}\right)^2-1\right]$$

$$\mu=\sqrt{2\left[\left(\frac{11}{9}\right)^2-1\right]}=0.994$$

106. Frequency modulated signal with single-tone modulation has a frequency deviation of 15kHz and bandwidth of 50 kHz. The frequency of the modulating signal will be

(a) 05 kHz (b) 10 kHz (c) 20 kHz (d) 30 kHz

106. Ans: (b)

Sol: $\Delta f = 15$ kHz

BW = 50 kHz

$BW = 2\Delta f + 2f_m$

$50k = 2\times15k + 2f_m$

$2f_m = 50k - 30k = 20k$

$$f_m=\frac{20k}{2}=10\text{kHz}$$

107. When the carrier and one of the sidebands are suppressed in an AM wave modulated to a depth of 50%, the power saving will be

(a) 84.4% (b) 88.6% (c) 94.4% (d) 98.6%

107. Ans:(c)

Sol: Total Power, $P_t = P_c\left[1+\frac{\mu^2}{2}\right]$

If the carrier and one of the side band is suppressed, the power saving is $P_c+\frac{P_c\mu^2}{4}$

$$\%\text{ of Power saving} = \frac{P_c + \frac{P_c\mu^2}{4}}{P_c\left[1+\frac{\mu^2}{2}\right]}\times 100$$

$$= \frac{1+\frac{\mu^2}{4}}{1+\frac{\mu^2}{2}}\times 100 = \frac{1+\frac{0.25}{4}}{1+\frac{0.25}{2}}\times 100$$

$$= \frac{\frac{4.25}{4}}{\frac{2.25}{2}}\times 100 = \frac{4.25}{4}\times\frac{2}{2.25}\times 100$$

$= 94.4\%$

108. An output of balanced modulator contains

(a) Carrier, LSB and USB

(b) Modulation frequency, carrier frequency and LSB

(c) Modulation frequency, carrier frequency and USB

(d) Modulation frequency, LSB and USB

108. Ans: (d)

Sol: Balanced modulator balanced with carrier. So, the output of balanced modulator Contains modulation frequency, upper side band and lower side band components.

109. The temperature of a particular place varies between 14°C and 34°C. For the purpose of transmitting the temperature record of that place using PCM the record is sampled at an appropriate sampling rate and the samples are quantized. If the error in the representation of the samples due to quantization is not to exceed ±1% of the dynamic range, the minimum number of quantization levels that can be used will be

(a) 40 (b) 50

(c) 60 (d) 70

109. Ans: (b)

Sol: Dynamic range = 34 – 14 = 20

Maximum error = $\frac{\Delta}{2}$

$$\frac{\Delta}{2} = \frac{1}{100}\times 20 \Rightarrow \Delta = \frac{40}{100} = 0.4$$

$$\Delta = \frac{\text{Dynamic range}}{\text{Quantization levels}} = \frac{20}{L}$$

$$\frac{20}{L} = 0.4$$

$$L = \frac{200}{4} = 50.$$

110. A telephone signal band limited to 4 kHz is to be transmitted by PCM. If the signal to quantization noise is to be at least of 40 dB, the number of levels into which the signal is to be encoded will be

(a) 32 (b) 64 (c) 81 (d) 128

110. Ans: (d)

Sol: W = 4kHz

SNR = 40dB

1.8+6n = 40dB

$$6n = 40 - 1.8 \Rightarrow 6n = 38.2 \Rightarrow n = \frac{38.2}{6} = 7$$

$L = 2^7 = 128$

111. To avoid slope overload error in delta modulation, the maximum amplitude of the input signal is

(a) $A \le 2\pi f_m$ (b) $A \le \sin 2\pi f_m$ (c) $A \le \frac{2\pi f_m}{\Delta f_s}$ (d) $A \le \frac{\Delta f_s}{2\pi f_m}$

111. Ans: (d)

Sol: $\frac{\Delta}{T_s} \ge A 2\pi f_m$

$$\Delta f_s \ge A2\pi f_m, \quad A \le \frac{\Delta f_s}{2\pi f_m}$$


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112. If bandwidth is of primary concern, which one of the following scheme is generally not considered ?

(a) PSK (b) ASK (c) DPSK (d) FSK

112. Ans: (d)

Sol: When compared with all techniques, non coherent FSK requires more bandwidth

113. The process of assigning to each one of the sample values of the message signal, a discrete value from a prescribed set of a finite number of such discrete values is called

(a) Filtering (b) Noise removal

(c) Decoding (d) Quantization

113. Ans: (d)

Sol: Quantizer assigns sample value of the message signal to a prescribed set of discrete value. This process is called "Quantization".

114. Which one of the following types of fiber suffers with modal dispersion ?

(a) Single-mode step-index fiber

(b) Multimode graded-index fiber

(c) Multimode step-index fiber

(d) Single-mode graded-index fiber

114. Ans: (c)

Sol: Modal dispersion is the dominant source of dispersion in multimode fibers. Modal dispersion does not occur in single mode fibers.

115. An inductor is described by input output relation as

$$y(t) = \frac{1}{L}\int_{-\infty}^{\infty} x(\tau)d\tau$$

The operation representing the inverse system x(t) will be

(a) $L\frac{d}{dt}y(t)$ (b) L (c) $\frac{d}{dt}y(t)$ (d) Ly(t)

115. Ans: (a)

Sol: $y(t)=\frac{1}{L}\int_{-\infty}^{t}x(\tau)d\tau \xrightarrow{LT} Y(s)=\frac{X(s)}{Ls}$

$X(s) = Ls\,Y(s)$

$\downarrow$ ILT

inverse system is $x(t)=\frac{Ldy(t)}{dt}$

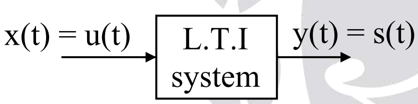
116. Step response of the system is defined as

1. The output due to a unit step input signal
2. The running sum of impulse response
3. The running integral of impulse response for a continuous-time system

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

116. Ans: (d)

Sol: 1. Step response is defined as the output due to unit step input



2. $s(n)=\sum_{k=-\infty}^{n}h(k)\rightarrow$ running summation of I.R

3. $s(t)=\int_{-\infty}^{t}h(\tau)\rightarrow$ running integral of I.R

All are correct

117. The signal flow graph of a system is constructed from its

(a) Differential equations

(b) Algebraic equations

(c) Algebraic equations through the cause-and-effect relations

(d) Differential equations through the cause-and-effect relations

117. Ans: (c)

Sol: Signal flow graph is constructed from its linear algebraic equations through the cause-and-effect relations.

118. If all the roots of the characteristics equation have negative real parts, the system is

(a) Stable (b) Unstable

(c) Marginally stable (d) Conditionally stable

118. Ans: (a)

Sol: If the all the roots of characteristic equation have negative real part, then the system is stable, because the system given bounded output to bounded input.

119. A unity feedback system is characterized by the open loop transfer function

$$G(s) = \frac{1}{s(0.5s+1)(0.2s+1)}$$

The steady state errors for unit-step and unit-ramp inputs are respectively

(a) 0 and 0

(b) 0 and 1

(c) 1 and 0

(d) 1 and 1

119. Ans: (b)

Sol: Unit step Input: $e_{ss} = \frac{A}{1+K_p}$

$$K_p = \underset{S\to 0}{Lt}\, G(s) = \underset{S\to 0}{Lt} \frac{1}{s(0.5s+1)(0.2s+1)} = \infty$$

$$e_{ss} = \frac{A}{1+\infty} = 0$$

Unit Ramp input: $e_{ss} = \frac{A}{K_v}$

$$K_v = \underset{s\to 0}{Lt}\, s\, G(s) = \underset{s\to 0}{Lt}\, s \frac{1}{s(0.5s+1)(0.2s+1)}$$

$K_v = 1$

$$e_{ss} = \frac{1}{1} = 1$$

120. Which of the following statements are correct ?

1. A continuous time system is said to be time invariant if the parameters of the system do not change with time
2. The characteristics of time-invariant system are fixed over a time
3. If the input to the time invariant system is delayed by t_0 second, the characteristics of the output response is also delayed by t_0 seconds

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1,2 and 3

120. Ans: (d)

121. A single-phase full wave rectifier uses semiconductor diodes. The transformer voltage is 35 V rms to center tap. The load consists of a 40 μF capacitor in parallel with a 250 Ω resistor. The diode and transformer resistances and leakage reactance are neglected. If the power line frequency is 50 Hz, the dc current in the circuit will be

(a) 132 mA (b) 144 mA

(c) 156 mA (d) 168 mA

121. Ans: (a)

Sol: $V_{max} = V_m = 35V_2 = 49.5\text{Volts}$

We can write, $V_{dc} = I_{dc}R_L = V_m - \frac{I_{dc}}{4f_C}$

$$\therefore I_{dc} = \frac{V_m}{R_L + \frac{1}{4fc}} = \frac{V_m}{R_L + R_0}$$

$\therefore$ Here, $R_L = 250\Omega$

$$R_0 = \frac{10}{4fc} = \frac{1}{4\times 50\times 40\times 10^{-6}} = 125\Omega$$

$$\therefore I_{dc} = \frac{49.5}{250+125} = 132\text{mA}$$

122. Silicon dioxide (SiO_2) is used in ICs, because it

(a) Facilitates the penetration of diffusants

(b) Has high heat conduction

(c) Prevents diffusion of impurities

(d) Controls the concentration of diffusants

122. Ans: (c)

Sol: SiO_2 Features

(i) It is easy to fabricate SiO_2 on top of silicon substrate

(ii) It does not allow diffusion of impurities through it

(iii) It dissolves only in Hydrofluoric Acid

123. Consider an n-channel MOSFET with parameters

$K_n = 0.25$ mA/V^2, $V_{TN} = 1$ V, $\lambda = 0$, $C_{gd} = 0.04$ pF and $C_{gs} = 0.2$ pF

If the transistor is biased at $V_{GS} = 3$ V, the unity gain bandwidth of an FET will be

(a) 626 MHz

(b) 646 MHz

(c) 663 MHz

(d) 683 MHz

123. Ans: (c)

Sol: Unity gain bandwidth $A_i \approx \dfrac{g_m}{j\omega(C_{gs}+C_{gd})}$

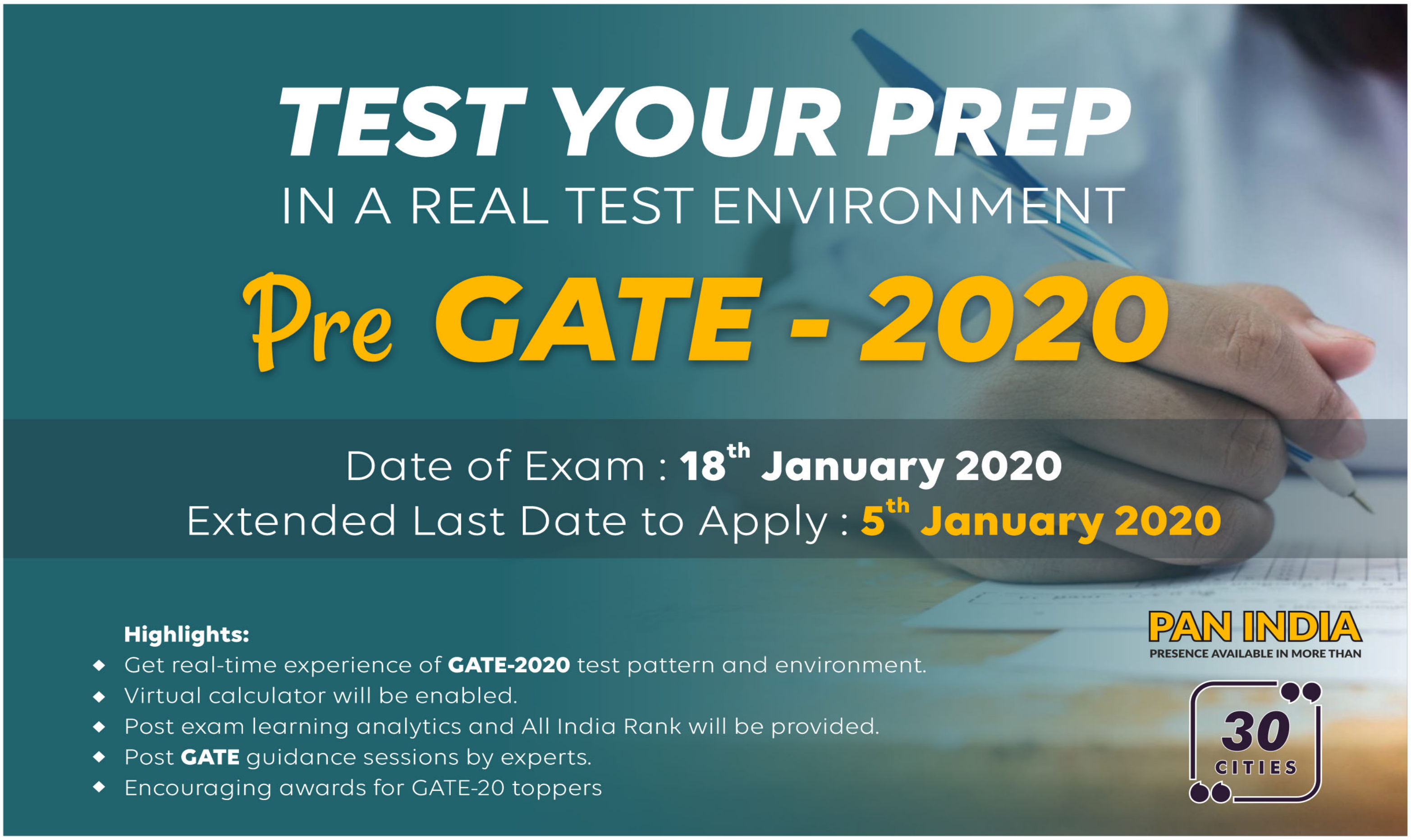
The unity-gain frequency f_T is defined as the frequency at which the magnitude of the short-circuit current gain is 1.

The unity-gain frequency or bandwidth

$$f_T = \frac{g_m}{2\pi(C_{gs}+C_{gd})}$$

$$g_m = 2k_n(V_{GS} - V_T) = 1\text{mA/V}$$

$$f_T = \frac{1\times10^{-3}}{2\pi(0.2+0.04)\times10^{-12}} \approx 663\,\text{MHz}$$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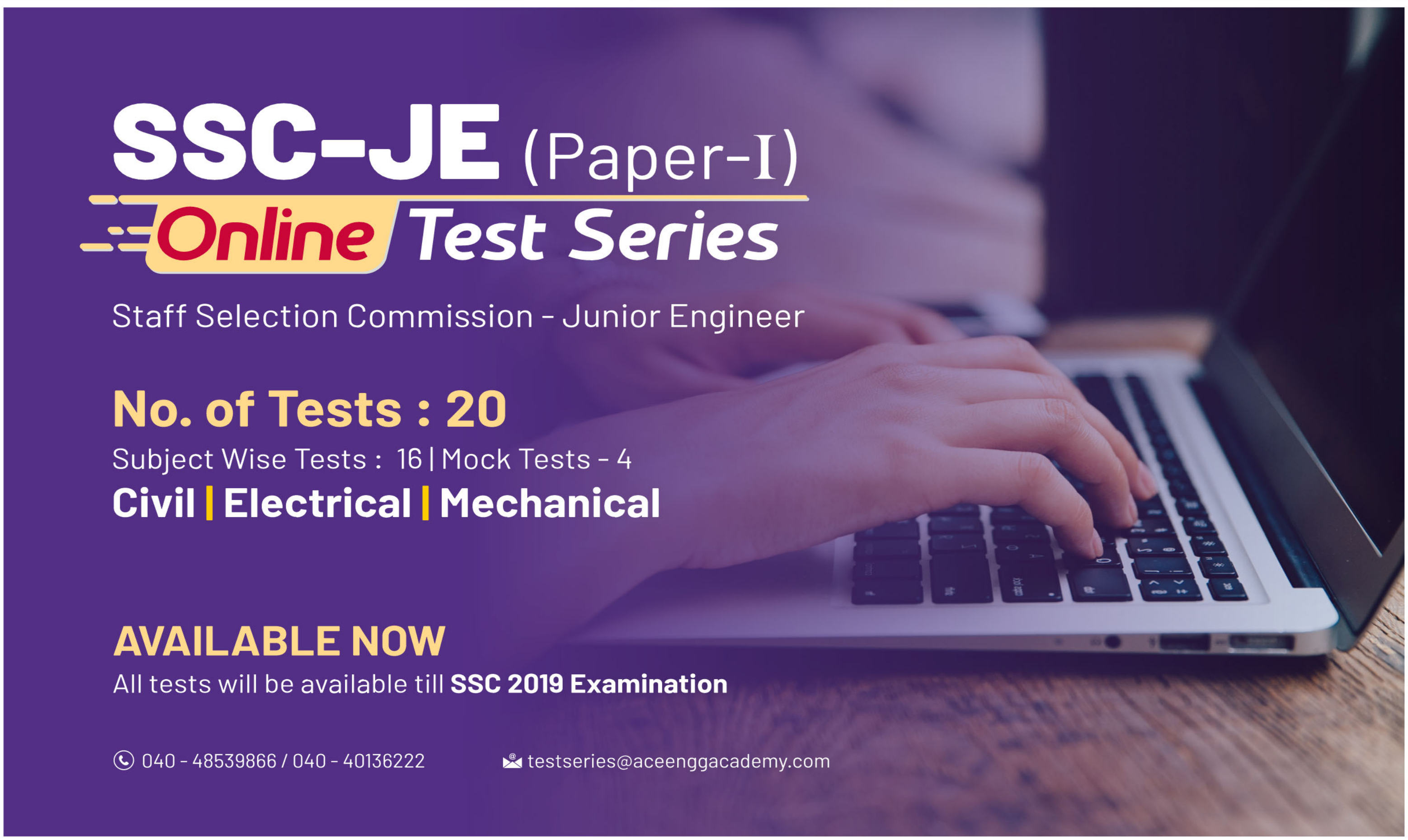
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124. The voltage gain of CE amplifier circuit can be approximated for an ideal input ac source and is given by

(a) $A_{V_s} = \frac{r_e'}{(R_C \times R_L)}$

(b) $A_{Vs} = -\frac{r_e'}{(R_C \parallel R_L)}$

(c) $A_{V_s} = -\frac{(R_C \parallel R_L)}{r_e'}$

(d) $A_{V_s} = \frac{(R_C \times R_L)}{r_e'}$

Where : R_L = Load resistance

R_C = Collector resistance

r_e' = Effective resistance at input of transistor from emitter resistance R_E

124. Ans: (c)

Sol: Voltage gain $A_V = -\frac{h_{fe}R_L'}{h_{ie}}$ ______(1) [$\because$ ideal voltage source, $R_s = 0$]

Where $\frac{h_{fe}}{h_{ie}} = g_m$ & $R_L' = R_C // R_L$ ______(2)

$\Rightarrow A_V = -g_m R_C//R_L$ ______(3)

$\therefore A_V = -\frac{R_C // R_L}{r_e'}$ ______(4) $\left[\because g_m = \frac{1}{r_e'}\right]$

125. The advantage of using a Class-B push-pull transistor amplifier over a Class-A push-pull transistor amplifier is

(a) A negligible power loss at no input signal

(b) Harmonic distortion is lower

(c) Self-bias can be used

(d) Supply voltages have good regulation

125. Ans: (a)

Sol: **Case (i):** In class-A push-pull amplifiers, the conduction angle of transistors used in the circuit is 360°. i.e the transistors are biased in such a way that they are kept ON for ever. Therefore there will be considerable amount of power loss in the transistors in the absence of input signal.

Case (ii): In class-B push-pull amplifiers, the conduction angle of each transistor is 180° i.e the transistors are biased in such a way that each transistor conductor for one half-cycle of input. Therefore there will negligible power loss at no input signal. [Both the transistors will be OFF at no input signal hence they will not draw any power from power supply]

126. The overall decibel (dB) voltage gain of a multistage amplifier is

(a) The dB voltage gain of the first stage

(b) The product of the dB voltage gains of the individual stages

(c) The sum of the dB voltage gains of the individual stages

(d) The dB voltage gain of the last stage

126. Ans: (c)

Sol: In a multistage amplifier, the overall gain is given by

$A_{V_{overall}} = A_{V_1} \times A_{V_2} \times ..... \times A_{V_n}$ _______(1)

$\therefore$ overall decibel (dB) voltage gain, $A_{V_{overall}}\,dB = 20\log\left[A_{V_1} \times A_{V_2} \times ..... \times A_{V_n}\right]$

$= 20\log A_{V_1} + 20\log A_{V_2} + ... + 20\log A_{V_n}\,dB$

$A_{V_{overall}}dB = A_{V_1}dB + A_{V_2}dB + ... + A_{V_n}dB$

127. If an op-amp having specified signal bandwidth (BW) of 1 MHz and closed loop gain A_{CL} = 200 V/mV, the cutoff frequency f_c will be

(a) 25 Hz (b) 15 Hz

(c) 5 Hz (d) 1 Hz

127. Ans: (c)

Sol: Unity gain B.W of op-Amp = 1MHz _____(1)

Method (1):

Unity gain (A=1) × 1MHz = $A_{CL} \times f_C$ _____(2)

$\therefore\ f_C = \dfrac{1 \times 1 \times 10^6\,Hz}{200 \times 10^3} = 5Hz$ ______(3)

Method (2):

The frequency of input signal at which the gain of an amplifier becomes unity is called as Unity-Gain Band width of that amplifier.

i.e

$$|A| = 1 = \frac{A_{CL}}{\sqrt{1+\left(\frac{f}{f_C}\right)^2}} \text{ \_\_\_\_(1)}$$

Where f is the frequency at which gain = 1

i.e., f = BW

$$\approx \frac{A_{CL}}{\sqrt{\left(\frac{f}{f_C}\right)^2}} \text{ \_\_\_\_(2)}$$

$[\because\ f = BW >> f_C]$

$$= \frac{f_C}{f} \times A_{CL} \text{ \_\_\_\_(3)}$$

$$\therefore\ f_C = \frac{f}{A_{CL}} = \frac{1\text{MHz}}{200\times10^3} = 5\text{Hz} \text{ \_\_\_\_(4)}$$

128. If the bias current in the IC-741 op-amp is I_Q = 19 μA and the internal frequency compensation capacitor C_1 = 30 pF, the slew rate of the op-amp will be nearly

(a) 1.58 V/μs (b) 1.26 V/μs (c) 0.93 V/μs (d) 0.63 V/μs

128. Ans: (d)

Sol: Slew rate of an op-amp $= \left[\frac{dV_0}{dt}\right]_{max}$ _____(1)

$$= \frac{I_{Bias}}{C_{compensation}} \text{ \_\_\_\_(2)}$$

$$= \frac{I_Q}{C_i} \text{ \_\_\_\_(3)}$$

$$= \frac{19\mu A}{30pF} \text{ \_\_\_\_(4)}$$

= 0.633V/μsec ____(5)

129. Which one of the following statements regarding slew rate is correct?

(a) It signifies how rapidly the output of an op-amp can change in response to changes in the frequency of the input signal

(b) It does not change with change in voltage gain

(c) It should be smaller for high-speed op-amp applications

(d) It is not fixed for an op-amp

129. Ans: (a)

Sol: Definition of slew Rate:

The maximum rate of change in the output of an op-Amp is considered as its slew Rate.

i.e Slew Rate $= \left[\frac{dV_0}{dt}\right]_{max}$ ______(1)

130. Which one of the following is correct for an ideal operational amplifier?

(a) Input resistance $R_i = \infty$, output resistance $R_o = 0$ and bandwidth = 0

(b) Input resistance $R_i = 0$, output resistance $R_o = \infty$ and bandwidth = 0

(c) Input resistance $R_i = \infty$, output resistance $R_o = 0$ and bandwidth = ∞

(d) Input resistance $R_i = 0$, output resistance $R_o = 0$ and bandwidth = ∞

130. Ans: (c)

Sol: Characteristics of an ideal op-Amp:

(1) $A = \infty$

(2) $R_i = \infty$

(3) $R_0 = 0$

(4) U.G.B.W (Unity Gain Band Width) (or) Specified signal bandwidth = ∞

131. The advantage of ILD over LED is

(a) ILD emits incoherent light where as LED emits coherent light

(b) In ILD it is difficult to couple light whereas in LED it is easy to couple light

(c) In ILD coupling loss is more whereas in LED coupling loss is less

(d) ILD emits coherent light whereas LED emits incoherent light

131 Ans: (d)

Sol: ILD emits coherent light where as LED emits incoherent light

LED – Light Emitting Diode source of incoherent light

ILD – Injection Laser Diode source of coherent light

Advantages of ILD over LED

→ It is easier to couple light emitted by the ILD into an optical fibre cable. This reduces the coupling losses and allows smaller fibers to be used

→ ILDs provide a higher drive power so that it operate over longer distances.

→ ILDs can be used at higher bit rates than LEDs

→ ILDs generate monochromatic light, which reduces chromatic (or) wavelength dispersion

132. The quantum efficiency η for the photo-detector is

(a) $\frac{I_{ph}}{P_o}$

(b) $\frac{I_{ph}/e}{P_o/(hc/\lambda)}$

(c) $\frac{P_o}{I_{ph}}$

(d) $\frac{P_o/(hc/\lambda)}{I_{ph}/e}$

Where I_{ph} = Average photocurrent

P_o = Average incident optical power

hc/λ = incident photon energy

132 Ans: (b)

Sol: $$\text{Quantum efficiency } \eta = \frac{\text{number of electron hole pairs generated}}{\text{number of photons that are incident}}$$

$$= \frac{(I_{ph}/e)}{(P_o/h\nu)} = \frac{(I_{ph}/e)}{[P_o/(hc/\lambda)]} \qquad \because \nu = \frac{C}{\lambda}$$

133. According to Kirchhoff's voltage law, the algebraic sum of all the voltage in any closed loop of a network is always

(a) Negative

(b) Positive

(c) Zero

(d) Determined by the battery emf

133. Ans: (c)

Sol: Definition of KVL: KVL is applicable any closed path

The algebraic sum of all current in any closed path is zero.

134. Ohm's law is applicable to

(a) DC circuit only

(b) AC circuit only

(c) DC circuit as well as AC circuit, provided account is taken of the induced emf resulting from the self-inductance of circuit and of the distribution of current in cross-section of circuit

(d) DC circuit as well as AC circuit, provided account is taken of the induced emf resulting from mutual-inductance of circuit and of the distribution of current in cross-section of circuit.

134. Ans: (c)

135. A car having an axle of 2 m length is travelling with 72 km/h at a vertical component of the earth's magnetic field of 40 μWb/m^2, the emf generated in the axle of a car will be

(a) 1.2 mV (b) 1.6 mV

(c) 2.2 mV (d) 2.6 mV

135. Ans: (b)

Sol: $E = Bl\nu$

$$= 40\times10^{-6} \times 2 \times \frac{72000}{3600}$$

$$= 1.6\text{mV}$$


Hearty Congratulations
to our GATE-2019 Top Rankers
AIR 1 PRAKHAR SINGH CE
AIR 1 SURYANARYANA PI
AIR 1 RAJAT SONI EC
AIR 1 PRANAV SHARMA CSIT
AIR 1 SHASHANK MANGAL IN
AIR 2 KUNAL G EE
AIR 2 MUKESH POONIA EE
AIR 2 ANAND JERRY GEORGE EC
AIR 2 PRIYANKA GUPTA IN
AIR 2 VINAY SEELAM PI
AIR 3 ANKIT KULHARI ME
AIR 3 IDRIS MANAQIBWALA CE
AIR 3 SHUBHAM MAURYA EC
AIR 3 PRATEEK AGARWAL CSIT
AIR 3 VINEET GOSWAMI IN
AIR 3 ROHIT KHANNA PI
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AIR 7 SAIKIRAN CHOLLETI EC
AIR 7 DEEPITA ROY EE
AIR 7 SHUBHAM MITTAL EE
AIR 7 SAISH KALASKAR IN
AIR 7 SHWETA YADAV IN
AIR 7 AMIT LAL SHAH PI
AIR 7 ANUJ MEENA PI
AIR 9 RAVI SHANKAR MISHRA CSIT
AIR 9 ARKA RAY CSIT
AIR 9 RANJIT KUMAR SINGH EC
AIR 9 DEEP ADHVARYU IN
AIR 9 B. SREEKAR IN
AIR 9 ATULYA JYOTI PI
AIR 10 GEETH GEORGE EE
AIR 10 ASIF KHAN CE
AIR 10 MAHESH SINGH YADAV ME
AIR 10 GARVIT GUPTA XE
AIR 10 MANMOHAN ARORA PI
AIR 10 SHUBHAM PANDE PI
and many more...
CE TOP 10 5 TOP 100 44
ME TOP 10 6 TOP 100 60
EE TOP 10 7 TOP 100 71
EC TOP 10 9 TOP 100 74
CS TOP 10 5 TOP 100 28
IN TOP 10 10 TOP 100 74
PI TOP 10 10 TOP 100 49

136. Crest factor for an alternating current source is the ratio of

(a) Maximum value to RMS Value

(b) RMS value to Maximum value

(c) RMS value to Average value

(d) Maximum value to average value

136. Ans: (a)

Sol: Crest factor is also called peak factor

$$\text{Crest factor} = \frac{\text{Peak (or) Maximum value}}{\text{RMS value}}$$

137. A 200 KVA, 3300/240 V, 50 Hz single-phase transformer has 80 turns on the secondary winding. Assuming an ideal transformer, the primary current I_1 and secondary current I_2 on full load are nearly

(a) 60.6 A and 833 A

(b) 72.2 A and 833 A

(c) 60.6 A and 720 A

(d) 72.2 A and 720 A

137. Ans: (a)

Sol: 200KVA, 3300/240V, f = 50 Hz

Sec turns, $N_s = 80$, I_1 & I_2 on F.L = ?

$V_1I_1 = 200\text{KVA}$

$(3300)I_1 = 200\text{KVA}$

$$I_1 = \frac{200\times10^3}{3300} = 60.6\text{A}$$

$V_2I_2 = 200\text{KVA}$

$(240)I_2 = 200\text{KVA}$

$$I_2 = \frac{200\times10^3}{240} = 833.33\text{A}$$

138. Consider the following date regarding the name plate of 1-phase, 4-pole induction motor: Output = 373 W; 230 V, frequency = 50 Hz, input current = 2.9 A, power factor = 0.71, speed = 1410 rpm. The efficiency of motor will be nearly

(a) 72.8%

(b) 78.8%

(c) 84.4%

(d) 88.4%

138. Ans: (b)

Sol: $1-\phi$, P = 4, output = 373 watt, V = 230V, f = 50 Hz

Input current = 2.9A, p.f = 0.71, N = 1410 rpm, η = ?

Input = $VI\cos\phi$

$= 230\times2.9\times0.71$

$= 473.57\text{w}$

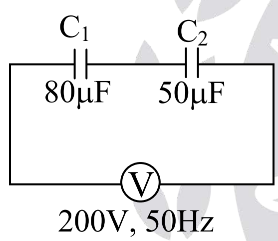
$$\eta = \frac{\text{output}}{\text{input}} = \frac{373\text{w}}{473.57\text{w}}\times100 = 78.76\%$$

139. Two capacitors of 80 μF and 50 μF are connected in series. When 200 V at 50 Hz are applied across the series circuit, the maximum energy stored in the circuit will be

(a) 0.63 J (b) 1.23 J (c) 2.66 J (d) 3.26 J

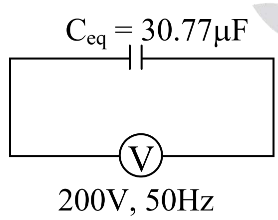
139. Ans: (b)

Sol:



$$C_{eq} = \frac{80\times50}{80+50} = 30.77\mu\text{F}$$

≡



Maximum energy stored by the capacitor combination,

$$W_C = \frac{1}{2}CV_{max}^{\ 2} \quad = \frac{1}{2}C\left(\sqrt{2}V_{rms}\right)^2$$

$$= \frac{1}{2}\times30.77\times10^{-6}\times200\times200\times2$$

$= 1.23\text{J}$

140. In a 4-pole dynamo the flux/pole is 15mWb. If armature is driven at 600 rpm, the average emf induced in one of the armature conductors will be

(a) 0.3 V (b) 0.4 V (c) 0.5 V (d) 0.6 V

140. Ans: (a)

Sol: P= 4, $\phi = 15\times10^{-3}$ Wb, N = 600 rpm,

$$E_g/\text{cond} = \frac{\phi NP}{60A} = \frac{15\times10^{-3}\times600\times4}{60\times2}$$

$$= 0.3\text{V}$$

(assumption: wave connected)

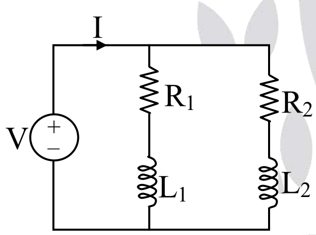
141. Two coils are connected in parallel and a voltage of 200 V is applied to the terminals. The total current taken is 15 A and the power dissipated in one of the coils is 1500 W, the resistance of each coil will be nearly

(a) 26.7 Ω and 23.4 Ω (b) 22.4 Ω and 23.4Ω

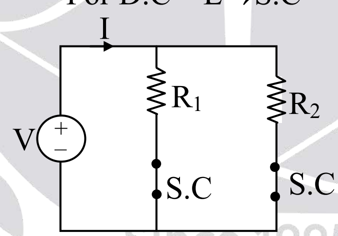
(c) 26.7 Ω and 26.7 Ω (d) 22.4 Ω and 26.7 Ω

141. Ans: (c)

Sol:



For D.C L→S.C



V = 200V, I = 15A

Total power dissipated is P = VI = (200) 15

= 3000 Watts

Coil (1) → P_1 = 1500W (given)

Coil (2) → $P_2 = VI - P_1 = 3000 - 1500$

= 1500 Watts

$$P_1 = P_2 \Rightarrow R_1 = R_2 = R \Rightarrow R_q = \frac{R}{2}$$

$$\frac{V^2}{R_{eq}} = 3000 \Rightarrow R_{eq} = \frac{V^2}{3000}$$

$$R_{eq} = \frac{(200)^2}{3000} = \frac{40}{3} = 13.33$$

$$\frac{R}{2} = 13.33 \Rightarrow R = 26.67$$

Resistors $R_1 = R_2 = 26.07\Omega$

142. The value of total potential difference created between the electrodes, when the cell is **not** connected to an external circuit is known as its

(a) Electromotive force (b) Electrostatic force

(c) Electromagnetic force (d) Electrochemical force

142. Ans: (a)

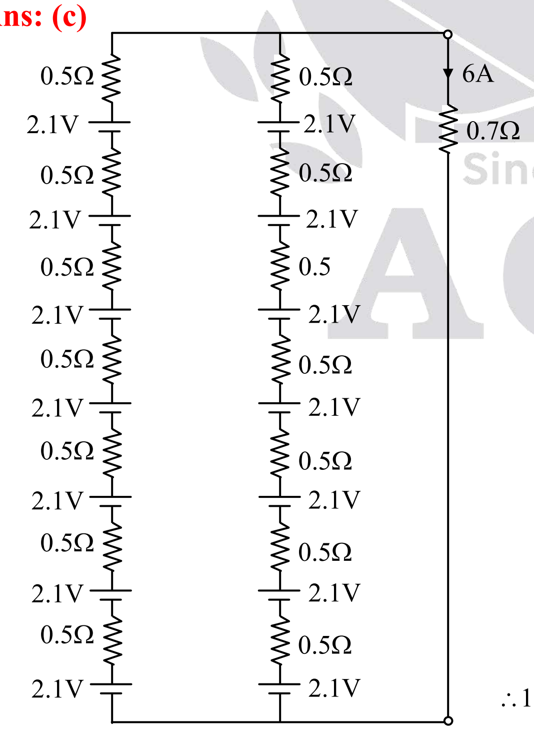
Sol: The value of total potential difference created between the electrodes when cell is not connected is called electromotive force.

143. The cells are connected in two rows in parallel to pass a current of 6 A through an external resistance 0.7 Ω. If the electromotive force of each cell is 2.1 volts and internal resistance 0.5 Ω, the minimum number of cells will be

(a) 10 cells (b) 12 cells (c) 14 cells (d) 16 cells

143. Ans: (c)

Sol:



$\therefore$ 14 cells

7 cells are in row

$\therefore$ 14 cells in two rows

$\therefore$ $(2.1)\times 7 = 14.7V$

$$r = R_T = \frac{(0.5\times 7)}{2} = 1.75,$$

$$\therefore\ I = \frac{V}{r+R_L} \Rightarrow 6 = \frac{14.7}{1.75+0.7} = 6A$$

144. Which of the following are the active materials of a lead acid cell?

1. Lead Peroxide (PbO_2) for positive plate
2. Sponge Lead (Pb) for negative plate
3. Concentrated Sulphuric acid (H_2SO_4) as electrolyte
4. Dilute Sulphuric acid (H_2SO_4) as electrolyte

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

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

144. Ans: (b)

Sol: Active materials of a lead acid cell are

(i) Lead peroxide (PbO_2) for positive plate

(ii) Sponze Lead (Pb) for negative plate

(iv) Dilute Sulphuric acid (H_2SO_4) as electrolyte.

145. Which of the following materials are used for high-technology applications?

1. Semi conductors
2. Bio materials
3. Smart materials

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

145. Ans: (d)

Sol: The materials used for high technology applications are,

1. Semiconductors
2. Bio materials
3. Smart mahials

146. The theoretical density ρ for the crystal structure of a metallic solid is

(a) $\frac{nV_C}{AN_A}$ (b) $\frac{nN_A}{AV_C}$ (c) $\frac{nA}{V_CN_A}$ (d) $\frac{nAN_A}{V_C}$

Where n = number of atoms associated with each unit cell

V_C = Volume of unit cell

A = Atomic weight

N_A = Avogadro's number

146. Ans: (c)

Sol: The theoretical density $= \frac{n \times AW}{AN \times V_{uc}}$

n = effective number of atoms inside unit cell

AW = Atomic weight

AN = Avagadro's number

V_{vc} = Volume of unifull

So, $\rho = \frac{nA}{N_A V_C}$

147. A circular dislocation loop has edge character all round the loop and this dislocation can glide only on a surface that contains

(a) Burgers vector (b) Both burgers vector and t vector

(c) t vector (d) No vector

147. Ans: (b)

Sol: In edge dislocation burger's vector and t vector are perpendicular to each other.

148. The critical stress σ_c for crack propagation in a brittle material, using the principles of fracture mechanics is

(a) $\left(\frac{2E\gamma_s}{3\pi a}\right)^{\frac{1}{2}}$ (b) $\left(\frac{3E\gamma_s}{2\pi a}\right)^{\frac{1}{2}}$ (c) $\left(\frac{2E\gamma_s}{\pi a}\right)^{\frac{1}{2}}$ (d) $\left(\frac{3E\gamma_s}{\pi a}\right)^{\frac{1}{2}}$

Where: E = Modulus of elasticity

γ_s = Specific surface energy

a = One half the length of an internal crack

148. Ans: (c)

Sol: Fracture strength from Griffith's formula

$$\sigma_{fra} = \left(\frac{2E\gamma_S}{\pi a}\right)^{\frac{1}{2}}$$

E = Modulus of elasticity

γ_s = Specific surface energy

a = one half the length of an internal crack

149. Ceramic materials are

(a) Organic and metallic
(b) Inorganic and metallic
(c) inorganic and non metallic
(d) Organic and non metallic

149. Ans: (c)

Sol: Ceramics are compounds of both metal & non metal and inorganic materials

Ex: Nacl

150. Which of the following points are important on the viscosity scale in the fabrication and processing of glasses?

1. Softening point
2. Working point
3. Melting point

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

150. Ans: (d)

Sol: The important points on the viscosity scale in the fabrication and processing of glasses are

1. Softening point
2. Working point
3. Melting point

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to our ESE-2019 Top Rankers
AIR 1 KARTIKEYA SINGH EE
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AIR 1 ABUZAR GAFFARI CE
AIR 2 SHAMBHAVI T EE
AIR 2 ANKUSH MANGLA E&T
AIR 2 SAHIL GOYAL ME
AIR 3 ABHISHEK ANAND EE
AIR 3 ROHIT KUMAR E&T
AIR 3 KUMAR CHANDAN ME
AIR 3 AMARJEET CE
AIR 4 ANKIT TAYAL EE
AIR 4 AMIR KHAN E&T
AIR 4 SAURAV ME
AIR 4 AMAN GULIA CE
AIR 5 KUMAR MAYANK EE
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AIR 7 RAHUL JAIN E&T
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AIR 8 KULDEEP KUMAR E&T
AIR 8 HEMANT KUMAR SINGH ME
AIR 8 YOGESH KUMAR CE
AIR 9 DEEPITA ROY EE
AIR 9 SHUBHAM KARNANI E&T
AIR 9 DWEEP SABAPARA ME
AIR 9 ANKIT KUMAR CE
AIR 10 ANKITA SHARMA EE
AIR 10 GAURAV SRIVASTAVA E&T
AIR 10 SUMIT BHAMBOO ME
and many more...
Total Selections in Top 10: 33 | EE : 9 | E&T : 8 | ME : 9 | CE : 7